GOVERNMENT POLYTECHNIC, PUNE

(AN AUTONOMOUS INSTITUTE OF GOVT. OF MAHARASHTRA)

180 OB CURRICULUM

(Since 2019-20)

DIPLOMA IN ELECTRICAL ENGINEERING PROGRAMME
IN

DEPARTMENT OF ELECTRICAL ENGINEERING

GOVERNMENT POLYTECHNIC, PUNE

INDEX

Government Polytechnic, Pune

(An Autonomous Institute of Government of Maharashtra)

Department of Electrical Engineering

Vision and Mission of Institute

VISION

To develop self-reliant, versatile, innovative, quality conscious engineers for betterment of society.

MISSION

- **M1:** Imparting updated curriculum in association with stakeholders.
- **M2:** Providing with the state of art infrastructure & facilities.
- **M3:** Set up strategic alliance with industries.
- **M4:** Enhancing e-governance.
- **M5:** Continuous development of faculty & staff.

Vision and Mission of Electrical Department

VISION

To develop competent, socially responsible, energy cautious ,industry ready Electrical Engineers.

MISSION

1) Updating Electrical Engineering curriculum in tune with the industry and society.
2) Modernizing laboratories for employable skill development.
3) Preparing students to work in diverse condition.
4) Inculcating Energy conservation habits in society.
5) Adapting the latest techniques in engineering for enhancing quality of education through training of staff and students.

Program Educational Objectives (PEOs)

A Diploma Electrical Engineer will be able to -

PEO1: Provide socially responsible, environment friendly solutions to electrical engineering problems adapting professional ethics.

PEO2: Adapt state - of - the art engineering broad-based technologies to work in multidisciplinary working environment.

PEO3: Fine tune knowledge and skills with advanced trends through lifelong learning.

PROGRAM OUTCOMES (POs):

1. Basic and discipline specific knowledge:
Apply knowledge of basic mathematics, science and Engineering fundamentals and engineering specialization to solve the Electronics & Telecommunication engineering problems.

2. Problem analysis:
Identify and analyze well defined Electronics & Telecommunication engineering problems using discipline specific knowledge.

3. Design/Development of solutions:
Design solutions for well defined technical problems which will support design of system components or process to meet specified need in Electronics & Telecommunication engineering.

4. Engineering tools, experimentation and testing:
Apply modern Electronics & Telecommunication engineering tools and appropriate technique to demonstrate & practice experimental measurements.

5. Engineering practice for society, sustainability and environment:
Apply appropriate technology in context of society, sustainability, environment & Ethical Practices.

6. Project & Management:
Use engineering management principles individually, as a team member or a leader to manage projects and effectively communicate about well-defined engineering activities in multidisciplinary field.

7.Life-long learning:
Ability to analyze individual, societal needs and engage in updating in the context of technological changes.

Program Specific outcomes (PSOs)

Student will be able to:

PSO1: Work for testing, installation, operation and maintenance of various electrical equipment**.**

PSO2: The student of electrical engineering will work in automation and power system to solve practical problems in the field of electrical engineering and cope up with changing technology.

PSO3: The student of electrical engineering will design, estimate and execute electrical installation and will work as an entrepreneur and/or exhibit project management skills working in a team.

PSO4: The student of electrical engineering will follow practices regarding electrical safety and energy conservation in context with society & environment.

Acknowledgement

I appreciate the trust laid in me by Dr. Abhay Wagh, Director, Directorate of Technical Education, Mumbai, Maharashtra and Dr. Dattatray Jadhav, Joint Director, Regional Office Directorate of Technical Education, Pune region, Maharashtra and Dr. Vinod Mohitkar, Director, Maharashtra State Board of Technical Education, Mumbai, Maharashtra as the Chairman PBOS for 180OB Curriculum Design and Development. I am grateful to Dr. Vitthal Badal, Principal Government Polytechnic, Pune for the trust bestowed on me during the Curriculum Design and Development activities. Dr. Vitthal Badal's guidance, support and affection added to the joy of carrying out the assignments of the Curriculum Design and Development.

I recognise, rejoice and deeply appreciate Mr. Milind Dhongade, Chairman, Board of Governance for the support and work towards the Curriculum Design and Development and thank all the members of the Board of Studies for their studied guidance and deep involvement as an Expert.

I would like thank and express my gratitude towards Dr. Dattatray Jadhav, Joint Director, Regional Office, Directorate of Technical Education, Pune region, Maharashtra and Chairman, Board of Governance and the all the members of the Board of Governance for all the support given time to time.

I deeply appreciate all the Industry Expert and Academicians in Program wise Board of Studies panel members of Electrical Engineering Program for the support and work towards the Curriculum Design and Development. Their deep involvement and efficient outcome in the meetings held are highly recognised.

I thank Mr. A.S. Zanpure, Incharge, Curriculum Development Cell and his team at institute level for coordinating all the activities and support during this period.

I highly appreciate the unstinted support of colleagues, which I received during curriculum design and development activities. I recognise, rejoice and deeply appreciate their support and work toward this activity and thank them all, who took on the task of drafting instructional content for the curriculum and sharing their updated curriculum. Deep involvement, hectic activity and efforts of many professional colleagues together with similarity in thought for curricula content for Electrical Engineering Program, has brought this report to a stage of completion.

Dr. Sachin S. Bharatkar

Head of Department and Chairman,
Electrical Engineering Program

Introduction

Government Polytechnic Pune is offering three years Diploma Programme in Electrical Engineering since 1967. Subsequently under World Bank Project this institute was awarded the status of an autonomous institute of Government of Maharashtra. There onwards Government Polytechnic Pune is holding the responsibility of designing and revising its own curriculum. The first curriculum was implemented in 1994 under academic autonomy and subsequently it was revised and implemented in 1999, 2004, 2009, 2014 and the current revision 2019 is being implemented from academic year 2019-20. The curriculum revision is now a regular activity and the mandatory requirement of involvement of industry personnel in curriculum revision helps in enhancing the relevance of the programme curriculum.

Year of revision of curriculum	Name of curriculum	Total credits	Brief Information of Curriculum
1994	190	190	Objective based curriculum, 7 Levels
1999	180	180	Objective based curriculum, 7 Levels
2004	180 R	180	Objective based Revised curriculum, 7 Levels
2009	180Q	180	Quality Function Deployment based curriculum, 7 Levels
2014	180S	180	Objective based **S**cientific curriculum, 5 Levels
2019	180 OB	180	Outcome based curriculum, 5 Levels

Well defined methodology is adopted for revising the curriculum structure and the content detailing of individual courses is carried out by group of experts. This is then approved by

- Board of Studies (BOS),
- Programme Wise Board of Studies (PBOS), and
- Governing Body (GB).

The process adopted for designing the curriculum is as follows:

1. Identify skills (Cognitive, psychomotor and affective domain) by conducting industrial survey through questionnaire.
2. Record degree of identified skills of Diploma holder in industry on the scale of 1 to 4 (1- Most Important, 2-Important, 3- Less important, 4- Not preferred) through questionnaire.
3. Identify courses based on identified skills in industrial survey/feedback.
4. Categorize courses into three main streams
5. Placing the identified courses in appropriate levels.
6. Identify Course Objectives for each course based on the identified skill
7. Collection of feedback from experienced faculty about content details, teaching scheme and evaluation scheme
8. Revising the components of curriculum based on all the above feedbacks.
9. Validate the revised curriculum by Industry experts and Academia through conference.
10. Obtain equivalence from Maharashtra State Board of Technical Education Mumbai in due course of time.

For designing/revising the curriculum, the various domains have been identified in Electrical Engineering Programme. These domains are

- Testing and maintenance of electrical equipment.
- Generation and utilization of electrical power.
- Recent trends.

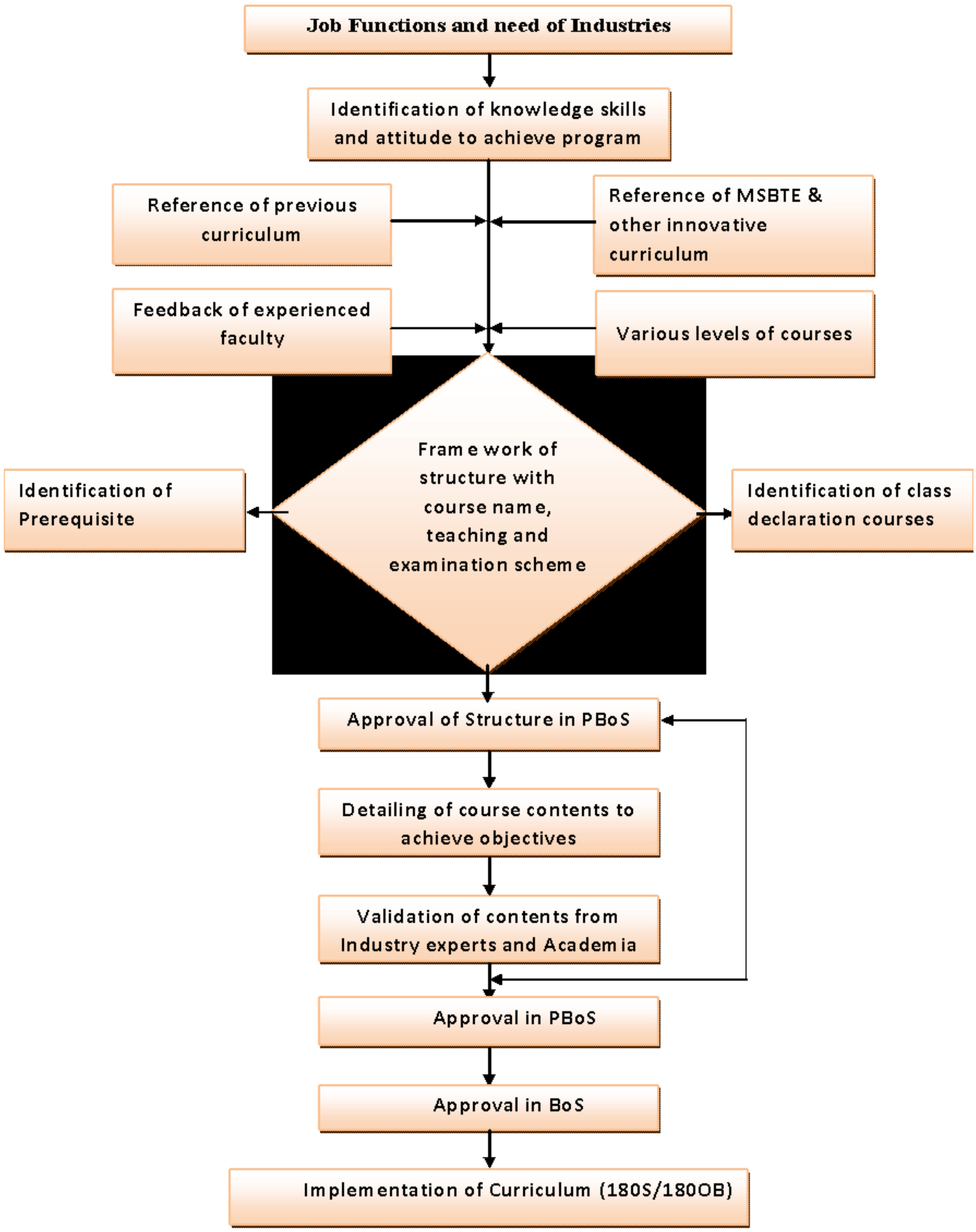
The procedure adopted for revising the curriculum is as follows:

- Defining Vision and Mission statement of the department
- Defining Program Education Outcomes (PEOs) and Program Specific Outcomes (PSOs)
- Identification of unit outcomes (UOs) and Course Outcomes (Cos) for each course
- Mapping COs with POs and PSOs
- Presentation of sample COs to PBoS committee for approval
- Refining of COs based on the feedback from PBoS and experience of the faculty members

The revised **180 OB**, Outcome based curriculum is being implemented from academic year **2019-20**.

- The curriculum format for the course is also improvised with the addition of list of major equipment required along with specification, student activities, special instructional strategies, learning resources including list of books with ISBN number and addresses of websites.
- Based on the feedback, new courses such as entrepreneurship development and start-ups The special feature of this 180 OB curriculum is inclusion of six weeks in-plant training for all the students.
- Some Pre-requisite courses are also newly added.

Flow diagram of Methodology for Curriculum Revision



Government Polytechnic, Pune

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Department of Electrical Engineering
List of members Governing Body (GB)

Sr. No.	Name and Designation	Designation
1	Dr. Dattatray Jadhav, Joint Director of Technical Education Pune	Chairman
2	Mr. Milind Dhongade, Managing Director, Computer Home, Pune.	Member
3	Mr. Shashank Hiwarkar, Director, ETH Limited, Pune.	Member
4	Mr. Vikas Waghmare, Chief Engineer, Suma Shilp Ltd., Pune.	Member
5	Mr. Kiran Jadhav, Managing Director, Accurate Industrial Control Pvt. Ltd., Pune.	Member
6	Mr. Abhijit Phadke, Director-CTCI Test and Lab ops. Cell, Cummins India Ltd. Pune.	Member
7	Dr. Bharat Ahuja, Director, Government College of Engineering, Pune.	Member
8	Mr. Shahid Usmani, Deputy Secretary, Regional office, MSBTE, Mumbai	Member
9	Dr. S.S. Kedar, Co-ordinator, National Institute for Technical Teachers Training & Research, Extension Center, Pune	Member
10	Regional Officer, Western Regional Office (AICTE), 2nd floor, Industrial Assurance Building, Veer Nariman Road, Church gate, Mumbai.	Member
11	Prof. K. K. Ghosh, FIE, Chairman, Pune Local Chapter, Institution of Engineers (India)	Member
12	Mr. P. D. Rendalkar, General Manager, District Industries Centre, Agriculture College Compound, Shivaji Nagar, Pune	Member
13	Dr. Vitthal Bandal, Principal, Government Polytechnic, Pune	Member Secretary

Government Polytechnic, Pune

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Department of Electrical Engineering
List of members of Board of Studies (BoS)

Sr. No.	Name and Designation	Designation
1	Mr. Milind Dhongade, Managing Director, Computer Home, Pune	Chairman
2	Dr. Vitthal Bandal, Principal, Government Polytechnic, Pune	Invitee
3	Dr. Sunil Patil, Ex Director, Symbiosis Institute of Telecom Management, Pune	Member
4	Mr. Ravikiran Chaudhari, Foretech Precision Pvt. Ltd., A – 1, Sonal Residency, Ideal Colony, Kothrud, Pune.	Member
5	Mr. Ashok Atkekar, Project Management Consultant, Pune	Member
6	Mr.Avinash Joshi, Cubix Automation, Pune	Member
7	Mr. Sanjay Mahajan, Director, SM Engineers, Pune	Member
8	Mr. Prakash Raut, Superintendent Engineer, Maharashtra State Electricity Distribution Company Ltd., Rasta Peth, Pune	Member
9	Prof. Prakash Wani, Ex. Professor, Dept. of Electronics & Telecommunication Engg., Government College of Engineering, Shivajinagar, Pune.	Member
10	Mrs. Minal Joshi, MD, Uzazi, Pune	Member
11	Dr. Shaheed Usmani, Dy. Secretary, Maharashtra State Board of Technical Education, Pune Region, Pune	Member
12	Mr Vishanath Tambe, Head of Civil Engg. Dept., Government Polytechnic, Pune	Member
13	Mr Vyankatesh Kondawar, Head of Civil Engg. Dept., (Second shift), Government Polytechnic, Pune	Member
14	Dr Sachin Bharatkar, Head of Electrical Engg. Dept., Government Polytechnic, Pune	Member
15	Mr Rajesh Shelke, Head of Electrical Engg. Dept.,(second shift), Government Polytechnic, Pune	Member
16	Mr. Rajreddy Shikari., Head of Electronics and Tele. Engg. Dept., Government Polytechnic, Pune	Member

17	Dr. Sandiapan Narote, Head of Electronics and Tele. Engg. Dept., (Second Shift) Government Polytechnic, Pune	Member
18	Dr. Nitin Kulkarni, Head of Electrical Engg. Dept., and Academic Coordinator, Government Polytechnic, Pune	Member
19	Mrs. Namita Kadam, Head of Metallurgical Engg. Dept., Government Polytechnic, Pune	Member
20	Dr. Shankar Nikam, I/c Head of Computer Engg. Dept., Government Polytechnic, Pune	Member
21	Mrs. Mrunal Kokate, Head of Information Technology Dept., Government Polytechnic, Pune	Member
22	Mrs Shubahngi Shinde, I/c. Head of Dress Designing & Garment Mfg. Engg. Dept., Government Polytechnic, Pune	Member
23	Dr. V.B. Jaware, Controller of Examinations, Government Polytechnic, Pune	Member
24	Mr. Anant Zanpure, I/C. C.D.C., Government Polytechnic, Pune	Member

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Department of Electrical Engineering
List of members of Program wise Board of Studies (PBoS)

Sr.No.	Name of Member	Designation	Organization
1.	Dr. Sachin S. Bharatkar	Chairman and CDC Head	HOD(Electrical), G. P. Pune
2.	Shri Rajesh U. Shelke	Vice Chairman	HOD(Electrical), G. P. Pune
3.	Dr. V. S. Bandal	Special Invitee (Principal)	Principal, G. P. Pune
4.	Mr. Shahid Usmani	PBOS Member	RBTE Pune
5.	Dr. R. N. Awale	PBOS Member	Professor Ele Engg ,VJTI Mumbai
6.	Prof. S. S. Dambhare	PBOS Member	HOD(Electrical), C.O.E.P. Pune
7.	Smt. K. G. Mankar	PBOS Member	HOD(Electrical), CWIT Pune
8.	Mr. Uday Bhosale	PBOS Member	Ex. Engineer , MSEDCL
9.	Shri Y. V. Talware	PBOS Member	Director , Strome Energy Pvt Ltd
10.	Shri Amit Ursal	PBOS Member	Proprietor , Purandar Electrical Consultant, Pune
11.	Shri Shriniwas R. Deshingkar	PBOS Member	Chairman & Managing Director , Shree Electricals & Engineers(India) Pvt. Ltd, Pune
12.	Shri Suresh Warade	PBOS Member	Dirctor , Warade Automation, Pune
13.	Smt. U. S. Tulangekar	Member Secretary	G. P. Pune
14.	Shri S. S. Ashtputre	Member	G. P. Pune
15.	Shri N. G. Kulkarni	Invitee	(Academic Coordinator), G. P. Pune

16.	Dr. V. B Jaware	Invitee	(Exam. Controller), G. P. Pune
17	Smt. A. N. Duraphe	Invitee	(LEE), G. P. Pune
18.	Dr. B. R. More	Invitee	(LEE), G. P. Pune
19	Dr. V. K. Jadhav	Invitee	(LEE), G. P. Pune
20	Shri J. G. Momin	Invitee	(LEE), G. P. Pune
21	Shri. S. P. Date	Invitee	(LEE), G. P. Pune
22	Shri. R. B. Chauthmal	Invitee	(LEE), G. P. Pune
23	Smt. R. T. Patil	Invitee	(LEE), G. P. Pune

Government Polytechnic, Pune

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Department of Electrical Engineering
Curriculum Development Cell committee of Institute

Institute Level CDC Team:

S. No.	Name of Members	Post at CDC
1	Shri Anant Sharad Zanpure, Lecturer in Mechanical Engineering.	In-Charge
2	Dr Vijaykumar Kishanrao Jadhav , Lecturer in Electrical Engineering.	Member
3	Smt Pranita Mangesh Zilpe, Lecturer in E&TC Engineering.	Member

Program wise CDC In- charges :

S. No.	Name of Members	Name of Program
1	Smt. Sindhu R. Panapalli Smt. Jyotsna.S. Thorat	Civil Engineering
2	Smt. Ujwala S. Tulangekar Shri. Sunil P. Date	Electrical Engineering
3	Smt. Pranita M. Zilpe Mrs. Sarika S. Chhatwani	Electronics & Telecommunication
4	Mr. Sudin B. Kulkarni Dr. Aniruddha A. Gadhikar	Mechanical Engineering
5	Shri. A.V.Mehtre	Metallurgical Engineering
6	Smt. Megha G. Yawalkar Mrs. Sayali P. Ambavane Smt. Lalita S. Korde Mr. Tarun P. Sharma	Computer Engineering
7	Mrs. Priyanka L. Sonwane	Information Technology
8	Mrs. Namita V. Gondane	Dress Designing & Garment Manufacturing
9	Smt. Komal Mankar	Science & Humanities
10	Smt. Dipti Saurkar	Science & Humanities
11	Shri. Sachin Yede	Science & Humanities
12	Smt. Saroj Patil	Science & Humanities

GOVERNMENT POLYTECHNIC, PUNE

An autonomous Institute of Government of Maharashtra

DIPLOMA IN ELECTRICAL ENGINEERING

Program Structure 180 OB **(Regular & PTD Students)**

Level - I : Foundation Level Courses (All Compulsory)

Sr. No	COURSE CODE	COURSE	PREREQUISITE	TEACHING SCHEME				EXAMINATION SCHEME					CD
				CREDITS				THEORY		PRACTICAL		TOTAL MARKS	
				TH	PR	TUT	TOTAL	PA	ESE	PA*	ESE		
1	HU1101	Communication Skills-I	---	2	0	1	3	10	40	25	25$	100	--
2	HU1102	Communication Skills-II	HU1101	2	0	1	3	10	40	50	--	100	--
3	SC1101	Applied Mathematics -I	---	3	0	2	5	20	80	25	--	125	--
4	SC1102	Applied Mathematics -II	SC1101	3	0	2	5	20	80	25	--	125	--
5	SC1104	Engineering Physics	----	3	2	0	5	20	80#	25	25*	150	--
6	SC1105	Engineering Chemistry	----	3	2	0	5	20	80#	25	25*	150	--
Total Level I				**16**	**4**	**6**	**26**	**100**	**400**	**175**	**75**	**750**	**--**

Level - II : Core Technology Courses (Group A & B)

Level - II : GROUP - A (All Compulsory)

Sr. No	COURSE CODE	COURSE	PREREQUISITE	TEACHING SCHEME				EXAMINATION SCHEME					CD
				CREDITS				THEORY		PRACTICAL		TOTAL MARKS	
				TH	PR	TUT	TOTAL	PA	ESE	PA*	ESE		
1	AM2101	Engineering Mechanics	--	4	2	0	6	20	80	25	--	125	--
2	CM2102	Fundamentals of ICT	--	1	2	0	3	--	--	25	25*	50	--
3	EE2101	Basic Electrical Engineering	--	3	2	0	5	20	80	25	25*	150	--
4	EE2104	Electrical Wiring And Domestic Appliances	**--**	0	2	0	2	--	--	25	--	25	**--**
5	EE2105	Computational Laboratory	--	1	2	0	3	--	--	25	25$	50	--
6	ET2108	Electronic Components & Circuits	--	2	2	0	4	10	40	25	25$	100	--
7	ME2104	Engineering Graphics	--	2	2	0	4	--	--	50	--	50	--
8	ME2107	Fundamentals of Mechanical Engineering	--	2	2	0	4	20	80	25	--	125	--
9	WS2102	Workshop Practice (Electrical)	--	0	2	0	2	--	--	25	25*	50	--
Total (Level II : Gp - A)				**15**	**18**	**0**	**33**	**70**	**280**	**250**	**125**	**725**	**--**

Level - II : GROUP - B (Any One)													
Sr. No	COURSE CODE	COURSE	PREREQUISITE	TEACHING SCHEME				EXAMINATION SCHEME					CD
				CREDITS				THEORY		PRACTICAL		TOTAL MARKS	
				TH	PR	TUT	TOTAL	PA	ESE	PA*	ESE		
1	EE2106	Electrical Safety	--	3	0	0	3	20	80	--	--	100	--
2	SC2103	Mathematics III	SC1102	3	0	0	3	20	80	--	--	100	--
Total (Level II : Gp - B)				**3**	**0**	**0**	**3**	**20**	**80**	**0**	**0**	**100**	**--**
Total Level II				**18**	**18**	**0**	**36**	**90**	**360**	**250**	**125**	**825**	**--**

Level - III : Basic Technology Courses (All Compulsory)													
Sr. No	COURSE CODE	COURSE	PREREQUISITE	TEACHING SCHEME				EXAMINATION SCHEME					CD
				CREDITS				THEORY		PRACTICAL		TOTAL MARKS	
				TH	PR	TUT	TOTAL	PA	ESE	PA*	ESE		
1	EE3101	Electrical CAD	--	0	2	0	2	--	--	25	25*	50	--
2	EE3102	Electrical Circuit Analysis	--	3	2	1	6	20	80	25	25*	150	--
3	EE3103	Electrical Measurements & Instruments	--	3	2	0	5	20	80	25	25$	150	--
4	EE3104	Generation of Electrical Power	--	3	0	1	4	20	80	25	--	125	--
5	EE3105	DC Machines & Transformers	EE2101	3	2	1	6	20	80	25	25*	150	--
6	EE3106	Transmission & Distribution of Electrical Power	--	3	0	1	4	20	80	25	--	125	--
7	EE3107	Instrumentation & Control	--	3	2	0	5	20	80	25	25$	150	--
8	ET3101	Digital Techniques & Applications	ET2108	3	2	0	5	20	80	25	25*	150	--
Total Level III				**21**	**12**	**4**	**37**	**140**	**560**	**200**	**150**	**1050**	**--**

Level - IV : Applied Technology Courses (Group A, B & C)													
Level - IV : Group- A [Auxiliary Courses (Two : Course with @ is Compulsary and Any One from the remaining)]													
Sr. No	**COURSE CODE**	**COURSE**	**PREREQUISITE**	**TEACHING SCHEME**				**EXAMINATION SCHEME**					**CD**
				CREDITS				**THEORY**		**PRACTICAL**		**TOTAL MARKS**	
				TH	**PR**	**TUT**	**TOTAL**	**PA**	**ESE**	**PA***	**ESE**		
1	AU4101	Environmental Science **@**	--	0	2	0	2	--	--	50	--	50	--
2	AU 4102	Renewable Energy Technologies	--	2	0	0	2	10	40#	--	--	50	--
3	AU4103	Engineering Economics	--	2	0	0	2	10	40#	--	--	50	--
4	AU4104	Ethical Sources and Sustainability	--	2	0	0	2	10	40#	--	--	50	--
5	AU4105	Digital Marketing	--	0	2	0	2	--	--	25	25$	50	--
Total (Level IV : Gp - A)				**2**	**2**	**0**	**4**	**10**	**40**	**50**	**0**	**100**	--

Level - IV : Group- B [Management courses (Two : Course with @ is Compulsary and Any One from the remaining)]													
Sr. No	**COURSE CODE**	**COURSE**	**PREREQUISITE**	**TEACHING SCHEME**				**EXAMINATION SCHEME**					**CD**
				CREDITS				**THEORY**		**PRACTICAL**		**TOTAL MARKS**	
				TH	**PR**	**TUT**	**TOTAL**	**PA**	**ESE**	**PA***	**ESE**		
1	MA4101	Entrepreneurship & Startups **@**	--	2	0	0	2	10	40#	--	--	50	--
2	MA4102	Industrial Organization and Management	--	2	0	0	2	10	40#	--	--	50	--
3	MA4103	Material Management	--	2	0	0	2	10	40#	--	--	50	--
4	MA4104	Disaster Management	--	2	0	0	2	10	40#	--	--	50	--
5	MA4105	Introduction to E-commerce	--	2	0	0	2	10	40#	--	--	50	--
6	MA4106	Information Management	--	2	0	0	2	10	40#	--	--	50	--
Total (Level IV : Gp - B)				**4**	**0**	**0**	**4**	**20**	**80**	**0**	**0**	**100**	**--**

Level - IV : Group- C [Program specific Courses (All Compulsory)]														
Sr. No	**COURSE CODE**	**COURSE**	**PREREQUISITE**	**TEACHING SCHEME**				**EXAMINATION SCHEME**						**CD**
				CREDITS				**THEORY**		**PRACTICAL**		**TOTAL MARKS**		
				TH	**PR**	**TUT**	**TOTAL**	**PA**	**ESE**	**PA***	**ESE**			
1	EE4101	Industry Inplant Training	L1 & L2 term grant	0	6	0	6	--	--	50	50$	100		--
2	EE4102	Project	90 Credits & L1 pass	0	4	0	4	--	--	50	50$	100		CD
3	EE4103	Seminar	90 Credits & L1 pass	0	2	0	2	--	--	25	25$	50		CD
4	EE4104	Power Electronics & Applications	ET2108 term grant & L1 pass	3	2	0	5	20	80	25	25$	150		CD
5	EE4105	AC Machines	EE3105 term grant & L1 pass	3	2	1	6	20	80	25	25*	150		CD
6	EE4106	Installation, Testing and Maintenance of Electrical equipment	EE4105 term grant & L1 pass	4	2	0	6	20	80	25	25*	150		CD
7	EE4107	Switchgear & Protection	L1 pass	4	2	0	6	20	80	25	25$	150		CD
8	EE4108	Electrical Estimation & Costing	EE2104 term grant	3	2	0	5	20	80	25	25$	150		--
9	EE4109	Utilization of Electrical Energy	L1 pass	3	1	0	4	20	80	25	25$	150		CD
10	EE4110	Energy Conservation & Audit	L1 pass	3	2	0	5	20	80	25	25$	150		CD
Total (Level IV : Gp - C)				**23**	**25**	**1**	**49**	**140**	**560**	**300**	**300**	**1300**		
Total Level IV				**29**	**27**	**1**	**57**	**170**	**680**	**350**	**300**	**1500**		

Level - V : Diversified Technology Courses

Level - V : GROUP - A (Any Two)

Sr. No	COURSE CODE	COURSE	PREREQUISITE	TEACHING SCHEME				EXAMINATION SCHEME					CD
				CREDITS				THEORY		PRACTICAL		TOTAL MARKS	
				TH	PR	TUT	TOTAL	PA	ESE	PA*	ESE		
1	EE5101	Microcontroller and Applications	ET3101 term grant & L1 pass	3	2	1	6	20	80	25	25*	150	CD
2	EE5102	Industrial Automation	EE4105 term grant & L1 pass	3	2	1	6	20	80	25	25$	150	CD
3	EE5103	Power System Operation & Control	EE3104 & EE3106 term grant & L1 pass	3	2	1	6	20	80	25	25$	150	CD
4	EE5104	Special Purpose Machines	L1 pass	3	2	1	6	20	80	25	25$	150	CD
Total (Level V : Gp - A)				**6**	**4**	**2**	**12**	**40**	**160**	**50**	**50**	**300**	

Level - V : GROUP - B (Any Two)

Sr. No	COURSE CODE	COURSE	PREREQUISITE	TEACHING SCHEME				EXAMINATION SCHEME					CD
				CREDITS				THEORY		PRACTICAL		TOTAL MARKS	
				TH	PR	TUT	TOTAL	PA	ESE	PA*	ESE		
1	EE5105	Illumination Engineering	L1 pass	3	2	1	6	20	80	25	25$	150	CD
2	EE5106	Electrical Machine Design	EE4105 term grant & L1 pass	3	2	1	6	20	80	25	25$	150	CD
3	EE5107	Electrical Mobility Systems	L1 pass	3	2	1	6	20	80	25	25$	150	CD
4	EE5108	Building Maintenance System	L1 pass	3	2	1	6	20	80	25	25$	150	CD
Total (Level V : Gp - A)				**6**	**4**	**2**	**12**	**40**	**160**	**50**	**50**	**300**	
Total Level V				**12**	**8**	**4**	**24**	**80**	**320**	**100**	**100**	**600**	
Grand Total (Level I to Level V)				**96**	**69**	**15**	**180**	**580**	**2160**	**1075**	**600**	**4725**	

Note : L1 = Level 1 Courses , L2 =Level 2 Courses	
The credit ratio of Theory to Practical is (96 : 84 ie) 53 : 47	Marks ratio of Theory to Practical (2900:1825 i.e) 61:39
Abbreviations : TH- Theory , PR- Practical , TUT- Tutorial, CD - Class Declaration course, PA-Progressive Assessment (Test Marks), ESE- End Sem Exam Marks, PA *- Term Work Marks , $ - Oral Exam , * - Practical Exam, # - Online Exam	
Head of Electrical Department	**I/c CDC**

Government Polytechnic , Pune

(An autonomous Institute of Government of Maharashtra)

DIPLOMA IN ELECTRICAL ENGINEERING

(180 OB) Sample Path for **Regular** Students (Shift I & Shift II)

For Exam Pattern Please Refer Structure of 180 OB

Semester I

Sr. No	COURSE CODE	COURSE	PREREQUISITE	TEACHING SCHEME CREDITS				EXAMINATION SCHEME					CD
								THEORY		PRACTICAL		TOTAL MARKS	
				TH	PR	TUT	TOTAL	PA	ESE	PA*	ESE		
1	HU1101	Communication Skills-I	---	2	0	1	3	10	40	25	25	100	--
2	SC1101	Applied Mathematics -I	---	3	0	2	5	20	80	25	--	125	--
3	SC1104	Engineering Physics	----	3	2	0	5	20	80	25	25	150	--
4	CM2102	Fundamentals of ICT	--	1	2	0	3	--	--	25	25	50	--
5	EE2104	Electrical Wiring And Domestic Appliances	--	0	2	0	2	--	--	25	--	25	--
6	ME2104	Engineering Graphics	--	2	2	0	4	--	--	50	--	50	--
7	WS2102	Workshop Practice (Electrical)	--	0	2	0	2	--	--	25	25	50	--
8	AU4101	Environmental Science	--	0	2	0	2	--	--	50	0	50	--
Total				**11**	**12**	**3**	**26**	**50**	**200**	**250**	**100**	**600**	

Semester II

Sr. No	COURSE CODE	COURSE	PREREQUISITE	TEACHING SCHEME CREDITS				EXAMINATION SCHEME					CD
								THEORY		PRACTICAL		TOTAL MARKS	
				TH	PR	TUT	TOTAL	PA	ESE	PA*	ESE		
1	HU1102	Communication Skills-II	HU1101	2	0	1	3	10	40	50	--	100	--
2	SC1102	Applied Mathematics - II	SC1101	3	0	2	5	20	80	25	--	125	--
3	SC1105	Engineering Chemistry	----	3	2	0	5	20	80	25	25	150	--
4	AM2101	Engineering Mechanics	--	4	2	0	6	20	80	25	--	125	--
5	EE2101	Basic Electrical Engineering	--	3	2	0	5	20	80	25	25	150	--
6	ET2108	Electronic Components & Circuits	--	2	2	0	4	10	40	25	25	100	--
Total				**17**	**8**	**3**	**28**	**100**	**400**	**175**	**75**	**750**	

Semester III

Sr. No	COURSE CODE	COURSE	PREREQ UISITE	TEACHING SCHEME				EXAMINATION SCHEME					CD
				CREDITS				THEORY		PRACTICAL		TOTAL MARKS	
				TH	PR	TUT	TOTAL	PA	ESE	PA*	ESE		
1	EE2105	Computational Laboratory	--	1	2	0	3	--	--	25	25	50	--
2	EE2106	Electrical Safety **OR**	--	3	0	0	3	20	80	--	--	100	--
	SC2103	Mathematics III	SC1102										
3	EE3101	Electrical CAD	--	0	2	0	2	--	--	25	25	50	
4	EE3102	Electrical Circuit Analysis	--	3	2	1	6	20	80	25	25	150	--
5	EE3103	Electrical Measurements & Instruments	--	3	2	0	5	20	80	25	25	150	--
6	EE3104	Generation of Electrical Power	--	3	0	1	4	20	80	25	--	125	--
7	ME2107	Fundamentals of Mechanical Engg	--	2	2	0	4	20	80	25	--	125	--
8	AU 4102	Renewable Energy Technologies	--	2	0	0	2	10	40	--	--	50	--
Total				**17**	**10**	**2**	**29**	**110**	**440**	**150**	**100**	**800**	

Semester IV

Sr. No	COURSE CODE	COURSE	PREREQ UISITE	TEACHING SCHEME				EXAMINATION SCHEME					CD
				CREDITS				THEORY		PRACTICAL		TOTAL MARKS	
				TH	PR	TUT	TOTAL	PA	ESE	PA*	ESE		
1	EE3105	DC Machines & Transformers	EE2101	3	2	1	6	20	80	25	25	150	--
2	EE3106	Transmission & Distribution of Electrical Power	--	3	0	1	4	20	80	25	--	125	--
3	EE3107	Instrumentation & Control	--	3	2	0	5	20	80	25	25	150	--
4	ET3101	Digital Techniques & Applications	ET2108	3	2	0	5	20	80	25	25	150	--
5	MA4102	Industrial Organization and Management	--	2	0	0	2	10	40	--	--	50	--
6	EE4108	Electrical Estimation & Costing	EE2104	3	2	0	5	20	80	25	25	150	--
Total				**17**	**8**	**2**	**27**	**110**	**440**	**125**	**100**	**775**	

Note: After this semester --Student will undergo inplant training of 6 weeks which will be evaluated with ESE of semester V and then after successful completion, 6 credits will be awarded to the student.

Semester V														
Sr. No	COURSE CODE	COURSE	PREREQ UISITE	TEACHING SCHEME				EXAMINATION SCHEME					CD
				CREDITS				THEORY		PRACTICAL		TOTAL MARKS	
				TH	PR	TUT	TOTAL	PA	ESE	PA*	ESE		
1	EE4101	Industry Inplant Training	L1 & L2 term grant	0	6	0	6	--	--	50	50	100	--
2	EE4103	Seminar	90 Credits & L1 pass	0	2	0	2	--	--	25	25	50	CD
3	EE4104	Power Electronics & Applications	ET2108 term grant & L1 pass	3	2	0	5	20	80	25	25	150	CD
4	EE4105	AC Machines	EE3105 term grant & L1 pass	3	2	1	6	20	80	25	25	150	CD
5	EE4107	Switchgear & Protection	L1 pass	4	2	0	6	20	80	25	25	150	CD
6	MA4101	Entrepreneurship & Startup	--	2	0	0	2	10	40	--	--	50	--
7	*	Elective - 1 (From Level V - A)	**	3	2	1	6	20	80	25	25	150	CD
8	*	Elective - 2 (From Level V - B)	**	3	2	1	6	20	80	25	25	150	CD
Total				**18**	**18**	**3**	**39**	**110**	**440**	**200**	**200**	**950**	
Note : EE4101 is only for evaluation. Student has already completed the work in summer													

Semester VI														
Sr. No	**COURSE CODE**	**COURSE**	**PREREQ UISITE**	**TEACHING SCHEME**				**EXAMINATION SCHEME**					**CD**
				CREDITS				**THEORY**		**PRACTICAL**		**TOTAL MARKS**	
				TH	**PR**	**TUT**	**TOTAL**	**PA**	**ESE**	**PA***	**ESE**		
1	EE4102	Project	90 Credits & L1 pass	0	4	0	4	--	--	50	50	100	CD
2	EE4106	Installation, Testing and Maintenance of Electrical equipment	EE4105 term grant & L1 pass	4	2	0	6	20	80	25	25	150	CD
3	EE4109	Utilization of Electrical Energy	L1 pass	3	1	0	4	20	80	25	25	150	CD
4	EE4110	Energy Conservation Audit	L1 pass	3	2	0	5	20	80	25	25	150	CD
5	*	Elective - 3 (From Level V - A)	**	3	2	1	6	20	80	25	25	150	CD
6	*	Elective - 4 (From Level V - B)	**	3	2	1	6	20	80	25	25	150	CD
Total				**16**	**13**	**2**	**31**	**100**	**400**	**175**	**175**	**850**	
Note : * Electives are to be chosen from **Level - V** ** Prerequisite is mentioned in structure of 180 OB													
Grand Total				**96**	**69**	**15**	**180**	**580**	**2320**	**1075**	**750**	**4725**	
Note : L1 = Level 1 Courses , L2 = Level 2 Courses													
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DIPLOMA IN ELECTRICAL ENGINEERING

(180 OB) Sample Path for **PTD** Students

Semester I

Sr. No	COURSE CODE	COURSE	PREREQ UISITE	TEACHING SCHEME CREDITS				EXAMINATION SCHEME					CD
								THEORY		PRACTICAL		TOTAL MARKS	
				L	P	T	C	PA	ESE	PA*	ESE		
1	HU1101	Communication Skills-I	---	2	0	1	3	10	40	25	25	100	--
2	SC1101	Applied Mathematics -I	---	3	0	2	5	20	80	25	--	125	--
3	SC1104	Engineering Physics	---	3	2	0	5	20	80	25	25	150	--
4	EE2104	Electrical Wiring And Domestic Appliances	--	0	2	0	2	--	--	25	--	25	--
5	ME2104	Engineering Graphics	--	2	2	0	4	--	--	50	--	50	--
6	WS2102	Workshop Practice (Electrical)	--	0	2	0	2	--	--	25	25	50	--
Total				**10**	**8**	**3**	**21**	**50**	**200**	**175**	**75**	**500**	

Semester II

Sr. No	COURSE CODE	COURSE	PREREQ UISITE	TEACHING SCHEME CREDITS				EXAMINATION SCHEME					CD
								THEORY		PRACTICAL		TOTAL MARKS	
				L	P	T	C	PA	ESE	PA*	ESE		
1	HU1102	Communication Skills-II	HU1101	2	0	1	3	10	40	50	--	100	--
2	SC1102	Applied Mathematics -II	SC1101	3	0	2	5	20	80	25	--	125	--
3	SC1105	Engineering Chemistry	----	3	2	0	5	20	80	25	25	150	--
4	CM2102	Fundamentals of ICT	--	1	2	0	3	--	--	25	25	50	--
5	EE3101	Electrical CAD	--	0	2	0	2	--	--	25	25	50	--
6	AU4101	Environmental Science	--	0	2	0	2	--	--	50	--	50	--
Total				**9**	**8**	**3**	**20**	**50**	**200**	**200**	**75**	**525**	

Semester III

Sr. No	COURSE CODE	COURSE	PREREQ UISITE	TEACHING SCHEME CREDITS				EXAMINATION SCHEME					CD
								THEORY		PRACTICAL		TOTAL MARKS	
				L	P	T	C	PA	ESE	PA*	ESE		
1	AM2101	Engineering Mechanics	--	4	2	0	6	20	80	25	--	125	--
2	EE2101	Basic Electrical Engineering	--	3	2	0	5	20	80	25	25	150	--
3	EE2106	Electrical Safety **OR**	--	3	0	0	3	20	80	--	--	100	--
	SC2103	Mathematics III	SC1102										
4	ET2108	Electronic Components & Circuits	--	2	2	0	4	10	40	25	25	100	--
5	ME2107	Fundamentals of Mechanical Engineering	--	2	2	0	4	20	80	25	--	125	--
Total				**14**	**8**	**0**	**22**	**90**	**360**	**100**	**50**	**600**	

Semester IV

Sr. No	COURSE CODE	COURSE	PREREQ UISITE	TEACHING SCHEME CREDITS				EXAMINATION SCHEME					CD
								THEORY		PRACTICAL		TOTAL MARKS	
				L	P	T	C	PA	ESE	PA*	ESE		
1	EE2105	Computational Laboratory	--	1	2	0	3	--	--	25	25	50	--
2	EE3102	Electrical Circuit Analysis	--	3	2	1	6	20	80	25	25	150	--
3	EE3103	Electrical Measurements & Instruments	--	3	2	0	5	20	80	25	25	150	--
4	EE3104	Generation of Electrical Power	--	3	0	1	4	20	80	25	--	125	--
5	ET3101	Digital Techniques & Applications	ET2108	3	2	0	5	20	80	25	25	150	--
Total				**13**	**8**	**2**	**23**	**80**	**320**	**125**	**100**	**625**	

Semester V

Sr. No	Course Code	Course Title	PREREQUISITE	Teaching Scheme				Examination Scheme					CD
								Theory		Practical		TOTAL MARKS	
				L	P	T	C	PA	ESE	PA*	ESE		
1	EE3105	DC Machines & Transformers	EE2101	3	2	1	6	20	80	25	25	150	--
2	EE3106	Transmission & Distribution of Electrical Power	--	3	0	1	4	20	80	25	--	125	--
3	EE3107	Instrumentation & Control	--	3	2	0	5	20	80	25	25	150	--
4	AU 4102	Renewable Energy Technologies	--	2	0	0	2	10	40	--	--	50	--
5	EE4108	Electrical Estimation & Costing	EE2104	3	2	0	5	20	80	25	25	150	--
Total				**14**	**6**	**2**	**22**	**90**	**360**	**100**	**75**	**625**	

Semester VI

Sr. No	COURSE CODE	COURSE	PREREQUISITE	TEACHING SCHEME CREDITS				EXAMINATION SCHEME					CD
								THEORY		PRACTICAL		TOTAL MARKS	
				L	P	T	C	PA	ESE	PA*	ESE		
1	EE4104	Power Electronics & Applications	ET2108 term grant & L1 pass	3	2	0	5	20	80	25	25	150	CD
2	EE4105	AC Machines	EE3105 term grant & L1 pass	3	2	1	6	20	80	25	25	150	CD
3	EE4107	Switchgear & Protection	L1 pass	4	2	0	6	20	80	25	25	150	CD
4	EE4109	Utilization of Electrical Energy	L1 pass	3	1	0	4	20	80	25	25	150	CD
Total				**13**	**7**	**1**	**21**	**80**	**320**	**100**	**100**	**600**	

Semester VII

Sr. No	COURSE CODE	COURSE	PREREQ UISITE	TEACHING SCHEME CREDITS				EXAMINATION SCHEME					CD
								THEORY		PRACTICAL		TOTAL MARKS	
				L	P	T	C	PA	ESE	PA*	ESE		
1	EE4103	Seminar	90 Credits & level1 pass	0	2	0	2	--	--	25	25	50	CD
2	EE4110	Energy Conservation & Audit	L1 pass	3	2	0	5	20	80	25	25	150	CD
3	MA4101	Entrepreneurship & Startups	--	2	0	0	2	10	40	--	--	50	--
4	MA4102	Industrial Organization and Management	--	2	0	0	2	10	40	--	--	50	--
5	*	Elective -1(From Level V - A)	**	3	2	1	6	20	80	25	25	150	CD
6	*	Elective -2(From Level V -B)	**	3	2	1	6	20	80	25	25	150	CD
				13	**8**	**2**	**23**	**80**	**320**	**100**	**100**	**600**	

Note : * Electives are to be chosen from **Level - V**   **** Prerequisite is mentioned in structure of 180 OB

Semester VIII

Sr. No	COURSE CODE	COURSE	PREREQ UISITE	TEACHING SCHEME CREDITS				EXAMINATION SCHEME					CD
								THEORY		PRACTICAL		TOTAL MARKS	
				L	P	T	C	PA	ESE	PA*	ESE		
1	EE4101	Industry In-plant Training	L1 & L2 term grant	0	6	0	6	--	--	50	50	100	--
2	EE4102	Project	90 Credits & level1 pass	0	4	0	4	--	--	50	50	100	CD
3	EE4106	Installation, Testing and Maintenance of Electrical equipment	EE4105 term grant & L1 pass	4	2	0	6	20	80	25	25	150	CD
4	*	Elective -3(From Level V - A)	**	3	2	1	6	20	80	25	25	150	CD
5	*	Elective -4(From Level V -B)	**	3	2	1	6	20	80	25	25	150	CD
Total				**10**	**16**	**2**	**28**	**60**	**240**	**175**	**175**	**650**	

Note : EE4101 is only for evaluation. PTD students **WILL NOT** undergo in-plant training of 6 weeks as they are already working in Industry. They should submit the report of respective Industry. * Electives are to be chosen from Level - V ** Prerequisite is mentioned in structure of 180 OB

Grand Total		L	P	T	C	PA	ESE	PA*	ESE	TOTAL MARKS
Grand Total		**96**	**69**	**15**	**180**	**580**	**2320**	**1075**	**750**	**4725**

Note : L1 = Level 1 Courses , L2 = Level 2 Courses

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<u>Level 1 Curriculum</u>

Government Polytechnic , Pune

'180 OB' – Scheme

Programme	Diploma in **CE/EE/ET/ME/MT/CO/IT/DDGM**
Programme Code	**01/02/03/04/05/06/07/08/15/16/ 17/18/19/21/22/23/24/26**
Name of the Course	Communication Skills -I
Course Code	HU1101
Prerequisite	No
Class Declaration	No

1. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P)		Examination Scheme				
					Theory		Practical		Total Marks
L	T	P	C		ESE	PA	$ESE	PA	100
02	01	00	03	Marks	40	10	25	25	
				Exam Duration	2 Hrs	1 Hrs	---	--	--

Legends: L- lecture, T-Tutorial/teacher guided theory practice, P-practical, C-Credits, ESE-End semester examination, PA- Progressive Assessments(Test I, II/Term Work), * - Practical Exam, $ - Oral Exam. # - Online Exam., Each lecture/practical period is of one clock hour.

2. RATIONALE

Communication skills is a natural and necessary part of an organizational life . The goal of communication skills course is to produce civic-minded and competent communicators. At the end, students will acquire proficiency in oral and written methods along with non verbal communication.

3. COMPETENCY

The aim of this course is to attend following industry competency through various teaching learning experiences:

- **To develop English Language Speaking Abilities, enrich fluency, and to make students get acquainted with basics of communication skills.**

4. COURSE OUTCOMES (COs)

The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry-oriented COs associated with the above-mentioned competency**:**

1. Communicate effectively to overcome barriers.
2. Apply Nonverbal codes for effective communication.

3. Apply Learning Skills .
4. Interpret information to present orally.
5. Use Language lab for improving listening and speaking abilities

5. SUGGESTED PRACTICALS/ EXERCISES

Sr. No.	Unit No.	**Practical Exercises** (Outcomes in Psychomotor Domain)	Relevant CO	Approx. Hrs. required
1	1	Introduction to Communication Cycle	1	1
2	1	Analyze Communication Events.	1	1
3	2	Collect Different Pictures Depicting Body actions.	2	2
4	2	Utilize Signs, Symbols & color codes.	2	1
5	3	Loud Reading of Given Paragraph.	3	2
6	3	Utilize Techniques of Listening with the help of lingua phone	3	2
7	4	Topic Writing on Current Issues	4	2
8	4	Comprehending Information and extempore it	4	1
9	5	Practice Vocabulary I (Identify words from various Technical Jargons.)	5	2
10	5	Practice Vocabulary II(Homophones/abbreviations/Synonyms/antonyms)	5	2
11	1 to 5	*Complete the Micro-project as per the guidelines in point no 11 -compulsory.	1 to 5	2
		Total Hrs		**16**

Assignment no 11 is compulsory. *Perform assignment no.5 or 6.

Sr. No.	Performance Indicators	Weightage in %
a.	Arrangement of available equipment / test rig or model	-
b.	Setting and operation	-
c.	Safety measures	-
d.	Observations and Recording	40
e.	Interpretation of result and Conclusion	-
f.	Answer to sample questions	30
g.	Submission of report in time	30
	Total	**100**

6. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

The major equipment with broad specification mentioned here will usher in uniformity in conduct of practical, as well as aid to procure equipment by authorities concerned**.**

Sr. No.	Equipment Name with Broad Specifications	Experiment Sr. No
1	Language Lab	5,6

7. THEORY COMPONENTS

Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
Unit 1 : Introduction and Principles of Communication (08hrs, 12 marks)	
1a.Interpret different communication skills 1b. Define elements of communication 1c. Describe process of communication 1d. Identify barriers for finding remedies 1e. Interpret principles of communication	1.1Introduction to communication 1.2Definition and elements of communication 1.3Process of communication 1.4Barriers to communication and remedies to overcome it. 1.5Principles of communication
Unit 2 : Nonverbal Skills (06hrs, 10marks)	
1a.Differentiate graphic communication 1b.Use different nonverbal codes 1c.Interpret various graphic forms.	1.1 Graphic communication 1.2 Nonverbal codes [Kinesics, Proxemics, Chronemics, Haptics 1.3 Vocalics Dress and Appearance] 1.4 Reading graphic forms[Bar graphPie chart]
Unit 3 : Learning Skills (06hrs, 04 marks)	
1a.Recall listened information 1b.Apply oral skills 1c.Perceives various fonts & use it 1d.Compose sentences & paragraphs	1.1 Listening skills 1.2 Speaking skills 1.3 Reading skills 1.4 Writing Skills
Unit 4 Comprehension (06hrs, 06marks)	
1a. Improve writing techniques 1b. Interpret information 1c.Summarize to extempore	1.1 Topic Writing (current issues) 1.2 Comprehend various information 1.3 Extempore some current Activities
Unit 5 Language Skills (06hrs, 08marks)	

1a. Use phonetic signs and symbols for pronunciation 1b. Practice Pronunciation using lingua-phone 1c. Utilize listening skills 1d. Classify jargon wise vocabulary for improvement	1.1 Phonetics(Practice of pronunciation) 1.2Listening skills 1.3Use of lingua-phone (language lab) 1.4Vocabulary building

8. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Introduction and principles of communication	08	04	06	02	12
II	Nonverbal Communication	06	02	02	06	10
III	Comprehension	06	00	02	04	06
IV	Learning Skills	06	00	00	04	04
V	Language skills	06	-	02	06	08
Total		**32**	**06**	**12**	**22**	**40**

9. SUGGESTED STUDENT ACTIVITIES

Other than the classroom and laboratory learning, following are the suggested student-related ***co-curricular*** activities which can be undertaken to accelerate the attainment of the various outcomes in this course: Students should conduct following activities in group and prepare reports of about 5 pages for each activity, also collect/record physical evidences for their (student's) portfolio which will be useful for their placement interviews:

a. Prepare journal based on practical performed inLing phone laboratory. Journal consists of drawing, observations, required equipment's, date of performance with teacher signature.
b. Collection of Paper cuttings from magazines, Newspapers, periodicals etc
c. Encyclopedia

10. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are sample strategies, which the teacher can use to accelerate the attainment of the various outcomes in this course:

a. Massive open online courses (***MOOCs***) may be used to teach various topics/sub topics.
b. About ***15-20% of the topics/sub-topics*** which is relatively simpler or descriptive in nature is to be given to the students for ***self-directed learning*** and assess the development of the COs through classroom presentations (see implementation guideline for details).
c. With respect to item No.8, teachers need to ensure to create opportunities and provisions for ***co-curricular activities***.
d. Guide student(s) in undertaking micro-projects.

e. Correlate subtopics with power plant system and equipment.
f. Use proper equivalent analogy to explain different concepts.
g. Use Flash/Animations to explain various components, operation and
h. Teacher should ask the students to go through instruction and Technical manuals

11. SUGGESTED MICRO-PROJECTS

.

Only one micro-project is planned to be undertaken by a student that needs to be assigned to him/her in the beginning of the semester. In the first four semesters, the micro-project are group-based. However, in the fifth and sixth semesters, it should be preferably be ***individually*** undertaken to build up the skill and confidence in every student to become problem solver so that s/he contributes to the projects of the industry. In special situations where groups have to be formed for micro-projects, the number of students in the group should ***not exceed three.***

The micro-project could be industry application based, internet-based, workshop-based, laboratory-based or field-based. Each micro-project should encompass two or more COs which are in fact, an integration of POs, UOs and ADOs. Each student will have to maintain dated work diary consisting of individual contribution in the project work and give a seminar presentation of it before submission. The total duration of the micro-project should not be less than ***16 (sixteen) student engagement hours*** during the course. The student ought to submit micro-project by the end of the semester to develop the industry-oriented COs.

A suggestive list of micro-projects is given here. Similar micro-projects could be added by the concerned faculty:

a. Student must collect pictures depicting various body actions.
b. Students should utilize signs, symbols, signals and color code to represent traffic signals.
c. Student should prepare a table of Jargon wise vocabulary of various technical domains.
d. Student should extempore on a given topic.
e. Student should collect abbreviations related to corporate world.

12. SUGGESTED LEARNING RESOURCES

Sr. No.	Title	Author	Publisher, Edition , Year of publication and ISBN Number
1	Communication skills	Joyeeta Bhatacharya	Macmillan Co. ISBN :
2	Written communication in English	Sarah Freeman	Orient Longman Ltd. ISBN-10 :8125004262 ISBN -13 :978-8125004264
3	Developing Communication skills	Krishna Mohan and Meera Banerji	Macmillan India Ltd. ISBN-10 – 938487289X ISBN-13- 9789384872892

13. SOFTWARE/LEARNING WEBSITES

1. www.talkenglish.com
2. www.Edutech.com
3. www.Swayam.com
4 .www.mooc.org

14. PO - COMPETENCY- CO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	-	-	1	-	-	1
CO2	3	-	-	-	1	-	1
CO3	3	1	-	-	1	1	1
CO4	3	-	-	-	1	-	1
CO5	2	-	-	-	1	-	1

	PSO1	PSO2	PSO3
CO1	-	-	-
CO2	-	1	-
CO3	-	-	-
CO4	-	1	-
CO5	-	1	-

Sign: Name: Mrs. S.C.Patil Mrs. S.S.Kulkarni Dr. M.S.Ban (Course Experts)	Sign: Name : Mrs.N.S.Kadam (Head of Department)
Sign: Name: Dr. S. S. Bharatkar/Shri. R. U. Shelke (Program Head) (Department of Electrical Engineering)	Sign: Name : Mr.A.S.Zanpure (CDC Incharge)

Government Polytechnic, Pune

'180 OB' – Scheme

Programme	Diploma in **ET/CE/EE//ME/MT/CM/IT/DDGM**
Programme code	01/02/03/04/05/06/07/08/16/17/21/22/23/24/26
Name of Course	**Communication Skills II**
Course Code	**HU1102**
Prerequisite	**HU1101 - Communication Skills I**
Class Declaration	**No**

1. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P)	Examination Scheme				
				Theory Marks		Practical Marks		Total Marks
L	T	P	C	ESE	PA	ESE	PA	100
2	1	0	3	40	10	-	50	

Legends: L- lecture, T-Tutorial/teacher guided theory practice, P-practical, C-Credits, ESE-End semester examination, PA- Progressive Assessments(Test I, II/Term Work), * - Practical Exam, $ - Oral Exam. # - Online Exam., Each lecture/practical period is of one clock hour.

2. RATIONALE

Communication skills course is used in all spheres of human life – personal, social and professional. Students will get fair knowledge of communication skills to handle the future jobs in industry. This course includes the practice of oral and written communication, correspond with others and give presentations**.**

3. COMPETENCY

The aim of this course is to attend following industry competency through various teaching learning experiences:

- **To build confidence in written correspondence required in technical fields.**

4. COURSE OUTCOMES (COs)

The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry-oriented COs associated with the above-mentioned competency**:**

CO1: Prepare various speeches for presentation

CO2: Write application for Business purposes.

CO3: Write various technical reports.
CO4**:** Write business letters.

5. SUGGESTED PRACTICALS/ EXERCISES

The practicals in this section are PrOs (i.e. sub-components of the COs) to be developed and assessed in the student for the attainment of the competency**:**

S. No.	**Unit No.**	**Practical Exercises** (Learning Outcomes in Psychomotor Domain)	**CO No**	**Approx. Hrs. required**
1	1	Practice to write various speeches like vote of thanks, guest introduction etc.	CO1	2
2	1	Write job application, resume, leave application	CO3	2
3	2	Draft a project report to start a new industry (Or to write down the market survey report)	CO2	2
4	3	Prepare industrial visit report after visit	CO3	1
5	3	Write a placing an order letter, complaint letter	CO3	2
6	4	Write a joining letter	CO4	1
7	3	Draft a notice, circular and memorandum	CO3	2
8	3	Write a fall in production report	CO3	1
9	3	Work progress report	CO3	1
10	4	Description of devices	CO4	2
11 *	all	Complete a micro project based on guidelines provided in Sr. No. 11	All	2
		Total		16

* Sr. No. 11is compulsory , perform Sr.No. 3 or 7

Sr.No.	**Performance Indicators**	**Weightage in %**
a.	Arrangement of available equipment / test rig or model	-
b.	Setting and operation	-
c.	Safety measures	-
d.	Observations and Recording	50
e.	Interpretation of result and Conclusion	20
f.	Answer to sample questions	20
g.	Submission of report in time	10
	Total	**100**

6. MAJOR EQUIPMENT/ INSTRUMENTSREQUIRED

NA

7. THEORY COMPONENTS

The following topics/sub topics should be taught and assessed in order to develop UOs for achieving the COs to attain the identified competency**.**

Unit Outcomes (UOs) (in cognitive domain)	**Topics and Sub-topics**
Unit 1 Writing Speeches(08hrs,10 marks)	
1a. Give in own words the introduction of guest. 1b. Express feelings in own words to welcome 1c. Express feelings in own words for Farewell Speech 1d.Give in own words	1.1 Introduction of guest 1.2 Welcome speech 1.3 Farewell speech 1.4 Vote of thanks
Unit 2 Writing Applications(06hrs, 08 marks)	
1a.Write official correspondence for Job 1b.Application with Resume 1c.Write application for leave. 1d.Write application for getting NOC from corporation. 1e.Students can write various applications	1.1 Job application with resume 1.2 Leave application 1.3 Miscellaneous applications
Unit 3 Writing Reports and Notices(10hrs,10 marks)	
1a. Students can write Industrial visit report after visit. 1b. Students can write survey report. 1c. Students can write Fall in production report. 1d. Students can draft circular and other notices. 1e. Students can draft Memos.	1.1 Visit report 1.2 Survey report(feasibility report) 1.3 Fall in production report 1.4 Circular/notice 1.5 Memos
Unit 4 Drafting Business Letters(08hrs, 12 marks)	
1a. Students can write Enquiry Letter. 1b. Students can write Placing an order letter. 1c. Student can write Complaint Letter. 1d.Students can write Appointment Letter. 1e.Students can draft Joining Letter.	1.1 Enquiry letter 1.2 Placing an order letter 1.3 Complaint letter 1.4 Appointment letter 1.5 Joining letter

8. SUGGESTED SPECIFICATION TABLE FORQUESTION PAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Writing speeches	**08**	**2**	**2**	**6**	**10**
II	Writingapplications	**06**	**2**	**2**	**4**	**08**
III	Writing Reports and Notices	**10**	**2**	**2**	**6**	**10**
IV	Business letters	**08**	**2**	**4**	**6**	**12**
Total		**32**	**8**	**10**	**22**	**40**

9. SUGGESTED STUDENT ACTIVITIES

Other than the classroom and laboratory learning, following are the suggested student-related ***co-curricular*** activities which can be undertaken to accelerate the attainment of the various outcomes in this course: Students should conduct following activities in group and prepare reports of about 5 pages for each activity, also collect/record physical evidences for their (student's) portfolio which will be useful for their placement interviews:

a. Prepare journal based on practical performed inLingua- phone- laboratory. Journal consists of drawing, observations,required equipment's, date of performance with teacher signature.

10. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are sample strategies, which the teacher can use to accelerate the attainment of the various outcomes in this course:

a. Massive open online courses (***MOOCs***) may be used to teach various topics/sub topics.
b. About ***15-20% of the topics/sub-topics*** which is relatively simpler or descriptive in nature is to be given to the students for ***self-directed learning*** and assess the development of the COs through classroom presentations (see implementation guideline for details).
c. With respect to item No.8, teachers need to ensure to create opportunities and provisions for ***co-curricular activities***.
d. Guide student(s) in undertaking micro-projects.
e. Correlate subtopics with power plant system and equipments.
f. Use proper equivalent analogy to explain different concepts.
g. Use Flash/Animations to explain various components, operation and
h. Teacher should ask the students to go through instruction and technical manuals

11. SUGGESTED MICRO-PROJECTS

Only one micro-project is planned to be undertaken by a student that needs to be assigned to him/her in the beginning of the semester. In the first four semesters, the micro-project is group-based. However, in the fifth and sixth semesters, it should be preferably be

individually undertaken to build up the skill and confidence in every student to become problem solver so that s/he contributes to the projects of the industry. In special situations where groups have to be formed for micro-projects, the number of students in the group should ***not exceed three.***

The micro-project could be industry application based, internet-based, workshop-based, laboratory-based or field-based. Each micro-project should encompass two or more COs which are in fact, an integration of PrOs, UOs and ADOs. Each student will have to maintain dated work diary consisting of individual contribution in the project work and give a seminar presentation of it before submission. The total duration of the micro-project should not be less than ***16 (sixteen) student engagement hours*** during the course. The student ought to submit micro-project by the end of the semester to develop the industry-orientedCOs.

A suggestive list of micro-projects isgiven here. Similar micro-projects could be added by the concerned faculty:

1. **Practice to write various speeches and give speech on any of it.**
2. **Draft personal Resume/ Biodata/CV**
3. **For drafting project report to start a new industry student should have a market survey and search other accepts to be and an entrepreneur**
4. **Prepare an industrial visit report after visiting an industry.**
5. **Describe various technical devices and prepare a PPT on any one of it.**

12. SUGGESTED LEARNING RESOURCES

Sr.No.	Author	Title	Publication	ISBN
1	Joyeeta Bhatacharya	Communication skills	Macmillan Co.	--
2	Sarah Freeman	Written communicationin English	Orient Longman Ltd.	ISBN-13 : 978-8125004264
3	Krishna Mohan and Meera Banerji	Developing Communication skills	Macmillan India Ltd.	0333929195 9780333929193

13. SOFTWARE/LEARNING WEBSITES

A. **www.talkenglish.com**
B. **www.edutech.com**
C. **www.makeuseof.com**
D. **www.mooc.org**

14. PO –PSO- - CO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	2	-	1	3	1	2
CO2	3	1	-	-	2	1	3
CO3	3	3	-	1	2	1	3
CO4	3	2	-	1	2	-	3

	PSO1	PSO2	PSO3
CO1	-	-	-
CO2	1	1	-
CO3	1	1	-
CO4	1	1	-

15. Prepared by :

Sign: Name: Smt. S.C.Patil Smt. S.S.Kulkarni Dr. M.S.Ban (Course Experts)	Sign: Name :Mrs.N.S.Kadam (Head of Department)
Sign: Name: Dr. S. S. Bharatkar/Shri. R. U. Shelke (Program Head) (Department of Electrical Engineering)	Sign: Name : Mr.A.S.Zanpure (CDC Incharge)

GOVERNMENT POLYTECHNIC, PUNE

'180 OB' – Scheme

Programme	Diploma in **CE/EE/ET/ME/MT/CM/IT**
Programme code	**01/02/03/04/05/06/07/15/16/17/18/19/21/22/23/24/26**
Name of Course	**APPLIED MAHEMATICS I**
Course Code	SC1101
Prerequisite	No
Class Declaration	No

1. TEACHING AND EXAMINATION SCHEME

<table>
<tr><th colspan="3">Teaching Scheme (In Hours)</th><th>Total Credits (L+T+P)</th><th rowspan="2"></th><th colspan="5">Examination Scheme</th></tr>
<tr><th colspan="3"></th><th></th><th colspan="2">Theory</th><th colspan="2">Tutorials</th><th rowspan="2">Total Marks</th></tr>
<tr><th>L</th><th>T</th><th>P</th><th>C</th><th></th><th>ESE</th><th>PA</th><th>ESE</th><th>PA</th></tr>
<tr><td rowspan="2">03</td><td rowspan="2">02</td><td rowspan="2">00</td><td rowspan="2">05</td><td>Marks</td><td>80</td><td>20</td><td>00</td><td>25</td><td>125</td></tr>
<tr><td>Exam Duration</td><td>3 Hrs</td><td>1 Hr</td><td>00</td><td>--</td><td>—</td></tr>
</table>

Legends: L- lecture, T-Tutorial/teacher guided theory practice, P-practical, C-Credits, ESE-End semester examination, PA- Progressive Assessments(Test I, II/Term Work), * - Practical Exam, $ - Oral Exam. # - Online Exam., Each lecture/practical period is of one clock hour.

2. RATIONALE

The students of Diploma in Engineering and technology must acquire some essential Competencies in Mathematics

3. COMPETENCY

The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- **Solve various engineering related problems using the principles of applied mathematics**

4. COURSE OUTCOMES (COs)

The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry oriented COs associated with the above mentioned competency**:**

1. Apply the concepts of algebra to solve engineering related problems.
2. Utilize basic concepts of trigonometry to solve elementary engineering problems.
3. Solve basic engineering problems under given conditions of straight lines.
4. Solve the problems based on measurement of regular closed figures and regular solids.

5. SUGGESTED PRACTICALS/ EXERCISES

Experiment Sr. No.	**Practical Exercises** (Learning Outcomes in Psychomotor Domain)	Unit No.	Approx. Hrs. required
1	Solve simple problems of Logarithms based on definition and laws	1	2
2	*Solve problems on determinant to find area of triangle, and solution of simultaneous equation by Cramer's Rules.	1	4
3	*Resolve into partial fraction using linear non repeated, repeated, and irreducible factors	1	4
4	Solve problems on Compound, Allied, multiple and sub multiple angles.	2	4
5	Practice problems on factorization and de factorization.	2	2
6	Solve problems on inverse circular trigonometric ratios.	2	2
7	Practice problems on equation of straight lines using different forms.	3	4
8	Solve problems on perpendicular distance, distance between two parallel lines, and angle between two lines.	3	2
9	Solve problems on Area, such as rectangle, triangle, and circle.	4	2
10	Solve problems on surface and volume, sphere, cylinder and cone.	4	2
11	Solve simple problems of Logarithms based on definition and laws	4	2
12	Skill test		2
13	*Complete a Micro- project as per the guidelines in point no. 11 towards the fulfillment of the COs of the course.	ALL	4
	Total		32

***Experiment No. 13 compulsory, perform experiment 2 or 3.**

Sr. No.	Performance Indicators	Weightage in %
a.	Prepare experimental set up	-
b.	Handling of instruments during performing practical.	-
c.	Follow Safety measures	-
d.	Accuracy in calculation	20
e.	Answers to questions related with performed practices.	40
f.	Submit journal report on time	20
g.	Follow Housekeeping	10
h.	Attendance and punctuality	10
Total		**100**

6. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

The major equipment with broad specification mentioned here will be used in uniformity in conduct of practical, as well as aid to procure equipment by authorities concerned.

S. No.	Equipment Name with Broad Specifications	PrO. No.
1	LCD Projector	1-11
2	Interactive Classroom	1-11

7. THEORY COMPONENTS

Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
Units 1 : Algebra (Hours: 12 , Weightage: 24)	
1a. Solve the given simple problem based on laws of logarithm. 1b. Calculate the area of the given triangle by determinant method. 1c. Solve given system of linear 1d. Equations using by Cramer's rule. 1e. Obtain the proper and improper partial fraction for the given simple rational function	1.1 Logarithm: Concept and laws of logarithm 1.2 Determinant a. Value of determinant of order 3x3 b. Solutions of simultaneous equations in three unknowns by Cramer's rule. 1.3 Partial Fractions: Types of partial fraction based on nature of factors and related Problems.
Unit 2:Trigonometry (Hours: 18 , Weightage: 24)	
2a. Apply the concept of Compound angle, allied angle, and multiple angles to solve the given simple engineering problem(s) 2b. Apply the concept of Sub- multiple angle to solve the given simple engineering related problem 2c. Employ concept of factorization and de-factorization formulae to solve the given simple engineering problem(s). 2d. Investigate given simple problems utilizing inverse trigonometric ratios	2.1 Trigonometric ratios of allied angles, compound angles, multiple angles (2A, 3A), submultiples angle.(without proof) 2.2 Factorization and De factorization formulae (without proof). 2.3 Inverse Trigonometric Ratios and related problems 2.4 Principle values and relation between trigonometric and inverse trigonometric ratios.
Unit 3: Co ordinate geometry (Hours: 09 , Weightage: 16)	
3a. Calculate angle between given two straight lines. 3b. Formulate equation of straight lines related to given engineering problems. 3c. Identify perpendicular distance from the given point to the line.. 3d.Calculate perpendicular distance between the given two lines.	3.1 Straight line and slope of straight line a. Angle between two lines. b. Condition of parallel and perpendicular lines. 3.2 Various forms of straight lines. a. Slope point form, two point form. b. Two points intercept form. c. General form. 3.3 Perpendicular distance from a Point on the line. 3.4 Perpendicular distance between two parallel lines

Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
Unit 4:Mensuration (Hours: 09 , Weightage: 16)	
4a. Calculate the area of given triangle and circle 4b. Determine the area of the given square, parallelogram, rhombus, trapezium. 4c. Compute surface area of given cuboids, sphere, cone and cylinder. 4d. Determine volume of given cuboids, sphere, cone and cylinder.	4.1 Area of regular closed figures, Area of triangle, square, parallelogram, rhombus, trapezium and circle. 4.2 Volume of cuboids, cone, cylinders and sphere.

8. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Algebra	12	6	12	6	24
II	Trigonometry	18	6	6	12	24
III	Co ordinate geometry	09	2	6	8	16
IV	Mensuration	09	2	6	8	16
Total		**48**	**16**	**30**	**34**	**80**

9. SUGGESTED STUDENT ACTIVITIES

Other than the classroom and laboratory learning, following are the suggested student-related ***co-curricular*** activities which can be undertaken to accelerate the attainment of the various outcomes in this course:

a. Identify engineering problems based on real world problems and solve with the use of free tutorials available on internet.
b. Use graphical software's: EXCEL, DPLOT and GRAPH for related topics.
c. Use Mathcad as Mathematical Tool and solve the problems on Calculus.
d. Indentify problems based on applications of differential equations and solve these problems

10. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are sample strategies, which the teacher can use to accelerate the attainment of the various outcomes in this course:

a. Massive open online courses (***MOOCs***) may be used to teach various topics/sub topics.
b. About ***15-20% of the topics/sub-topics*** which is relatively simpler or descriptive in nature is to be given to the students for ***self-directed learning*** and assess the development of the COs through classroom presentations (see implementation guideline for details).
c. Use Flash/Animations to explain various components, operation and
d. Teacher should ask the students to go through instruction and Technical manuals

11. SUGGESTED MICRO-PROJECTS

Only one micro-project is planned to be undertaken by a student that needs to be assigned to him/her. In special situations where groups have to be formed for micro-projects, the number of students in the group should ***not exceed three.***
The micro-project could be industry application based, internet-based, workshop-based, laboratory-based or field-based. Each micro-project should encompass two or more COs which are in fact, an integration of PrOs, UOs and ADOs.(Affective Domain Outcomes) .Each student will have to maintain activity chart consisting of individual contribution in the project work and give a seminar presentation of it before submission.. The student ought to submit micro-project by the end of the semester to develop the industry oriented COs.
A suggestive list of micro-projects is given here. Similar micro-projects could be added by the concerned faculty:

a. Prepare charts using determinant to find area of regular shapes.
b. Prepare models using trigonometry to solve engineering problems.
c. Prepare models using regular closed figures and regular solids to solve engineering problems.
d. Prepare models using Mensuration to solve engineering problems.

12. SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication
1.	Higher Engineering Mathematics	Grewal B. S.	Khanna publication New Delhi , 2013 ISBN: 8174091955
2.	A text book of Engineering Mathematics	Dutta. D	New age publication New Delhi, 2006 ISBN: 978-81-224-1689-3
3.	Advance Engineering Mathematics	Kreysizg, Ervin	Wiley publication New Delhi 2016 ISBN: 978-81-265-5423-2
4.	Advance Engineering Mathematics	Das H.K.	S Chand publication New Delhi 2008 ISBN: 9788121903455
5.	Engineering Mathematics Volume I (4th edition)	Sastry S.S.	PHI Learning, New Delhi, 2009 ISBN: 978-81-203-3616-2

13. SOFTWARE/LEARNING WEBSITE

a. www.scilab.org/ -SCI Lab
b. www.mathworks.com/product/matlab/ -MATLAB
c. Spreadsheet Applications
d. www.dplot.com
e. https://www.khanacademy.org/math?gclid=CNqHuabCys4CFdOJaddHoPig

14. PO - COMPETENCY- CO MAPPING

CO-PO Matrices of course

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
1	2	2	1	-	-	-	1
2	3	3	1	-	-	1	2
3	3	3	-	-	-	-	1
4	3	3	1	1	-	-	1

CO-PSO Matrices of course

	CE			ME		MT				EE			
CO	PSO 1	PSO 2	PS O3	PS O1	PSO 2	PSO 1	PSO 2	PSO 3	PSO 4	PSO 1	PSO 2	PSO 3	PSO 4
1	1	-	-	-	2	1	-	-	-	2	2	2	-
2	-	1	-	-	2	-	-	-	-	2	2	2	-
3	1	2	-	-	2	-	-	-	-	-	1	1	-
4	1	2	-	-	2	1	-	-	-	1	-	2	-

	ET			CM		IT		
CO	PSO 1	PSO 2	PSO 3	PSO 1	PSO 2	PSO1	PSO2	PSO3
1	1	1	-	-	2	-	2	1
2	1	-	-	-	1	-	1	1
3	1	-	-	-	-	-	-	-
4	1	-	-	-	1	-	1	-

Sign: Name: Shri S. B. Yede Shri V. B. Shinde Smt. P. R. Nemade (Course Experts)	Sign: Name :Mrs.N.S.Kadam (Head of Department)
Sign: Name: Dr. S. S. Bharatkar/Shri. R. U. Shelke (Program Head) (Department of Electrical Engineering)	Sign: Name : Mr.A.S.Zanpure (CDC Incharge)

GOVERNMENT POLYTECHNIC, PUNE

'180 OB' – Scheme

Programme	Diploma in **CE/EE/ET/ME/MT/CM/IT**
Programme code	**01/02/03/04/05/06/07/15/16/17/18/19/21/22/23/24/26**
Name of Course	**APPLIED MAHEMATICS II**
Course Code	SC1102
Prerequisite	SC1101 – Applied Mathematics I
Class Declaration	**NO**

1. TEACHING AND EXAMINATION SCHEM

<table>
<tr><th colspan="3">Teaching Scheme (In Hours)</th><th>Total Credits (L+T+P)</th><th></th><th colspan="5">Examination Scheme</th></tr>
<tr><th colspan="3"></th><th></th><th></th><th colspan="2">Theory</th><th colspan="2">Tutorials</th><th>Total Marks</th></tr>
<tr><th>L</th><th>T</th><th>P</th><th>C</th><th></th><th>ESE</th><th>PA</th><th>ESE</th><th>PA</th><th></th></tr>
<tr><td rowspan="2">03</td><td rowspan="2">02</td><td rowspan="2">00</td><td rowspan="2">05</td><td>Marks</td><td>80</td><td>20</td><td>00</td><td>25</td><td>125</td></tr>
<tr><td>Exam Duration</td><td>3 Hrs</td><td>1 Hr</td><td>00</td><td>--</td><td>—</td></tr>
</table>

Legends: L- lecture, T-Tutorial/teacher guided theory practice, P-practical, C-Credits, ESE-End semester examination, PA- Progressive Assessments(Test I, II/Term Work), * - Practical Exam, $ - Oral Exam. # - Online Exam., Each lecture/practical period is of one clock hour.

2. RATIONALE

This subject intends to teach students basic facts, concepts, principles and procedure of Mathematics as a tool to analyze Engineering problems and as such it lays down foundation for the understanding of engineering science and core technology subjects

3. COMPETENCY

The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- **Solve various engineering related problems using the principles of applied mathematics**

4. COURSE OUTCOMES (COs)

The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry oriented COs associated with the above mentioned competency**:**

1. Calculate the equation of tangent, maxima, minima, by differentiation.
2. Solve the given problems of integration using basic formulae.
3. Use basic concepts of statistics to solve engineering related problems.
4. Apply the concept of numerical methods to find the roots of equation.
5. Apply the concept of matrix to solve the engineering problems.

6. SUGGESTED PRACTICALS/ EXERCISES

Experiment Sr. No.	**Practical Exercises** (Learning Outcomes in Psychomotor Domain)	**Unit No.**	**Approx. Hrs. required**
1	Solve problems based on finding value of the function at different points	1	2
2	*Solve problems based on standard formulae of derivatives	1	2
3	*Solve problems to find derivatives of implicit function and parametric function.	1	2
4	Solve problems to find derivative of logarithmic and exponential functions	1	2
5	Solve problems based on finding equation of tangent and normal.	1	2
6	Solve problems based on finding maxima, minima of function	1	2
7	Solve problems based on finding radius of curvature at a given point.	1	2
8	Solve the problems based on standard formulae of integration.	2	2
9	Solve problems on finding range, coefficient of range and mean deviation.	3	2
10	*Solve problems on standard deviation.	3	2
11	*Solve problems on coefficient of variation and comparison of two sets. 2	3	2
12	Solve the algebraic equation using Bisection method, Regula falsi method and Newton –Raphson method	4	2
13	Solve the simultaneous equation using Gauss elimination method, Gauss Seidal and Jacobi's method	4	2
14	Solve elementary problems on Algebra of matrices.	5	2
15	Solve solution of Simultaneous Equation using inversion method.	5	4
16	*Complete a Micro- project as per the guidelines in point no. 11 towards the fulfillment of the COs of the course.	ALL	4
	Total		32

***Experiment No. 16 compulsory, perform experiment 2 or 3 and experiment 10 or 11.**

S.No.	**Performance Indicators**	**Weightage in %**
a.	Prepare experimental set up	-
b.	Handling of instruments during performing practical.	-
c.	Follow Safety measures	-
d.	Accuracy in calculation	20
e.	Answers to questions related with performed practices.	40
f.	Submit journal report on time	20

S.No.	Performance Indicators	Weightage in %
g.	Follow Housekeeping	10
h.	Attendance and punctuality	10
Total		**100**

7. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

The major equipment with broad specification mentioned here will be used in uniformity in conduct of practicals, as well as aid to procure equipment by authorities concerned**.**

S. No.	Equipment Name with Broad Specifications	PrO. No.
1	LCD Projector	1-15
2	Interactive Classroom	1-15

8. THEORY COMPONENTS

Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
Unit 1 : Differential Calculus (Hours: 24 , Weightage: 40)	
1a. Solve the given simple problems based on functions. 1b. Solve the given simple problems based on rules of differentiation. 1c. Obtain the derivatives of logarithmic, exponential functions. 1d. Apply the concept of differentiation to find given equation of tangent and normal. 1f. Apply the concept of differentiation to calculate maxima and minima and radius of curvature for given function.	1.1 Functions and Limits : a. Concept of function and simple b. Concept of limits without examples. 1.2 Derivatives: a. Rules of derivatives such as sum, Product, Quotient of functions. b. Derivative of composite functions to find derivative of given function (chain Rule), implicit and parametric functions. c. Derivatives of inverse, logarithmic and exponential functions. 1.3 Applications of derivative : a. Second order derivative without examples. b. Equation of tangent and normal c. Maxima and minima d. Radius of curvature
Unit 2: Integration (Hours: 06 , Weightage: 10)	
2a. Solve the given simple problem(s) based on rules of integration.	2.1 Simple Integration: Rules of integration and integration of standard functions
Unit 3: Statistics (Hours: 06 , Weightage: 10)	
3a. Obtain the range and coefficient of range of the given grouped and ungrouped data. 3b. Calculate mean and standard deviation of discrete and grouped data related to the given simple engineering problem.	3.1 Range, coefficient of range of discrete and grouped data. 5.2 Mean deviation and standard from mean of grouped and ungrouped data, weighted means 3.3 Variance and coefficient of variance. 3.4 Comparison of two sets of observation.

Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
3c. Determine the variance and coefficient of variance of given grouped and ungrouped data. 3d. Justify the consistency of given simple sets of data.	
Unit 4: Numerical Methods (Hours: 06 , Weightage: 10)	
4a. Apply the concept of approximate to find root of algebraic equation 4b. Apply the concept of iteration to solve the system of equations in three unknowns.	4.1 Solution of algebraic equations : a. Bisection method, b. Regula falsi method and c. Newton –Raphson method. 4.2 Solution of simultaneous equations containing three Unknowns : a. Gauss elimination method. b. Iterative methods- Gauss Seidal and Jacobi's method
Unit 5: Matrices (Hours: 06 , Weightage: 10)	
5a. Solve given system of linear equations using matrix inversion method	5.1 Matrices, algebra of matrices, transpose adjoint and inverse of matrices. 5.2 Solution of simultaneous equations by matrix inversion method.

8. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	**Differential Calculus**	24	8	12	20	40
II	**Integration**	06	2	8	--	10
III	**Statistics**	06	2	--	8	10
IV	**Numerical methods**	06	2	4	4	10
V	**Matrices**	06	2	4	4	10
Total		48	**16**	**28**	**36**	**80**

9. SUGGESTED STUDENT ACTIVITIES

Other than the classroom and laboratory learning, following are the suggested student-related ***co-curricular*** activities which can be undertaken to accelerate the attainment of the various outcomes in this course:

a. Identify engineering problems based on real world problems and solve with the use of free tutorials available on internet.
b. Use graphical software's: EXCEL, DPLOT and GRAPH for related topics.
c. Use Mathcad as Mathematical Tool and solve the problems on Calculus.
d. Indentify problems based on applications of differential equations and solve these problems

10. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are sample strategies, which the teacher can use to accelerate the attainment of the various outcomes in this course:

a. Massive open online courses (***MOOCs***) may be used to teach various topics/sub topics.
b. About ***15-20% of the topics/sub-topics*** which is relatively simpler or descriptive in nature is to be given to the students for ***self-directed learning*** and assess the development of the COs through classroom presentations (see implementation guideline for details).
c. Use Flash/Animations to explain various components, operation and
d. Teacher should ask the students to go through instruction and Technical manuals

11. SUGGESTED MICRO-PROJECTS

Only one micro-project is planned to be undertaken by a student that needs to be assigned to him/her. In special situations where groups have to be formed for micro-projects, the number of students in the group should ***not exceed three.***

The micro-project could be industry application based, internet-based, workshop-based, laboratory-based or field-based. Each micro-project should encompass two or more COs which are in fact, an integration of PrOs, UOs and ADOs.(Affective Domain Outcomes) .Each student will have to maintain activity chart consisting of individual contribution in the project work and give a seminar presentation of it before submission.. The student ought to submit micro-project by the end of the semester to develop the industry oriented COs.

A suggestive list of micro-projects is given here. Similar micro-projects could be added by the concerned faculty:

a. Prepare the model using the concept of tangent and normal bending of roads in case of sliding of a vehicle.
b. Prepare the model using the concept of radius of curvature to bending of railway tracks.
c. Prepare charts for grouped and ungrouped data.
d. Write algorithm to find the approximate roots of algebraic equations.
e. Write algorithm to find the approximate roots of transcendental equations.
f. Write algorithm to solve system of linear equations.
g. Prepare models using matrices to solve simple problems based on cryptography.

12. SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication
1.	Higher Engineering Mathematics	Grewal B. S.	Khanna publication New Delhi , 2013 ISBN: 8174091955
2.	A text book of Engineering Mathematics	Dutta. D	New age publication New Delhi, 2006 ISBN: 978-81-224-1689-3
3.	Advance Engineering Mathematics	Kreysizg, Ervin	Wiley publication New Delhi 2016 ISBN: 978-81-265-5423-2
4.	Advance Engineering Mathematics	Das H.K.	S Chand publication New Delhi 2008 ISBN: 9788121903455
5.	Engineering Mathematics Volume I (4^{th} edition)	Sastry S.S.	PHI Learning, New Delhi, 2009 ISBN: 978-81-203-3616-2

13 .SOFTWARE/LEARNING WEBSITES

a. *www.scilab.org/ -SCI Lab*
b. *www.mathworks.com/product/matlab/ -MATLAB*
c. *Spreadsheet Applications*
d. *www.dplot.com*
e. *https://www.khanacademy.org/math?gclid=CNqHuabCys4CFdOJaddHoPig*

14. PO - COMPETENCY- CO MAPPING

CO-PO Matrices of course

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
1	3	3	1	-	-	-	1
2	2	2	-	-	-	1	1
3	3	3	-	-	-	-	1
4	3	3	1	1	-	-	1
5	3	3	1	-	-	-	2

CO-PSO Matrices of course

	CE			ME		MT				EE			
CO	PSO 1	PSO 2	PSO 3	PSO 1	PSO 2	PSO 1	PSO 2	PSO 3	PSO 4	PSO 1	PSO 2	PSO 3	PSO 4
1	1	2	-	-	2	-	-	-	-	1	2	2	-
2	-	1	-	-	1	1	1	-	-	1	2	2	-
3	2	2	-	-	3	-	-	-	-	1	1	1	1
4	2	-	-	-	2	1	-	-	-	1	1	3	1
5	1	1	-	-	1	-	-	--	-	1	1	1	1

	ET			CM		IT		
CO	PSO 1	PSO 2	PSO 3	PSO 1	PSO 2	PSO1	PSO2	PSO3
1	2	-	-	-	2	-	2	
2	1	-	-	-	-	-	-	
3	1	-	-	-	2	-	2	
4	1	-	-	-	2	-	2	2
5	2	-	-	-	2	-	2	2

Sign: Name: Shri. S. B. Yede Shri. V.B.Shinde Smt. P. R. Nemade (Course Experts)	Sign: Name :Mrs.N.S.Kadam (Head of Department)
Sign: Name: Dr. S. S. Bharatkar/Shri. R. U. Shelke (Program Head) (Department of Electrical Engineering)	Sign: Name : Mr.A.S.Zanpure (CDC Incharge)

Government Polytechnic , Pune

'180 OB' – Scheme

Programme	Diploma in CE/**EE**/**ET**/ME/MT/**CO**/**IT**/DDGM
Programme Code	01/**02**/**03**/04/05/**06**/**07**/08/15/**16**/ **17**/18/19/21/**22**/**23**/24/**26**
Name of the Course	Engineering Physics
Course Code	SC1104
Prerequisite	No
Class Declaration	No

1. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P)		Examination Scheme				
					Theory		Practical		Total Marks
L	T	P	C		#ESE	PA	*ESE	PA	150
03	00	02	05	Marks	80	20	25	25	
				Exam Duration	2 Hrs	1 Hrs		--	--

Legends: L- lecture, T-Tutorial/teacher guided theory practice, P-practical, C-Credits, ESE-End semester examination, PA- Progressive Assessments(Test I, II/Term Work), * - Practical Exam, $ - Oral Exam. # - Online Exam., Each lecture/practical period is of one clock hour.

2. RATIONALE

This course is designed in the way by which fundamental information will help the diploma engineers to apply the basic principles and concepts of physics to solve broad-based engineering problems. The study of basic principles and concepts of motion, light, electricity, and modern physics will help in understanding the technology courses where emphasis is on the applications of these in different technology applications.

3. COMPETENCY

The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- **Apply principles of physics to solve broad-based engineering problems.**

4. COURSE OUTCOMES (COs)

The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry oriented COs associated with the above mentioned competency**:**

1. Estimate errors in measurement and Apply laws of motion in various applications.
2. Use basic principles of light in technical field.
3. Illustrate the basic principles of electrostatics in engineering field.
4. Apply basic principles of electricity to solve engineering problems.
5. Apply basic principles of magnetism to solve engineering problems.
6. Describe the principle and its application of modern physics in Engineering.

5. SUGGESTED PRACTICALS/ EXERCISES

Sr. No.	**Unit No.**	**Practical Exercises** (Outcomes in Psychomotor Domain)	**Relevant CO**	**Approx. Hrs. required**
1	1	Identify given instrument and i) Mention name and range of given instrument. ii) Calculate least count of given instrument. iii) List the uses of given instrument.	1	02
2	1	Use Vernier caliper to : i) Identify and calculate instrumental error. ii) Measure dimensions of different objects. iii) Estimate error in the measurement (if any).	1	04*
3	1	Use micrometer screw gauge to: i) Identify and calculate instrumental error. ii) Measures dimensions and determine volume of given object. iii) Estimate error in the measurement.	1	04*
4	1	Use simple pendulum to determine acceleration due to gravity.	1	02*
5	2	Determine refractive index of glass slab using total internal reflection.	2	02
6	2	Study the properties and working of laser using He-Ne laser beam.	2	02*
7	4	Use the principle of series / parallel resistance in solving electrical engineering problems.	4	02
8	4	Construct circuit to verify Ohm's law and i) Determine resistance of given material of wire. ii) Calculate specific resistance of given material of wire.	1,3,4	02*

9	4	Use meter bridge to: i) Determine resistance of given material of wire. ii) Calculate specific resistance of given material of wire.	1,4	04*
10	4	Use potentiometer to : i) Determine potential gradient of given cell (Principle of potentiometer). ii) Calibrate given voltmeter.	1,3,4	04*
11	4	Use potentiometer to : i) Compare emf of two cells	1,3,4	02
12	4	Use potentiometer to: i) Find internal resistance of a cell.	1,3,4	02
13	5	Use magnetic compass to draw magnetic lines of force of magnet of different shapes.	5	02
14	6	Use photoelectric cell to study effect of : i) Intensity of light on photoelectric current. ii) Applied potential on photoelectric current.	6	04*
15	All	Complete a Micro- project based on guidelines provided in Sr. no. 11	1 to 6	04*
		Total Hrs		**32**

Note: A suggestive list of PrOs is given in the above table. Minimum 10 practical need to be performed out of which practicals marked as * are compulsory. Any one practical out of Sr. No. 1,5,7,11,12 & 13 need to be performed.

S. No.	Performance Indicators	Weightage in %
a.	Arrangement of available equipment / test rig or model	10
b.	Setting and operation	10
c.	Safety measures	10
d.	Observations and Recording	20
e.	Interpretation of result and Conclusion	20
f.	Answer to sample questions	20
g.	Submission of report in time	10
	Total	**100**

6. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

The major equipment with broad specification mentioned here will usher in uniformity in conduct of practicals, as well as aid to procure equipment by authorities concerned**.**

S. No.	Equipment Name with Broad Specifications	Experiment No.
1	Vernier Calliper : Range: 0-15 cm, Resolution 0.01 cm.	1,2
2	Micrometer screw gauge: Range 0-25 mm, Resolution 0.01 mm.	1,2,8,9
3	Simple pendulum, Stop Watch.	4

4	Glass Slab 75x50x12mm.	5
5	He-Ne laser kit	6
6	Battery eliminator (0-12 V, 2 A)	7,8,9,10,11,12
7	Voltmeter(0-10 V), ammeter (0-5 A)	8
8	Meter Bridge (100 cm), Galvanometer (30-0-30) and jockey.	9
9	Potentiometer (400 cm).	10, 11, 12
10	Potentiometer, Daniell cell, Leclanche cell.	11,12
11	Bar Magnet, Magnetic Needle.	13
12	Photoelectric cell.	14

7. THEORY COMPONENTS

Unit Outcomes (UOs) (in cognitive domain)	**Topics and Sub-topics**
Unit 1 General Physics (8 hrs,12 marks)	
1a. List fundamental and derived quantities with their unit. 1b. Explain various systems of unit and its need for the measurement. 1c. Estimate errors in measurement. 1d. Derive relation between linear velocity and angular velocity. 1e. Calculate angular velocity of the given body 1f. Distinguish between centripetal and centrifugal force. 1g. Derive equation of SHM.	**1.1 Units and Measurement** Introduction, Definition of unit, Fundamental and derived units, Different System of units, Errors in measurements. **1.2 Circular Motion**: Definition, Uniform circular motion(UCM) Displacement, angular velocity, angular acceleration and units, relation between linear and angular velocity, relation between linear acceleration and angular acceleration, explanation of centripetal and centrifugal force, examples, applications of centripetal and centrifugal force, analytical treatment. **1.3 SHM**: Concept of time period, Frequency, Amplitude, Wavelength, Relation between wave velocity frequency and wavelength. Definition of SHM, examples of SHM, SHM as a projection of UCM on the diameter, Equation of SHM starting from mean position, analytical treatment.
Unit 2 Optics and Laser (6 hrs,12 marks)	

2a. State laws of reflection and refraction. 2b. Describe phenomenon of total internal reflection. 2c. Calculate acceptance angle and numerical aperture for given optical fiber. 2d. Distinguish between optical fiber communication system and ordinary system. 2e. Differentiate between properties of ordinary light and laser light. 2f. Explain spontaneous and stimulated emission. 2g. Describe working of He-Ne laser with energy level diagram. 2h. State applications of laser in different field.	**2.1 Light:** Introduction to reflection and refraction of light, Laws of reflection and refraction, Snell's law, Refractive index, Physical significance of refractive index, Critical angle, Total internal refraction of light, analytical treatment. **2.2 Fiber optics**: Propagation of light through optical fiber, Structure of optical fiber, Numerical aperture, Acceptance angle, Acceptance cone, Types of optical fibers, Applications of optical fiber, Comparison of optical fiber communication with electrical cable communication. **2.3 LASER:** Definition, Properties of LASER, Spontaneous and Stimulated emission, Population inversion, Metastable state, Pumping, Life time, He-Ne laser- construction and working with energy level diagram, Engineering applications of laser.
Unit 3 Electrostatics (10 hrs,16 marks)	
3a. Calculate electrostatic force, electric field and electric potential difference of the given static charge. 3b. Describe properties of electric lines of force. 3c. Explain working of capacitor. 3d. Calculate the equivalent capacity and energy stored in the combination of the capacitors are 3e. Establish relation between parameters affecting capacitance of condenser.	**3.1 Electric charge**, Coulomb's law in Electrostatics, unit of charge, electric field, intensity of electric field, electric lines of forces (Properties), electric flux, flux density, analytical treatment. **3.2 Electric potential:** Explanation, Definition**,** Potential due to a point charge, potential due to a charged sphere, potential of earth, absolute electric potential, analytical treatment. **3.3 Electric Capacitor :**Capacitance Introduction**,** of conductor, unit, principle of condenser, parallel plate condenser, capacitances in series and parallel, analytical treatment.
Unit 4 Current Electricity (10 hrs,16 marks)	

4a. State Ohm's law 4b. Establish relation between resistance and length , cross section area of given material of wire 4c. Calculate the value of given resistance using the principle of Whetstone's bridge. 4d. Explain principle of potentiometer 4e. Calculate the emf of given cell using potentiometer. 4f. Calculate energy consumption of different electric appliances.	**4.1 Current**, Resistance and its unit, Dependence of resistance- length, area of cross-section, temperature, Ohms law, specific resistance and its unit, Whetstone's network construction and principle, Meter bridge, Balancing condition of meter bridge, Measurement of unknown resistance using meter bridge, analytical treatment. **4.2 Potentiometer,** Principle of potentiometer**,** Potential gradient, Construction of potentiometer, Applications of potentiometer, E.M.F., Comparison of E.M.F. using potentiometer. **4.3 Electric work-** Electric power, Electric energy, Units and Calculations of electric bill.
Unit 5 Electromagnetism (8 hrs,14 marks)	
5a. State Ampere's right hand and Fleming's left hand rule. 5b. Explain Biot- Savert's Law (Laplace's Law), 5c. Calculate Magnetic induction for given conductor.	**5.1 Magnetic effect of electric current**, Ampere's rule, Coulombs inverse square law in magnetism, Intensity of magnetic field, Magnetic induction, Biot-Savert's Law (Laplace's Law), Fleming's left hand rule, Force experienced by current carrying straight conductor placed in magnetic field, analytical treatment.
Unit 6 Modern Physics (6 hrs,10 marks)	
6a. Explain production of X-rays. 6b. Describe properties and applications of X-ray in different field. 6c. Describe properties of photon 6d. Derive Einstein's photoelectric equation. 6e. Explain working of given photoelectric device.	**6.1 X- ray:** principle, production of X- rays using Coolidge tube, origin of X-rays, types of X-rays, properties of X-rays, engineering applications of X-rays, analytical treatment. **6.2 Photo electricity**: photoelectric effect, Plank's quantum theory, concept of photon, properties of photon, threshold frequency, threshold wavelength, stopping potential, photoelectric work function, Einstein's photoelectric equation, photocell (circuit diagram and working), applications of photoelectric cell, analytical treatment.

8. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
01	**General Physics**	**8**	2	4	6	12
02	**Optics and Laser**	**6**	2	4	6	12
03	**Electrostatics**	**10**	4	4	8	16
04	**Current Electricity**	**10**	4	4	8	16
05	**Electromagnetism**	**8**	2	4	8	14
06	**Modern Physics**	**6**	2	4	4	10
Total		**48**	**16**	**24**	**40**	**80**

9. SUGGESTED STUDENT ACTIVITIES

Other than the classroom and laboratory learning, following are the suggested student-related ***co-curricular*** activities which can be undertaken to accelerate the attainment of the various outcomes in this course: Students should conduct following activities in group and prepare reports of about 5 pages for each activity, also collect/record physical evidences for their (student's) portfolio which will be useful for their placement interviews:

a. Prepare journal based on practical performed in Physics laboratory. Journal consists of drawing, observations, required equipment's, date of performance with teacher signature.

10. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are sample strategies, which the teacher can use to accelerate the attainment of the various outcomes in this course:

a. Massive open online courses (***MOOCs***) may be used to teach various topics/sub topics.
b. About ***15-20% of the topics/sub-topics*** which is relatively simpler or descriptive in nature is to be given to the students for ***self-directed learning*** and assess the development of the COs through classroom presentations (see implementation guideline for details).
c. With respect to item No.9, teachers need to ensure to create opportunities and provisions for ***co-curricular activities***.
d. Use proper equivalent analogy to explain different concepts.
e. Use Flash/Animations to explain various components, operation and
f. Teacher should ask the students to go through instruction and Technical manuals.

11. SUGGESTED MICRO-PROJECTS

Only one Micro Project is planned to be undertaken by a student assigned to him/her in the beginning of the semester. She/He ought to submit it by the end of semester to develop industry oriented COs. Each micro-project should encompass two or more COs which are in fact, an integration of PrOs, UOs. The Micro-Project could be industry application based, internet based, workshop based, laboratory based or field based. The assessment of micro-project is to be done under Practical (PA) Assessment. The Micro Project preferably assign to the group of (4-6) students or an individual taking into the considerations the capabilities and circumstances at the time .

A suggested list is given here. Similar micro-project could be added by the concerned faculty.

a. **Systems and Units** : Prepare Chart on comparison of systems of units for different physical quantities..
b. **Magnetism :** Prepare chart on magnetic lines of force of bar magnet.
c. **Optics :**Prepare chart to study Total Internal Reflection/LASER.
d. **X-Ray** :Prepare chart showing properties of X-rays/Photoelectric cell.
e. Prepare Chart to Study **Ohm's Law**.

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12. SUGGESTED LEARNING RESOURCES

S. No.	Title	Author	Publisher, Edition Year of publication and ISBN Number
1	Physics Textbook Part I- Class XI	J.V.Narlikar, A.W.Joshi, et al.	National Council of Education Research and Training, New Delhi,2010, ISBN:8174505083
2	Physics Textbook Part II- Class XI	J.V.Narlikar, A.W.Joshi, et al.	National Council of Education Research and Training, New Delhi,2015, ISBN:8174505660
3	Physics Textbook Part I- Class XII	J.V.Narlikar, A.W.Joshi, et al.	National Council of Education Research and Training, New Delhi,2013, ISBN:8174506314
4	Physics Textbook Part II- Class XII	J.V.Narlikar, A.W.Joshi, et al.	National Council of Education Research and Training, New Delhi,2013, ISBN:8174506713
5	Fundamentals of Physics	David Halliday, Robert Resnick and Jearl Walker	7th EditionJohn Wily (2004)
6	Engineering Physics	R.K. Gaur and S. L. Gupta	Dhanpat Rai Publications ISBN 9788189928223 (1981)
7	Applied Physics	Prakash Manikpure	S. Chand Publishing ISBN 9788121919548
8	Applied Physics	Arthur Beiser	Schaum's Outline Series McGraw-HILL
9	Engineering Physics	Avadhanulu, Kshirsagar	S Chand ISBN 9788121908177

13. SOFTWARE/LEARNING WEBSITES

1) https://en.wikipedia.org/wiki/**Engineering_physics**
2) https://www.laser.com.ve
3) www.nanowerk.com
4) www.brainscape.com
5) https://www.open2study.com/courses/basic-physics
6) http://nptel.ac.in/course.php?disciplineId=115
7) http://nptel.ac.in/course.php?disciplineId=104
8) http://hperphysics.phy-astr.gsu.edu/hbase/hph.html
9) www.physicsclassroom.com
10) www.physics.org

14. PO - COMPETENCY- CO MAPPING (Information Technology)

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	3	1	2	2	1	3
CO2	3	3	2	2	3	1	3
CO3	3	3	2	2	3	1	3
CO4	3	3	2	2	3	1	3
CO5	3	1	-	2	3	-	3
CO6	3	1	1	2	3	1	3

CO	PSO1	PSO2	PSO3
1	3	-	-
2	3	-	-
3	3	-	-
4	3	-	-
5	3	-	-
6	3	-	-

14 . PO - COMPETENCY- CO MAPPING
(Electronics and Telecommunication Engineering)

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	3	1	2	2	1	3
CO2	3	3	2	2	3	1	3
CO3	3	3	2	2	3	1	3
CO4	3	3	2	2	3	1	3
CO5	3	1	-	2	3	-	3
CO6	3	1	1	2	3	1	3

CO	PSO1	PSO2	PSO3
1	3	2	-
2	3	2	-
3	3	2	-
4	3	2	-
5	3	2	-
6	3	2	

14. PO - COMPETENCY- CO MAPPING
(Computer Engineering)

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	3	1	2	2	1	3
CO2	3	3	2	2	3	1	3
CO3	3	3	2	2	3	1	3
CO4	3	3	2	2	3	1	3
CO5	3	1	-	2	3	-	3
CO6	3	1	1	2	3	1	3

CO	PSO1	PSO2
1	3	1
2	3	-
3	3	-
4	3	-
5	3	1
6	3	1

14 . PO - COMPETENCY- CO MAPPING
(Electrical Engineering)

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	3	1	2	2	1	3
CO2	3	3	2	2	3	1	3
CO3	3	3	2	2	3	1	3
CO4	3	3	2	2	3	1	3
CO5	3	1	-	2	3	-	3
CO6	3	1	1	2	3	1	3

CO/PO	PSO1	PSO2	PSO3	PSO4
1	3	1	2	-
2	3	2	2	1
3	1	3	-	1
4	3	2	1	2
5	3	2	1	1
6	2	2	1	1

Sign: Name: Smt. D. V. Saurkar Dr. R. B. Birajadar (Course Expert)	Sign: Name : Mrs.N.S.Kadam (Head of Department)
Sign: Name: Dr. S. S. Bharatkar/Shri. R. U. Shelke (Program Head) (Department of Electrical Engineering)	Sign: Name : Mr.A.S.Zanpure (CDC Incharge)

Government Polytechnic, Pune

'180OB' – Scheme

Programme	Diploma in EE/ET
Programme code	01/**02/03**/04/05/06/07/08/15/**16/17**/18/19/21/22/23/24/26
Name of Course	**Engineering Chemistry**
Course Code	**SC1105**
Prerequisite	No
Class Declaration	No

1. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			**Total Credits (L+T+P)**		**Examination Scheme**				
					Theory		**Practical**		**Total Marks**
L	**T**	**P**	**C**		**ESE**	**PA**	**ESE**	**PA**	
03	00	02	05	**Marks**	#80	20	*25	25	150
				Exam Duration	2 Hrs	1 Hr	2 Hr		

Legends: L- lecture, T-Tutorial/teacher guided theory practice, P-practical, C-Credits, ESE-End semester examination, PA- Progressive Assessments(Test I, II/Term Work), * - Practical Exam, $ - Oral Exam. # - Online Exam., Each lecture/practical period is of one clock hour.

2. RATIONALE

Applications of Material Science and Chemical Principles have resulted into the development of new materials used in modern medicines and automobiles, synthetic fibers, polymers, alloys, new energy sources and many other important products and processes.

Material Science is an important and expanding branch in the scientific engineering and economic field of our society.

The topic atomic structure includes the basic structure of matter, which governs the Mechanical, Electrical and Magnetic properties of the matter.

Corrosion and methods of prevention will make students realize the importance of care and maintenance of machines and equipment. Study of different polymers, insulators, adhesives and their chemical behavior will be useful in their applications in electrical appliances and electronics industries. Study of impurities and hardness in water and methods for water softening will help the students to make proper use of water.

Nanomaterials are widely used in the engineering field. It will help to understand the need of nanomaterial in different engineering fields.

3. **COMPETENCY**

The aim of this course is to help the students

- **To solve engineering problems applying principles of chemistry**

4. COURSE OUTCOMES (COs)

The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry oriented COs associated with the above mentioned competency:

1. Distinguish materials on the basis of atomic structure.
2. Solve the problems based on Faraday's laws.
3. Select metals and nonmetals for given applications.
4. Use corrosion preventive measures in industry.

5. SUGGESTED PRACTICALS/ EXERCISES

Expt Sr. No.	**Unit No.**	PrOs (Learning Outcomes in Psychomotor Domain)	**Relevant CO**	**Approx. Hrs. required**
1.	1	Write the electronic configuration of atoms from Z=1 to Z=30	1	2
1.	1	Write the formation of compounds NaCl, AlCl3, H2O, CO2, N2	1	2
1.	1	*Determine acidic and basic radical from unknown solution (solution 1)	1	4
1.	1	*Determine acidic and basic radical from unknown solution (solution 2)	1	4
1.	2	Determine electrochemical equivalent of copper metal using Faraday's first law and Faraday's second law.	2	2
1.	3	Use Hygrometer for testing Battery	2	2
1.	3	Measure the voltage developed due to chemical reactions by setting up the Daniel cell.	2	2
1.	4	Determine the percentage of iron in a given steel sample by redox titration.	3	4
1.	5	Prepare phenol formaldehyde resin.	1	2
1.	5	Determine acid value of given resin	1	2
1.	6	Determine electrode potential of various metals to study their tendency to corrosion.	4	2
12.	6	Determine the rate of corrosion of Aluminium in acidic and basic medium.	4	4
13	1 to 7	*Complete a Micro- project as per the guidelines in point no. 11	1 to 4	4
			TOTAL	32

*** Experiments No.13 compulsory. Perform Expt.No.3 or 4**

S.No.	Performance Indicators	Weightage in %
a.	Prepare experimental set up	20
b.	Handling of instruments during performing practical.	20
c.	Follow Safety measures	10
d.	Accuracy in calculation	20
e.	Answers to questions related with performed practices.	10
f.	Submit journal report on time	10
g.	Follow Housekeeping	5
h.	Attendance and punctuality	5
Total		**100**

6. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

The major equipment with broad specification mentioned here will usher in uniformity in conduct of practicals, as well as aid to procure equipment by authorities concerned**.**

S. No.	Equipment Name with Broad Specifications	Pr. No.
1	Electronic balance with the scale range of 0.001 gm to 500 gm	All
2	Hydrometer	6

7. THEORY COMPONENTS:

Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
UNIT 1 : Atomic Structure(Hrs- 05, Weightage-10,)	
1a.Explain the characteristics of fundamental particles of an atom. 1b. Distinguish between atomic number and atomic mass number 1c. Distinguish between orbit and orbital. 1d. Explain the significance of quantum numbers. 1e. Explain the formation of given molecule. 1f. State Aufbau's principle and Hund's rule. 1g. Define metallic bond with example. 1h. Draw orbital electronic configurations (s, p, d, f) of elements	1.1 Definition of atom, structure of atom, Characteristics of fundamental particles of an atom, definition of atomic number, atomic mass number and their difference 1.2 Orbits: Bohr's energy levels, sub-energy levels, s, p, d, f orbital, shapes and description of s and p orbital. Definition and significance of quantum numbers 1.3 Aufbau's principle, Hund's rule, orbital electronic configurations (s, p, d, f) of elements having atomic number 1 to 30. 1.4 Definitions of valence electrons, valenc, types of valencies, Definition of electrovalency, positive and negative electrovalency. 1.5 Formation of Electrovalent compounds-*Nacl*, $Alcl_3$ Definition of covalency, single, double and triple covalent bonds, formation of Covalent compounds H_2O, CO_2, N_2
UNIT 2 : Electrochemistry:**(** Hrs- 06,Weightage-10,)	
2a. Differentiate between atom and ion. 2b. Explain the assumptions of Arrhenius theory of electrolytic dissociation. 2c. Describe the process of electroplating by taking suitable examples. 2d. Explain the mechanism of electrolysis for the given electrolyte. 2e. Calculate CE, ECE, weight of substance deposited or liberated, time in the given numerical.	2.1 Definition of electrolyte, electrolysis, ionization, Arrhenius theory, Difference between atom and ion 2.2 Activity series, mechanism of electrolysis of CuSO4 using Pt electrode and Cu electrode 2.3 Applications of electrolysis: electroplating, electrorefining, 2.4 Faraday's laws of electrolysis and numerical.
UNIT 3 : Cells and batteries(Hrs- 06, Weightage- 12)	

<table>
<tr><td>3a. Distinguish between : metallic conductor, electrolytic conductors
3b. Describe the construction and working of cells.
3c. Explain the reactions taking place in given cells.
3d. Explain applications of cells.
3e. Explain the care and maintenance of battery</td><td>3.1 Types of conductors: metallic conductor, electrolytic conductors(definition and difference)
3.2 Conductance in metals, conductance in electrolyte, Factors affecting conductance: nature of solute, nature of solvent, temperature, concentration of solution.
3.3 Primary and secondary cell: Difference between primary cell and secondary cell, Construction, working and applications of Daniel cell (porous vessel and salt bridge), Dry cell, lead acid cell, Ni-Cd cell, Lithium ion battery
3.4 Maintenance of battery.</td></tr>
<tr><td colspan="2">UNIT 4: Metals and alloys (Hrs- 07, Weightage- 10,)</td></tr>
<tr><td>4a. Draw the flow chart showing different processes in metallurgy.
4b. Classify carbon steel giving properties and application of each type.
4c. Explain the purposes of heat treatment methods.
4d. Explain purposes of making alloys.
4e. classify alloys with suitable examples of each.
4f. Write the composition, properties and uses of alloys.</td><td>4.1 Occurrence of metals, definitions of mineral, ore, flux, matrix, slag and metallurgy, mechanical properties of metal.
4.2 Flow chart showing different processes in metallurgy, classification, properties and application of carbon steel, heat treatment (definition, purposes and methods)
4.3 Definition of alloy, purposes of making alloys with examples, classification of alloys (ferrous and non-ferrous),
4.4 Composition, properties application of Copper zinc alloy, Cadmium copper alloy, Chromium copper alloy, Brass, Bronze, Duralumin, Wood’s metal, Babbitt metal</td></tr>
<tr><td colspan="2">UNIT 5: Insulating materials:(Hrs- 10 Weightage- 16)</td></tr>
</table>

5a. Describe the formation of a given polymer. 5b. Distinguish between thermo softening and thermosetting plastics. 5c. Explain the applications of Plastic based on its properties. 5d. Explain the vulcanization process of natural rubber. 5e. Distinguish between synthetic and natural rubber. 5f. Distinguish between natural and synthetic rubber. 5g. Explain the preparation, properties and application reaction of given synthetic rubber 5h. Explain the properties and application of thermal insulators. 5i. Explain the properties and application of electrical insulators.	**Plastic** 5.1 Definition of monomer and polymer, polymerization, classification of plastic on the basis of monomer, on basis of thermal behavior, on basis of monomer structure, 5.2 Types of polymerization (Addition, and Condensation) applications of Plastic based on its properties. 5.3 synthesis, properties and applications of- Polythene, PVC, Teflon, Bakelite, Polystyrene. **Rubber** 5.4 Types of rubber, processing of natural rubber, properties of rubber, drawbacks of natural rubber, vulcanization of rubber. 5.5 synthetic rubber – preparation, properties and application of BUNA-S, BUNA-N, neoprene, Thiokol. **Thermal insulators:** 5.6 Properties and application of thermocol and glasswool. Electrical insulators: 5.7 Properties and applications of Ceramics, silicon fluid, nitrogen gas.
UNIT 6 : Corrosion (Hrs- 06, Weightage- 08)	
6a. Explain different types of oxide films. 6b. Explain the mechanism of electrochemical corrosion. 6c. Explain the factors affecting rate of atmospheric corrosion and electrochemical corrosion. 6d. Describe the galvanization process of protection of metal from corrosion. 6e. Distinguish between galvanization and tinning. 6f. Describe the given process of protection of metal from corrosion.	6.1 Definition, causes of corrosion types of corrosion-definition (atmospheric and electrochemical) Types of oxide films 6.2 Mechanism of atmospheric and electrochemical corrosion (evolution of hydrogen, absorption of oxygen). 6.3 Factors affecting rate of atmospheric corrosion and electrochemical corrosion. 6.4 Protection Methods-anodic and cathodic protection, Galvanization and tinning processes, sherardizing.
UNIT 7: Engineering materials (Hrs- 08, Weightage- 14,)	

7a. Explain the properties and application of nano materials. 7b. Explain the properties and application of magnetic materials. 7c. Distinguish between diamagnetic and paramagnetic materials. 7d. Explain the applications of Semiconducting materials. 7e. Difference between N-type and P- type semiconductors. 7f. Describe the properties of three groups of resistor materials. 7g. Explain the properties and applications of resistor materials..	7.1 **Nano materials-** properties and application of fullerene, graphene. 7.2 **Magnetic Material:** properties and applications of – diamagnetic materials, paramagnetic material and ferromagnetic materials. 7.3 **Semiconducting materials:** Definition, Applications of Semiconducting materials, Examples of Semiconductors commonly used, Intrinsic and extrinsic semiconductors, N-type and P- type semiconductors, Difference between N-type and P-type semiconductors, 7.4 **Resistor material:**Definition, Properties of three groups of resistor materials, Properties and applications of resistor materials: Tungsten, Carbon, Nichrome, Manganin, Eureka, Platinum.

8 SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
01	Atomic structure	05	02	04	04	10
02	Electrochemistry	06	02	04	04	10
03	Cells and batteries	06	02	02	08	12
04	Metals and alloys	07	02	02	06	10
05	Insulating materials	10	04	08	04	16
06	Corrosion	06	04	00	04	08
07	Engineering Materials	08	04	06	04	14
Total		**48**	**20**	**26**	**34**	**80**

9 SUGGESTED STUDENT ACTIVITIES

Other than the classroom and laboratory learning, following are the suggested student-related ***co-curricular*** activities which can be undertaken to accelerate the attainment of the various outcomes in this course: Students should conduct following activities in group and prepare reports of about 5 pages for each activity, also collect/record physical evidences for their (student's) portfolio which will be useful for their placement interviews:

a. Prepare journal based on practical performed in Chemistry laboratory. Journal consists of drawing, observations, required equipment, date of performance with teacher signature.

10 SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are sample strategies, which the teacher can use to accelerate the attainment of the various outcomes in this course:

a. Massive open online courses (***MOOCs***) may be used to teach various topics/sub topics.
b. About ***15-20% of the topics/sub-topics*** which are relatively simpler or descriptive in nature is to be given to the students for ***self-directed learning*** and assess the development of the COs through classroom presentations (see implementation guideline for details).
c. With respect to item No.8, teachers need to ensure to create opportunities and provisions for ***co-curricular activities***.
d. Use Flash/Animations to explain various components, operation and
e. Teacher should ask the students to go through instruction and Technical manuals

11 SUGGESTED MICRO-PROJECTS

Only **one micro- project** is planned to be undertaken by a student that needs to be assigned to him/her in the beginning of the semester. In special situations where groups have to be formed for micro-projects, the number of students in the group should ***not exceed three.*** S/he ought to submit it by the end of the semester to develop the industry oriented COs .Each micro project should encompass two or more COs which are in fact, an integration of PrOs .UOs and ADOs .(Affective Domain Outcomes) .The micro project could be application based, internet based, workshop based ,laboratory based or field based. Each student will have to maintain a dated work diary consisting of individual contributions in the project work.

A suggestive list of micro-projects is given here. Similar micro-projects could be added by the concerned faculty:

1. Types of bonds: Prepare a chart and models displaying different types of bonds with examples.

2. Battery and Cell: collect waste material from the lab and household and prepare a working model of cell.

3. Metals and Alloys: Prepare a chart showing Composition, properties application of Non Ferrous Alloys.

4. Insulating materials: Prepare a chart including different synthetic Plastic and Rubber and list their uses.

5. Engineering materials: Prepare a chart Nano materials/ Magnetic Materials/ Semiconducting materials/ Resistor materials and list their uses**.**

12 SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author, Publisher, Edition and Year of publication	Publication/ISBN
1	Polytechnic Chemistry	V.P.Mehta	Jain brothers, New Delhi.2012818360093X
2	Engineering Chemistry	P.C.Jain and Monica Jain,	DhanpatRai and sons, New Delhi.20169352161319
3	Engineering Chemistry	Dara S.S. Umare SChand	SChand 9788121903592

4	Engineering Chemistry	Jain and Jain	Dhanpat Rai and Sons, New Delhi,2015, ISBN: 9352160002
5	Engineering Chemistry	Vairam. S	Wiley Indian Pvt. Ltd, New Delhi, 2013 ISBN: 9788126543342
6	Chemistry for Engineers	Agnihotri,Rajesh	Wiley Indian Ptd.Ltd, New Delhi, 2014, ISBN: 9788126550784
7	Engineering Chemistry	Agrawal Shikha	Cambridge University press, New Delhi, 2015 ISBN: 97811074764

13 SOFTWARE/LEARNING WEBSITES

a. **www.chemistryteching.com**
b. **www.visionlearning.com**
c. **www.chem1.com**
d. **www.onlinelibrary.wiley.com**
e. **www.rsc.org**
f. **www.chemcollective.org**
g. **www.wqa.org**

14 PO - COMPETENCY- CO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	-	-	2	1	-	2
CO2	3	2	-	2	1	-	2
CO3	3	-	-	2	1	1	1
CO4	3	2	-	1	1	1	2

CO- PSO MAPPING

	ELECTRICAL				ELECTRONICS AND TELECOMMUNICATION		
	PSO 1	PSO 2	PSO 3	PSO 4	PSO1	PSO2	PSO3
CO1	1	1	1	-	2	-	-
CO2	1	1	1	1	2	-	-
CO3	2	1	2	1	1	-	-
CO4	1	1	1	1	-	1	-

Sign Name: Smt.G.M.Patel, Smt.S.A.Kakade (Course Experts)	Sign: Name: Mrs. N.S. Kadam (Head of Department)
Sign: Name: Dr. S. S. Bharatkar/Shri. R. U. Shelke (Program Head) (Department of Electrical Engineering)	Sign: Name : Mr.A.S.Zanpure (CDC Incharge)

Level 2 - A Curriculum

Government Polytechnic, Pune

180OB– Scheme

Programme	**Diploma in CE\ME\EE\MT**
Programme code	**01**/**02**/03/**04**/05/06/07/08/**15**/**16**/17/**18**/19/**21**/22/23/**24**/26
Name of Course	**Engineering Mechanics**
Course Code	**AM 2101**
Prerequisite course code and name	No
Class Declaration	No

1. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P)		Examination Scheme				
					Theory		Practical		Total Marks
L	T	P	C		ESE	PA	ESE	PA	
04	00	02	06	Marks	80	20	NA	25	125
				Exam Duration	3Hrs	1 Hr	----		

Legends: L- lecture, T-Tutorial/teacher guided theory practice, P-practical, C-Credits, ESE-End semester examination, PA- Progressive Assessments(Test I, II/Term Work), * - Practical Exam, $ - Oral Exam. # - Online Exam., Each lecture/practical period is of one clock hour.

2. RATIONALE

To find solutions to various practical problems, the student needs to study and get acquainted with the various aspects of Statics and Dynamics. The fundamental concepts to be studied in this course are required to study the strength of materials, Mechanics of Structures, and other Mechanical & Civil Engineering courses to be studied at a higher level.

3. COMPETENCY

This course aims to attend the following identified competency through various teaching-learning experiences:

- **Use different types of concepts and force systems for engineering applications.**

4. COURSE OUTCOMES (COs)

The theory, practical experiences, and relevant soft skills associated with this course are to be taught and implemented so that the student demonstrates the following industry-oriented COs associated with the competency mentioned above**:**

1. Apply concepts of engineering mechanics in the engineering field.
2. Determine the resultant of various Force systems and locate it
3. Verify simple laws and equations of equilibrium of forces.
4. Locate centroids and centre of gravity of plane laminas and solid bodies.
5. Solve numerical related to friction, simple lifting machines, work, power, energy, and kinetics.
6. Compute the Efficiency of different machines and draw graphs for the Law of machines, for load, and Efficiency.

5. SUGGESTED PRACTICALS/ EXERCISES

Sr. No.	**Practical Exercises** (Learning Outcomes in Psychomotor Domain)	Relevant CO	Approx. Hrs. required
1	To verify Law of polygon of Forces.	1	02
2	To verify Law of Moments.	2	02
3	To verify Lami's Theorem.	2	02
4	To determine Beam Reactions.	2	02
5	Graphic Statics: On Graph papers solve graphically two problems each on resultant of concurrent and parallel forces.	1	06
6	Graphic statics- On Graph papers solve graphically Two problems on beam reactions.	2	06
7	To Determine coefficient of friction for different surfaces in contact .(Minimum two different surfaces to be studied)	5	02
8	To study various lifting machines –To plot graphs for load Vs effort ,load Vs Efficiency and obtain Law of machine .for Differential axle and wheel, Worm and worm wheel, simple screw jack, Single purchase crab.	6	06
9	Complete a micro project based on guidelines provided in Sr. No. 11	1 to 6	4
	Total Hrs		32

Sr.No.	Performance Indicators	Weightage in %
a.	Arrangement of available equipment/test rig or model	20
b.	Setting and operation	20
c.	Safety measures	10
d.	Observations and Recording	10
e.	Interpretation of result and Conclusion	20
f.	Answer to sample questions	10
g.	Submission of a report in time	10
Total		**100**

6. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

The major equipment with the broad specification mentioned here will usher in uniformity in the conduct of practical and aid to procure equipment by authorities concerned**.**

Sr. No.	Major Equipment/ Instruments Required	Experiment Sr. No.
1	Worm &worm wheel	8
2	Single Purchase crab	8
3	Differential Axle & wheel	8
4	Parallel Forces Apparatus	4
5	Simple Screw Jack Indian make.	8
6	Cast Iron weights and hangers	All
7	Brass/Steel weights and Hangers	All
8	Aluminium pulley with Bracket, smoothly rotating	1 and 3
9	Combined Inclined Plane & friction slide ordinary	7
10	Law of moments apparatus	2
11	Universal Force Table	1
12	Sundry items like measuring scale , mirrors, thread, spirit levels, caliper .	All

7. THEORY COMPONENTS

Unit Outcomes (UOs) (in the cognitive domain)	**Topics and Sub-topics**
Unit– I Introduction (2 hrs, 2 marks)	
1a. Define terms related to engineering mechanics 1b. State the units of differentScalarandVectorquantity.	1.1 Fundamental Concepts such as Fundamental Units, Derived unit, system of unit, Scalar and Vector quantity, 1.2 Definition of Applied Mechanics, Statics Dynamics, Kinematics & Kinetics. 1.3 Definition of Gravity, Mass, Weight, Inertia, Newton's Law of Gravitation and Newton's laws of motion.
Unit– II Resolution and composition of Forces (10 hrs, 14 marks)	
2a Define terms related to force 2b Define terms related to the moment. 2c Principle of transmissibility of forces. 2d State Law of Parallelogram of forces. 2e Describe resolution and Composition of Coplanar force. 2f Solve problems on Composition & Resolution forces.	2.1 Concept of force, unit force, graphical Representation of force, Principle of transmissibility. 1.2 Systems of forces, coplanar, non-coplanar, concurrent non-concurrent, Parallel. 2.3 Resolution of a force, resolved parts, orthogonal and non-orthogonal Components of a force. 2.4 Concept of composition & resultant of Forces 2.5 Law of Parallelogram of forces, Triangle law of forces, Polygon law of forces. 2.6 Moment of a force, Varignon's A theorem of moments, couple & characteristics of a couple 2.7 Composition of Coplanar forces- Concurrent, parallel (like and unlike) Non-concurrent forces by analytical methods.
Unit– III Equilibrium (10 hrs, 14 marks)	
3a Define terms related to equilibrium. 3b State analytical conditions of equilibrium. 3c State Lami'stheorm 3d Define terms related to beam. 3e Solve problems related to Lami's theorem and beam reactions.	3.1 Concepts of equilibrium, equilibrant, Relation between resultant & Equilibrium. Analytical conditions of Equilibrium. 3.2 Equilibrium of coplanar concurrent forces, Lami's theorem & it's Applications. 3.3 Equilibrium of coplanar parallel and non-concurrent forces. 3.4 Beams reactions - simply supported beams subjected to concentrated & UDL only, beam supported on roller and hinge supports.
Unit– IV Centroid and Centre of Gravity (8 hrs, 10 marks)	
4a Define Centre of Gravity & Centroid. 4b State Centroid of a regular plane lamina. 4c Locate centroid of different geometric areas. 4d Solve problems related to the compound lamina 4e State the centre of gravity of solid bodies. 4f Simple numerical on Centre of gravity of simple solids bodies.	4.1 Concept of Centre of Gravity & Centroid. 4.2 Centroid of regular plane areas & compound areas consisting of regular Plane areas. Centroid of hollow objects such as hollow cylinder, hollow cone, hollow sphere. (No numericals to be set on hollow Objects in theory paper.) 4.3 Centre of gravity of simple solids- cylinder, cone, sphere and C.G of compound solid objects made Up of simple solids.

Unit Outcomes (UOs) (in the cognitive domain)	**Topics and Sub-topics**
Unit– V Friction (10 hrs, 10 marks)	
5a Define terms related to friction. 5b State laws of friction. 5c Apply Concept of friction. 5d Solve problems related to friction.	5.1 Introduction to Friction. 5.2 Types of friction, laws of static friction, coefficient of friction, angle of friction And angle of repose. 5.3 Equilibrium of body on horizontal & Inclined planes. 5.4 Ladder friction.(Numerical with smooth wall and flooring rough or Smooth to be only covered in theory.)
Unit– VI Kinetics (6 hrs, 8 marks)	
6a Define the concept of momentum and impulse. 6b Solve problems on momentum, impulse and impact. 6c State principle of conservation of momentum. 6d Solve the problem on the recoil velocity of the gun.	6.1 Concept of force, mass, acceleration, Momentum, impulse & impact. 6.2 Principle of conservation of Momentum & its applications, Recoil velocity of the gun.
Unit– VII Work, Power, Energy (8 hrs, 10 marks)	
7a. Define Work, Power, and Energy. 7b. Solve the problem on Work, Power, and Energy. 7c. State law of conservation of energy.	7.1 Definition and units of work, graphical Representation of work, work done by Constant and variable force. 7.2 Energy, types of energy, Law of conservation of energy, work-energy Principle and its applications. 7.3 Power- Definition, units. Numerical on Power of water pumps to be covered.
Unit– VIII Simple Machine (10 hrs, 12 marks)	
8a. Define terms related to simple lifting machine. 8b. Describe different types of simple lifting machine. 8c. State velocity ratio of machine. 8d. Solve problems related to simple lifting machine.	8.1 Definition of simple machine, mechanical advantage, velocity ratio,the efficiency with relations between them, friction in machines, Effort lost in friction (P_f). 8.2 condition of Reversibility, Law of a machine, Max MA & max efficiency. (Simple Numerical) 8.3 Study of machines - differential axle and wheel, simple screw jack, worm & Worm wheel, single purchase crab only. (Numerical to determine V.R, P_f., M.A. and Efficiency.)

8. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Introduction	02	02	00	00	02
II	Resolution & composition of forces	10	04	04	06	14
III	Equilibrium	10	02	04	08	14
IV	Centroid and centre of Gravity	08	02	04	04	10
V	Friction	10	02	02	06	10
VI	Kinetics	06	02	02	04	08
VII	Work, Power, energy	08	02	02	06	10
VIII	Simple lifting machines	10	04	04	04	12
Total		**64**	**20**	**22**	**38**	**80**

9. SUGGESTED STUDENT ACTIVITIES

Other than the classroom and laboratory learning following are the suggested student - related co-curricular activities which can be undertaken to accelerate the attainment of the various outcomes in this course.

a) Collect five different photographs indicating concurrent, parallel, general force system in equilibrium
b) Prepare a table of type of machine and relevant industrial application.
c) Collect five different situations where Law of movement plays an important role.
d) Prepare models representing various types of support (hinged, roller and fixed)
e) Illustrate situation wherein friction is essential and not essential
f) Prepare models in the form of geometrical figures and solids and locate centroid and centre of gravity of them.

10. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES(if any)

These are sample strategies, which the teacher can use to accelerate the attainment of the various outcomes in this course:

a. Massive open online courses (MOOCs) may teach various topics/subtopics.
b. 'L' in item No. 4 does not mean only the traditional lecture method, but different types of teaching methods and media that are to be employed to develop the outcomes.
c. About 15-20% of the topics/sub-topics that are relatively simpler or descriptive are to be given to the students for self-directed learning and assess the development of the LOs/COs through classroom presentations (see implementation guideline for details).
d. For item No.09, teachers need to create opportunities and provisions for co-curricular activities. . Guide student(s) in undertaking micro-projects.

11. SUGGESTED MICRO-PROJECTS

Only one micro-project is planned to be undertaken by a student assigned to them in the beginning of the semester. They ought to submit it by the end of the semester to develop the industry oriented COs. Each micro-project should encompass two or more COs that integrate practical's, cognitive domain and affective domain LOs. The micro-project could be industry application based, internet-based, workshop-based, laboratory-based or field-based. Each student will have to maintain a dated work diary of individual contributions to the project work and give a seminar presentation before submission.

In the first four semesters, the micro-project could be group-based. However, in higher semesters, it should be individually undertaken to build up the skill and confidence in every student to become a problem solver so that s/he contributes to the projects of the industry. A suggestive list is given here. The concerned faculty could add similar micro-projects:

a. **Types of Forces:** Prepare a chart showing real-life examples indicating various types of forces

b. **Lifting Machine:** Collect photographs of specific simple lifting machine and relate these machines with the machines being studied and prepare models of simple lifting machines using tools in "MECHANO" and "MECHANIX"

c. **Types of support:** Prepare chart showing actual and corresponding schematic diagram of various types of support

d. **Beams:** Prepare models of a beam subjected to point loads, uniformly distributed loads, simply supported, overhang and cantilever type beam.

e. **Friction:** Prepare a chart regarding the type of friction in various field conditions and collect data regarding the coefficient of friction by referring to books. Determine the coefficient of friction for three different types of surfaces

f. **Centre of Gravity:** Prepare a chart of situations wherein the concept of Centre of Gravity is vital.

12. SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publisher, Edition and Year of publication, ISBN Number
1	Engineering Mechanics	Timoshenko,DH Young	Mc Graw Hill Education ISBN-10,9781259062667
2	Engineering Mechanics	Dwaraka Prasad Sharma	Pearson Education ISBN-13,978131732229
3	Applied Mechanics	Khurmi R.S.	S.Chand Publication ISBN-13,9789352833961

13. SOFTWARE/LEARNING WEBSITES :

1.https://www.youtube.com/watch?v=-FUWGovGCAM&list=PLhD3O8cMTw14U-jtWrBGFAzXZkOzHL4Iq&index=3

2. https://www.youtube.com/watch?v=W9UDs-kSR0g assesedon 30 March 2016

14. PO - COMPETENCY- CO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	2	2	2	1	-	-
CO2	3	3	2	1	2	-	-
CO3	3	2	2	2	3	-	-
CO4	2	2	2	2	-	-	-
CO5	1	2	2	2	1	-	-
CO6	2	1	2	3	-	-	-

	PSO1	PSO2	PSO3
CO1	2	1	--
CO2	2	3	1
CO3	2	3	--
CO4	3	2	2
CO5	3	2	1
CO6	3	--	1

Sign: Name: Shri H.P. Naiknavare (Course Expert)	Sign: Name: Shri H. P. Naiknavare (I/c HoD AMD) Dr. S.M.S.Shashidhara (Former Head of Department) Shri. V G Tambe (HOD I Shift) Shri. V B Kondawar (HOD II shift)
Sign: Name: Dr. S. S. Bharatkar/Shri. R. U. Shelke (Program Head) (Department of Electrical Engineering)	Sign: Name : Mr.A.S.Zanpure (CDC Incharge)

Government Polytechnic, Pune

'180OB' – Scheme

Programme	Diploma in CE/EE/**ET**/ME/MT/CM/IT/DDGM
Programme code	01/02/**03**/04/05/06/07/08/15/16/**17**/18/19/21/22/**23**/24/26
Name of Course	**Fundamentals of ICT**
Course Code	**CM2102**
Prerequisite course code and name	No
Class Declaration	No

1. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P)		Examination Scheme				
					Theory		Practical		Total Marks
L	T	P	C		ESE	PA	*ESE	PA	
01	00	02	03	Marks	-	-	25	25	50
				Exam Duration	-	-	-	-	

Legends: L- lecture, T-Tutorial/teacher guided theory practice, P-practical, C-Credits, ESE-End semester examination, PA- Progressive Assessments(Test I, II/Term Work), * - Practical Exam, $ - Oral Exam. # - Online Exam., Each lecture/practical period is of one clock hour.

2. RATIONALE

In any typical business setup, in order to carry out routine tasks related to create business documents, perform data analysis and its graphical representations and making electronic slide show presentations, the student need to learn various software as office automation tools like word processing applications, spreadsheets and presentation tools. They also need to use these tools for making their project reports and presentations. The objective of Information and Communication Technology course is to develop the basic competency in students for using these office automation tools to accomplish the job.

3. COMPETENCY

The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- **Use Computers for electronic documentation, data analysis, slide presentations and use of various internet services.**

4. COURSE OUTCOMES (COs)

The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry oriented COs associated with the above mentioned competency**:**

1. Connect Computer System and its peripherals.
2. Prepare document using word processing tool.
3. Create and design spreadsheets and data tables.
4. Prepare professional presentations.
5. Use various web services.

5. SUGGESTED PRACTICALS/ EXERCISES

Sr. No.	Unit No.	Practical Exercises (Learning Outcomes in Psychomotor Domain)	Relevant CO	Approximate Hours Required.
1	1	i) Identify various Input/output devices, connections and peripherals of computer system ii) Demonstration of Front Panel View ,Rear Panel View, I/O Serial and Parallel Ports iii)Demonstration of opening and closing of the Computer	1	1
2	1	i) Connections inside CPU and its demonstration ii) Setting up the Cabinet. iii) Identification and Demonstration of different slots on motherboard. Mounting and Un mounting of RAM, Graphics card and Network card	1	1
3	1	i) Connecting various I/O Devices such as Mouse, Keyboards, Monitors, Printers, Web Cameras, Speakers, Scanners and External Hard disks etc. ii)Demonstration of RJ45 connector and its use and Bluetooth as an external interface	1	2
4	1	Functions and working of Secondary Storage devices i) Study of various types of Secondary Storage devices. ii) BIOS Settings for Primary and secondary Memory. iii) Installation, Configuration and Setting of Hard Disks and working of CD-ROM/DVD-ROM/ DVD-Combo/ DVD- Writer (Internal and External).	1	1
5	1	Execution of basic commands in command window: Ex: dir, md, copy, cd, move, rmdir, rd etc.	1	1
6	1	Various operations on Window based operating system part I: i) Windows Operations: Minimizing, Maximizing, Resizing. ii) Managing files and folders: Create, copy, rename, delete, move file and folder, Creating shortcuts.	1	1
7	1	Various operations on Window based operating system part II: i) Creating and Removing/Deleting User Accounts. ii) Using Add /Remove Programs and Hardware Utility. iii)Adding Fonts and Viewing Computer Configuration iv)Desktop settings: Display properties, Time and Date setting, Screen Saver , Appearance	1	2

8	2	i) Create, edit and save document : apply formatting features on the text - line, paragraph ii) Use bullets, numbering, page formatting iii) Insert and edit images and shapes, sizing, cropping, color, background, group/ungroup	2	2
9	2	i) Insert and apply various table formatting features on it. ii) Use mail merge with options.	2	1
10	2	Apply page layout features i)Themes, page background, paragraph, page setup ii)Create multicolumn page iii)Use different options to print the documents	2	2
11	3	Create, open and edit worksheet i)Enter data and format it, adjust row height and column width ii)Insert and delete cells, rows and columns iii) Apply wrap text, orientation feature on cell.	3	2
12	3	i) Insert formulas, "IF" conditions, functions and named ranges in worksheet. ii) Apply data Sort Filter and Data Validation features.	3	3
13	3	Create charts to apply various chart options.	3	2
14	3	Apply Page setup and print options for worksheet to print the worksheet.	3	1
15	3	Perform following in GUI based database software using GUI like MS-Access i) Create Database ii) Create tables and assign primary key. iii) Modify the table structure-add column, change the data type of column, delete the column from table. iv) Insert, update and delete the record from table. v) Retrieve data from the table according to condition given.	3	2
16	4	i)Create slide presentation ii)Apply design themes to the given presentation iii) Add new slides and insert pictures/images, shapes, apply animation effects to the text and slides. iv)Add tables and charts in the slides. v) Run slide presentation in different modes and Print it.	4	2
17	5	Configure Internet connection	5	1
18	5	Use internet for different web services.	5	2
19	5	Configure browser settings and use browsers.	5	1
20	All	Micro-project (Refer point 11 for micro project list)	All COs	2
		Total		**32**

Sr.No.	Performance Indicators	Weightage in %
a.	Use of Appropriate tool to solve the problem (Process)	40
b.	Quality of output achieved (Product)	30
c.	Complete the practical in stipulated time	10
d.	Observations and Recording	10
e.	Answer to sample questions	10
Total		**100**

6. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

The major equipment with broad specification mentioned here will usher in uniformity in conduct of practicals, as well as aid to procure equipment by authorities concerned.

Sr. No.	Major Equipment/ Instruments Required	Experiment Sr. No.
1	Computer system with all necessary components like; motherboard, random access memory (RAM), read-only memory (ROM), Graphics cards, sound cards, internal hard disk drives, DVD drive, Network interface card, Mouse, Keyboard, Monitors, Printers, Web Cameras, Speakers, Scanners and External Hard disks etc.	1 to 7
2	Laser printer	1,14,16
3	Hard Disks, CD-ROM/DVD-ROM/ DVD-Combo/ DVD-Writer (Internal and External).	3,4
4	Hubs, Switches, Modems.	18,19
5	Any operating system.	5 to 20
6	Any Office Software.	8,9,10, 11, 12, 13, 15,16,17
7	Any browser.	18,19,20

7. THEORY COMPONENTS

Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
Unit -1 Introduction to Computer System (Hours- 04)	
1a.Explain the given block diagram of computer system. 1b. Classify the given types of software. 1c.Explain characteristics of the specified type of network. 1d.Describe Procedure to manage file/folders. 1e.Describe application of the specified type of network connecting device.	1.1 Basics of Computer System: Overview of Hardware and Software ,block diagram of Computer System, Input /Output unit, CPU, Control unit, Arithmetic logic unit(ALU), Memory Unit 1.2 Internal Components: Processor, Motherboards, random access memory(RAM), read-only memory(ROM), Video cards, Sound cards and internal hard disk drives 1.3 External Devices: Types of Input/ Output Devices, Types of monitors, Keyboards, Mouse, Printers: Dot Matrix, Inkjet and LaserJet, Plotter and scanner, external storage devices CD/DVD , Hard disk and pen drive 1.4 Basic Commands in command window: Ex: dir, md, copy, cd, move, rmdir, rd etc. 1.5 Application Software: Word processing , Spreadsheet, database management systems, Control software, measuring

Unit Outcomes (UOs) (in cognitive domain)	**Topics and Sub-topics**
	software, photo editing software , video editing software, graphics manipulation software system software compilers, linkers, device drivers, operating systems and utilities 1.6 Network environments: Network interface cards, hubs, switches, routers and modems, concept of LAN, MAN, WAN, WLAN, Wi-Fi and Bluetooth 1.7 Working With Operating Systems: Create and manage file and folders, Copy a file, renaming and deleting files and folders, searching files and folders, application installation , creating shortcut of application on the desktop
Unit - 2 Word Processing (Hours- 03)	
2a.Write steps to create the given text document. 2b.Explain the specified feature for document editing. 2c.Explain the given page setup features of a document. 2d.Write the specified table formatting feature	2.1 Word Processing: Overview of Word processor, Basics of Font type, size, color, Effects like Bold, italic, underline, subscript and superscript, Case changing options, Previewing a document, Saving a document, Closing a document and exiting application. 2.2 Editing a Document: Navigate through a document, Scroll through text, Insert and delete text, Select text, Undo and redo commands, Use drag and drop to move text, Copy, cut and paste, Use the clipboard, Clear formatting, Format and align text, Formatting Paragraphs, Line and paragraph spacing, using FIND and REPLACE, Setting line spacing ,add bullet and numbers in lists, add borders and shading, document views, Page settings and margins, Spelling and Grammatical checks 2.3 Changing the Layout of a Document: Adjust page margins, Change page orientation, Create headers and footers, Set and change indentations, Insert and clear tabs 2.4 Inserting Elements to Word Documents: Insert and delete a page break, Insert page numbers, Insert the date and time, Insert special characters(symbols),Insert a picture from a file, Resize and reposition a picture 2.5 Working with Tables: Insert a table, Convert a table to text, Navigate and select text in a table, Resize table cells, Align text in a table, Format a table, Insert and delete columns and rows, Borders and shading, Repeat table headings on subsequent pages, Merge and split cells. 2.6 Working with Columned Layouts and Section Breaks: Add Columns, Section breaks, Creating columns, Newsletter style columns, Changing part of a document layout or formatting, Remove section break, Add columns to remainder of a document, Column widths, Adjust column spacing, Insert manual column breaks
Unit -3 Spreadsheets and Database (Hours- 04)	

Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
3a.Write steps to create the given spreadsheet. 3b.Explain the specified formatting feature of a worksheet. 3c.Write steps to insert formula and functions in the given worksheet. 3d.Write steps to create charts for the specified data set. 3e.Explain steps to perform advance operation on the given dataset	3.1 Working with Spreadsheets: Overview of workbook and worksheet, Create Worksheet Entering sample data, Save, Copy Worksheet, Delete Worksheet, and Open & Close Workbook. 3.2 Editing Worksheet: Insert and select data, adjust row height and column width, delete, move data, insert rows and columns, Copy and Paste, Find and Replace, Spell Check, Zoom In-Out, Special Symbols, Insert Comments, Add Text Box, Undo Changes,- Freeze Panes, hiding/un hiding rows and columns. 3.3 Formatting Cells and sheet: Setting Cell Type, Setting Fonts, Text options, Rotate Cells, Setting Colors, Text Alignments, Merge and Wrap, apply Borders and Shades, Sheet Options, Adjust Margins, Page Orientation, Header and Footer, Insert Page Breaks, Set Background. 3.4 Working with Formula: Creating Formulas, Copying Formulas, Common spreadsheet Functions such as sum, average, min, max, date, In, And, or, mathematical functions such as sqrt, power, applying conditions using IF. 3.5 Working with Charts: Introduction to charts, overview of different types of charts, Bar, Pie, Line charts, creating and editing charts. Using chart options: chart title, axis title, legend, data labels, Axes, grid lines, moving chart in a separate sheet. 3.6 Advanced Operations: Conditional Formatting, Data Filtering, Data Sorting, Using Ranges, Data Validation, Adding Graphics, Printing Worksheets, print area, margins, header, footer and other page setup options 3.7 Introduction to Database Management System: Meaning of Data, Database, DBMS, GUI based database software Creating tables and assign primary key, Modifying the table structure-add column, change the data type of column, and delete the column from table. And Insert, update and delete the record from table.
Unit – 4 Presentation Tool (Hours- 03)	
4a. Write the steps to create the specified slide presentation. 4b. Write the steps to insert multiple media in the given presentation. 4c. Write steps to apply table features in the given presentation 4d. Write steps to manage	4.1 Creating a Presentation: Outline of an effective presentation, Identify the elements of the User Interface, Starting a New Presentation Files, Creating a Basic Presentation, Working with text boxes, Apply Character Formats, Format Paragraphs, View a Presentation, Saving work, creating new Slides, Changing a slide Layout, Applying a theme, Changing Colors, fonts and effects, apply custom Color and font theme, changing the background, Arrange Slide sequence, 4.2 Inserting Media elements: Adding and Modifying

Unit Outcomes (UOs) (in cognitive domain)	**Topics and Sub-topics**
charts in the given presentation	Graphical Objects to a Presentation - Insert Images into a Presentation, insert audio clips, video/animation, Add Shapes, Add Visual Styles to Text in a Presentation, Edit Graphical Objects on a Slide, Format Graphical Objects on a Slide, Group Graphical Objects on a Slide, Apply an Animation Effect to a Graphical Object, Add 4.3 Working with Tables: Insert a Table in a Slide, Format Tables, and Import Tables from Other Office Applications. 4.4 Working with Charts: Insert Charts in a Slide, Modify a Chart, Import Charts from Other Office Applications
Unit - 5 Basics of Internet (Hours- 02)	
5a. Explain use of the given setting option in browsers. 5b.Explain features of the specified web service. 5c.Describe the given characteristic of cloud. 5d.Explain the specified option used for effective searching in search engine	5.1 World Wide Web: Introduction, Internet, Intranet, Cloud, Web Sites, Web Pages, URL, web servers, basic settings of web browsers-history, extension, default page, default search engine, creating and retrieving bookmarks, use search engines effectively for searching the content. 5.2 Web Services: e-Mail, Chat, Video Conferencing, e-learning, e-shopping, e-Reservation, e-Groups, Social Networking.

Transitions, Add Speaker Notes, Print a Presentation.

8. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

Unit No.	**Unit Title**	**Teaching Hours**	**Distribution of Theory Marks**			
			R Level	**U Level**	**A Level**	**Total Marks**
I	Introduction to Computer System	4	--	--	--	--
II	Word Processing	3	--	--	--	--
III	Spreadsheets and Database	4	--	--	--	--
IV	Presentation Tool	3	--	--	--	--
V	Basics of Internet	2	--	--	--	--
Total		**16**	--	--	--	--

9. SUGGESTED STUDENT ACTIVITIES

Other than the classroom and laboratory learning, following are the suggested student-related ***co-curricular*** activities which can be undertaken to accelerate the attainment of the various outcomes in this course: Students should conduct following activities in group and prepare reports of about 5 pages for each activity, also collect/record physical evidences for their (student's) portfolio which will be useful for their placement interviews:

a. Prepare journal of practicals performed in laboratory
b. Prepare a sample document with all word processing features.(Course teacher shall allot appropriate document type to each students)

c. Prepare PowerPoint Presentation with all the presentation features.(Course teacher shall allot various topics to the groups of students)
d. Prepare Database/spreadsheets in groups, related to various Fields/Organizations
e. Undertake micro projects

10. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are sample strategies, which the teacher can use to accelerate the attainment of the various outcomes in this course:

a. Massive open online courses (***MOOCs***) may be used to teach various topics/sub topics.
b. About ***15-20% of the topics/sub-topics*** which is relatively simpler or descriptive in nature is to be given to the students for ***self-directed learning*** and assess the development of the COs through classroom presentations (see implementation guideline for details).
c. With respect to item No.9, teachers need to ensure to create opportunities and provisions for ***co-curricular activities***.
d. Guide student(s) in undertaking micro-projects.
e. Correlate subtopics with power plant system and equipments.
f. Use proper equivalent analogy to explain different concepts.
g. Use Flash/Animations to explain various components, operation and
h. Teacher should ask the students to go through instruction and Technical manuals

11. SUGGESTED MICRO-PROJECTS

Only one micro-project is planned to be undertaken by a student that needs to be assigned to him/her. In special situations where groups have to be formed for micro-projects, the number of students in the group should ***not exceed three.***

The micro-project could be industry application based, internet-based, workshop-based, laboratory-based or field-based. Each micro-project should encompass two or more COs which are in fact, an integration of PrOs, UOs and ADOs. (Affective Domain Outcomes). Each student will have to maintain activity chart consisting of individual contribution in the project work and give a seminar presentation of it before submission. The student ought to submit micro-project by the end of the semester to develop the industry-oriented COs.

A suggestive list of micro-projects is given here. Similar micro-projects could be added by the concerned faculty:

a. Word documents: Prepare Time Table, Application Notes, Reports(Subject teacher shall assign a document to be prepared by the each students)
b. Slide Presentations: Prepare slides with all Presentation of reports (Subject teacher shall assign a presentation to be prepared by each student.
c. Spreadsheets: Prepare pay bills, tax statement, student's assessment record using spreadsheets (Teacher shall assign a spreadsheets to be prepared by each student
d. Web Browser/ Email : Create Email ID using any web browser and E-mail service and explore all the options available in Email e.g. drive, forms etc.

12. SUGGESTED LEARNING RESOURCES

S.N.	Title	Author	Publisher, Edition, Year of publication ,ISBN Number
1	Computer Fundamentals	Goel, Anita	Pearson Education, New Delhi, 2014 • ISBN-13: 978-8131733097
2	Computer Basics Absolute Beginner's Guide, Windows 10	Miller, Michael	QUE Publishing; 8th edition August 2015 • ISBN: 978-0789754516
3	Microsoft Office 2010 for Windows: Visual Quick Start	Schwartz, Steve	Pearson Education, New Delhi India, 2012 • ISBN:9788131766613
4	OpenOffice.org for Dummies	Leete, Gurdy, Finkelstein Ellen, Mary Leete	Wiley Publishing, New Delhi 2003 • ISBN : 978-0764542220
5	Microsoft Office 2010: On Demand	Johnson, Steve	Pearson Education, New Delhi India, 2010. • ISBN : 9788131770641

13. SOFTWARE/LEARNING WEBSITES

a. http://www.nptel.ac.in
b. https://www.microsoft.com/en-in/learning/office-training.aspx
c. http://www.tutorialsforopenoffice.org
d. https://s3-ap-southeast-1.amazonaws.com/r4ltue295xy0d

14. PO - COMPETENCY- CO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	2	-	-	2	1	-	2
CO2	-	-	-	2	2	2	2
CO3	3	2	2	2	2	2	2
CO4	-	-	-	2	2	2	2
CO5	1	-	-	-	1	-	1

	PSO1	PSO2	PSO3
CO1	2	-	-
CO2	-	1	-
CO3	-	1	-
CO4	-	1	-
CO5	2	1	-

Sign: Name: Smt. A. D. Kshirsagar Smt. K. S. Sathawane Smt. P.L. Sonwane (Course Experts)	Sign: Name: Shri. U. V. Kokate Dr. S. B. Nikam (Head of Department) (Department of Computer Engineering)
Sign: Name: Dr. S. S. Bharatkar/Shri. R. U. Shelke (Program Head) (Department of Electrical Engineering)	Sign: Name : Mr.A.S.Zanpure (CDC Incharge)

Government Polytechnic, Pune

'180 OB' – Scheme

Programme	Diploma in ET/CE/**EE**//ME/MT/ DDGM CM/IT/
Programme code	01/**02**/03/04/05/06/07/08/15/**16**/17/18/19/21/**22**/23/24/26
Name of Course	**Basic Electrical Engineering**
Course Code	**EE2101**
Prerequisite course code and name	No
Class Declaration	No

1. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P)		Examination Scheme				
					Theory		Practical		Total Marks
L	T	P	C		ESE	PA	* ESE	PA	
03	00	02	05	Marks	80	20	25	25	150
				Exam Duration	3 Hrs	1 Hr	-	-	

Legends: L- lecture, T-Tutorial/teacher guided theory practice, P-practical, C-Credits, ESE-End semester examination, PA- Progressive Assessments(Test I, II/Term Work), * - Practical Exam, $ - Oral Exam. # - Online Exam., Each lecture/practical period is of one clock hour.

2. RATIONALE

This is an entry course to Electrical Engineering Diploma programme. The basic concepts, rules and laws of Electric and Magnetic Circuits must be studied and understood by students before studying Electrical Engineering Diploma Course. This course covers fundamentals of D.C. circuits, electrostatics, magnetic circuits and electromagnetic induction. The outcome of this course is useful in linking the further courses of diploma curriculum.

3. COMPETENCY

The aim of this course is to attend following industry identified competency through various teaching learning experiences:

- **Apply basic laws and principles of Electrical Engineering**.

4. COURSE OUTCOMES (COs)

The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry oriented COs associated with the above mentioned competency:

1: To apply basic principles and different effects of electrical current in electrical engineeringfield.
2: To solve simple D.C. circuits by applying different methods and theorems.
3: To analyse behaviour of capacitor from basic concepts and principles. Selection type of Capacitors according to need.
4: To apply the principles of operation of electrical machines by knowing the concepts of magnetic circuits and electromagnetic induction.

5. SUGGESTED PRACTICALS/ EXERCISES

Pr. No	Unit No.	Practical Exercises (Outcomes in Psychomotor Domain)	Relevant CO	Approximate Hours Required.
1	--	Know your laboratory	All COs	04
2	1	Use of rheostat as a potential divider and current regulator.	1	02
3	1	Verify the effect of temperature on resistance of conductor.	1	02
4	2	Connect resistances in series and parallel to get required effective resistance of respective combination and verify the same by using Digital Multimeter.	2	04
5	2	Verify the voltage & current division formulae for series and parallel circuits respectively.	2	04
6	2	Use Kirchhoff's current law and Kirchhoff's voltage law to determine currents and voltages in given electric circuit .	2	04
7	2	Verification of star-delta transformation and delta-star transformation.	2	04
8	3	Determine the time constant of the given RC circuit, both analytically and practically. Plot the charging and discharging curve for the same.	3	02
9	4	Verification of Fleming's left hand rule.	4	02
10	4	Plot the nature of B – H curve of a magnetic material on D. C. generator.	4	02
11	5	Verification of Faraday's laws of electromagnetic induction and understanding of direction of induced e.m.f.	4	02
12		Microproject planning & Execution as written in suggested microproject list		02
13		Microproject report writing		02
14		Suggested student activity report		02
		Total Hrs		**38**

S.No.	Performance Indicators	Weightage in %
a.	Arrangement of available equipment / test rig or model	10
b.	Setting and operation	10
c.	Safety measures	20
d.	Observations and Recording	15
e.	Interpretation of result and Conclusion	20
f.	Answer to sample questions	10
g.	Submission of report in time	15
Total		**100**

6. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

The major equipment with broad specification mentioned here will usher in uniformity in conduct of practicals, as well as aid to procure equipment by authorities concerned**.**

Sr. No	Equipment Name with Broad Specifications	Pr. No.
1	Total laboratory equipments, meters and machines	1
2	Rheostats, Voltmeter, Ammeter	2,5,6,7
3	Winding, Rheostats, Voltmeter, Ammeter, Thermometer	3
4	Rheostats, Digital multimeter	4
5	Rheostats, Capacitance, Micro ammeter, Digital multimeter	8
6	D.C. Motor	9
7	D.C. Motor-Generator set, Rheostat, Voltmeter, Ammeter	10
8	Permanent Magnet, Galvanometer	11

7. THEORY COMPONENTS-

Unit Outcomes (UOs)(in cognitive domain)	*Topics and Sub-topics*
UNIT 1. Basic Concepts of Electrical Engineering	**HRS - 10 Marks-16**
1a. Explain the various basic electrical parameters. 1b. Describe the effects of electric current with relevant applications 1c. Identify the commonly used materials and components used in electrical engineering. 1d. Explain the concept of ideal and practical voltage and current sources. 1e. Convert the given Voltage source into Current source and Current source into Voltage source 1f. Solve numerical problems.	1.1 Charge, Current, Potential, Potential difference, Voltage, Electrical Resistance, Electromotive force, Terminal voltage and their Units. 1.2 Ohm's Law : applications and limitations 1.3 Specific Resistance and its unit 1.4 Definitions of Work, Power and Energy (No numerical) 1.5 Effects of electric current with relevant applications- Chemical effect, Magnetic effect, Heating effect 1.6 Parameters affecting the resistance, Effect of temperature on resistance of Conductors, Insulators, Alloys and temperature co-efficient of resistance 1.7 Different types of resistors- fixed and variable 1.8 Concept of Ideal and Practical Current Source

Unit Outcomes (UOs)(in cognitive domain)	***Topics and Sub-topics***
	and voltage source. 1.9 Source conversion. 1.10 Simple numerical on all above topics. 1.11 Effects of electric current- Heating effect, Magnetic effect, Chemical effect 1.12
UNIT-2. D. C. Circuits	**HRS -10 Marks -16**
2a. Apply voltage division rule for series circuit and current division rule for parallel circuits. 2b. Apply Kirchhoff's laws to determine current and voltage to the given circuits. 2c. Apply Loop analysis to find the currents flowing in various branches of the given circuits. 2d. Apply Nodal analysis to find the currents flowing in various branches of the given circuits. 2e. Apply Star-Delta and Delta-Star Conversion methods for the given circuits. 2f. Solve numerical problems.	2.1 Definitions of Circuit, Network, Mesh, Node, Active and passive circuit, Unilateral and bilateral circuit, Linear and nonlinear circuit. 2.2 Series circuits- Effective resistance, Voltage division rule (for two series resistances only), Applications. 2.3 Parallel circuits- Effective resistance, Current division rule (for two parallel resistances only) , Applications. 2.4 Kirchhoff's current law, Kirchhoff's voltage law (Upto two simultaneous equations) 2.5 Loop (Mesh) analysis (Upto two simultaneous equations) 2.6 Nodal analysis (Upto two simultaneous equations) 2.7 Star-Delta and Delta-Star Conversion of resistances 2.8 Simple Numerical on all above topics.
UNIT-3 Electrostatics	**HRS -08 Marks -16**
3a. Explain the working of Capacitor and state the factors affecting the capacitance of a capacitor. 3b. Define dielectric strength, breakdown voltage, permittivity. 3c. State the different types of capacitors and dielectrics. 3d. Enlist the technical Specifications of capacitors. 3e. Calculate the capacitance and the energy stored in Capacitors. 3f. Describe the working of capacitor in the given circuit. 3g. Solve numerical problems.	3.1 Definition of capacitor and Capacitance, Formation of capacitor, Capacitance of a parallel plate capacitor with single & composite dielectric medium. 3.2 Factors affecting capacitance. 3.3 Dielectric strength, Breakdown voltage and Permittivity. 3.4 Types of capacitors and applications 3.5 Types of dielectrics. 3.6 Specifications of capacitor. 3.7 Capacitors in Series and parallel. 3.8 Energy stored in capacitance (No Derivation but simple numerical). 3.9 Charging and discharging of capacitor through high resistance 3.10 Simple numerical on all above topics.
UNIT-4 Magnetic Circuits	**HRS -10 Marks -16**

Unit Outcomes (UOs)(in cognitive domain)	***Topics and Sub-topics***
4a. Describe the various basic parameters of Magnetic field. 4b. Explain Laws and Rules applicable to the magnetic field produced by solenoid, current carrying conductor. 4c. Give the comparison between Electric and Magnetic circuit. 4d. Explain Series and parallel magnetic circuits. 4e. Explain Leakage Flux, Useful Flux & Fringing. 4f. Describe the significance of Magnetization curve and Hysteresis loop. 4g. State and explain Fleming's left hand rule and application of it	4.1 Definitions -Magnetic field, Magnetic flux, Magnetic flux density, Magnetic field strength, Magneto motive force, Reluctance, Permeability, Factors affecting Reluctance. 4.2 Rules applied to magnetic field: -Right hand Gripping rule, Corkscrew rule. 4.3 Magnetic field produced by a straight current Carrying Conductor 4.4 Magnetic field of solenoid. 4.5 Comparison between Electric and Magnetic circuit. 4.6 Series and parallel magnetic circuits (numerical on series magnetic circuits with air gap). 4.7 Concept of Leakage Flux, Useful Flux & Fringing, Leakage Coefficient. 4.8 Magnetization curve and Hysteresis loop:- Relation between B and H, Magnetization curve, Practical importance of magnetization curve 4.9 Hysteresis loop, Practical importance of Hysteresis loop and Hysteresis loss. 4.10 Force on current carrying conductor and correlate it with motor action. 4.11 Fleming's left hand rule.
UNIT-5 Electromagnetic Induction	**HRS -10 Marks -16**
5a. Define phenomenon of Electromagnetic induction. 5b. State and apply Faraday's law, Lenz's law, Fleming's right hand rule. 5c. Differentiate between Statically and Dynamically induced EMF, self and mutual inductance. 5d. Identify the different types of inductors and explain their applications. 5e. Calculate the energy stored in magnetic field. 5f. Define Eddy current and eddy current loss.	5.1 Electromagnetic Induction. 5.2 Faraday's laws of Electromagnetic Induction. 5.3 Lenz's law 5.4 Fleming's right hand rule for Generator. 5.5 Statically and dynamically induced EMF. 5.6 Inductance: Self and Mutual Inductance 5.7 Simple numerical on self and Mutual induction 5.8 Concept of dot and undot conventions and Inductances in series. 5.9 Types of Inductors and their Applications:- Air Cored Inductors, Iron Cored Inductors, Ferrite Cored Inductors 5.10 Energy stored in Magnetic field. (No derivation but simple numerical). 5.11 Concept of Eddy current and eddy current loss.

8. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN-

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
1	Basic Concepts of Electrical Engineering	10	8	4	4	16
2	D. C. Circuits	10	4	4	8	16
3	Electrostatics	08	4	8	4	16
4	Magnetic Circuits	10	4	6	6	16
5	Electromagnetic induction	10	4	6	6	16
Total		48	**24**	**28**	**28**	**80**

9. SUGGESTED STUDENT ACTIVITIES

Other than the classroom and laboratory learning, following are the suggested student-related ***co-curricular*** activities which can be undertaken to accelerate the attainment of the various outcomes in this course: Students should conduct following activities in group and prepare reports of about 5 pages for each activity, also collect/record physical evidences for their (student's) portfolio which will be useful for their placement interviews:

Prepare journal based on practical performed in Electrical laboratory. Journal consists of drawing, observations, required equipment's, date of performance with teacher signature.

a) Prepare power point presentation related to use of electric circuit elements in various industrial applications.

b) Prepare a chart sharing the photographs of electrical equipment & the type of effect of electric current observed in that equipment.

c) Illustrate the situations where use of electrical energy is essential.

d) Prepare models to show the use of Faraday's Laws of electromagnetic induction.

10. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are sample strategies, which the teacher can use to accelerate the attainment of the various outcomes in this course:

a. Massive open online courses (***MOOCs***) may be used to teach various topics/sub topics.
b. About ***15-20% of the topics/sub-topics*** which is relatively simpler or descriptive in nature is to be given to the students for ***self-directed learning*** and assess the development of the COs through classroom presentations (see implementation guideline for details).
c. With respect to item No.8, teachers need to ensure to create opportunities and provisions for ***co-curricular activities***.
d. Use Flash/Animations to explain various components, operation and working principle.
e. Teacher should ask the students to go through instruction and Technical manuals.

11. SUGGESTED MICRO-PROJECTS

Only one micro-project is planned to be undertaken by a student that needs to be assigned to him/her. In the first four semesters, the micro-projects are group-based. However, in the fifth and sixth semesters, it should be preferably be **individually** undertaken to build up the skill and confidence in every student to become problem solver so that s/he contributes to the projects of the industry. In special situations where groups have to be formed for micro-projects, the number of students in the group should **not exceed three.**

The micro-project could be industry application based, internet-based, workshop-based, laboratory-based or field-based. Each micro-project should encompass two or more COs which are in fact, an integration of PrOs, UOs and ADOs. Each student will have to maintain dated work diary consisting of individual contribution in the project work and give a seminar presentation of it before submission. The total duration of the micro-project should not be less than **16 (sixteen) student engagement hours** during the course. The student ought to submit micro-project by the end of the semester to develop the industry oriented COs.

A suggestive list of micro-projects is given here. Similar micro-projects could be added by the concerned faculty:

1) Collect the photographs of different types of resistors & prepare a chart of different types of resistors with their symbols & applications.
2) Collect the coloured photographs of various fixed resistors of different ratings. Find their resistance values by using colour code. Prepare a chart showing these details.
3) Collect the photographs of different types of capacitors & prepare a chart of different types of capacitors with their symbol and applications.
4) Collect the coloured photographs of various fixed capacitors of different ratings. Find their capacitance values by using colour code. Prepare a chart showing these details.
5) Prepare a chart of different types of inductors with their photographs & their applications

12. SUGGESTED LEARNING RESOURCES

Sr.No.	Title	Author	Publication	ISBN No.
1	Electrical Technology	B.L. Theraja	S. Chand Publication, Delhi	ISBN-9788121924405
2	Basic Electrical Engineering	V.N. Mittle	Tata McGraw Hill Publishing Company Ltd., New Delhi.	ISBN-0074516329, 9780074516324
3	Electrical Technology	Edward Hughes	Low Price Edition	ISBN-9780582405196
4	Electrical Technology	H. Cotton	CBS Publishers & Distributors	ISBN-8123909284, 9788123909288

13. SOFTWARE/LEARNING WEBSITES

www.nptel.com
https://www.electrical4u.com
https://www.basicofelectricalengineering.com
https://www.allaboutcircuits.com

14. PO - COMPETENCY- CO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	1	1	1	2	1	3
CO2	3	2	1	1	2	1	3
CO3	3	2	2	2	2	1	3
CO4	2	1	2	2	2	1	3

	PSO1	PSO2	PSO3	PSO4
CO1	3	1	1	1
CO2	3	2	1	1
CO3	2	1	1	2
CO4	3	3	2	2

Sign: Name: **1.** Shri. S. B. Kale **2.** Smt. M. H. Bilgi **3.** Smt. R.T.Patil (Course Experts)	Sign: Name: Dr. S. S.Bharatkar/Shri.R.U. Shelke (Head of Department)
Sign: Name: Dr. S. S.Bharatkar/Shri.R.U. Shelke (Program Head) (Department of Electrical Engineering)	Sign: Name: Shri A. S. Zanpure (CDC Incharge)

Government Polytechnic, Pune

'180 OB' – Scheme

Programme	Diploma in ET/CE/**EE**//ME/MT/CM/IT/DDGM
Programme code	01/**02**/03/04/05/06/07/08/15/**16**/17/18/19/21/**22**/23/24/26
Name of Course	**Electrical Wiring and Domestic Appliances**
Course Code	**EE2104**
Prerequisite course code and name	No
Class Declaration	No

1. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P)		Examination Scheme				
					Theory		Practical		Total Marks
L	T	P	C		ESE	PA	* ESE	PA	
00	00	02	02	Marks	--	--	--	25	25
				Exam Duration	--	--	--	--	

Legends: L- lecture, T-Tutorial/teacher guided theory practice, P-practical, C-Credits, ESE-End semester examination, PA- Progressive Assessments(Test I, II/Term Work), * - Practical Exam, $ - Oral Exam. # - Online Exam., Each lecture/practical period is of one clock hour.

2. RATIONALE

The knowledge of domestic installations which consist of different types of loads such as lighting, fan and domestic power loads like water heaters, geysers, grinder, washing machine, refrigerator, air conditioning system, cooking range like hot plate, toaster, oven. Hence basic knowledge of safety precautions, simple repairing, wiring accessories and tools, lamps and their circuits, electrical gadgets is essential for technicians

3. COMPETENCY

The aim of this course is to attend following industry identified competency through various teaching learning experiences:

- **Maintain electrical wiring and domestic appliances**

4. COURSE OUTCOMES (COs)

The student should be able to:

1. Observe safety while working with electrical machines and equipment.
2. Use different tools for wiring.
3. Describe different types of lamps and prepare circuits for these lamps.
4. Find common faults in commonly used electrical gadgets.

5. SUGGESTED PRACTICALS/ EXERCISES

The practicals in this section are PrOs (i.e. sub-components of the COs) to be developed and assessed in the student for the attainment of the competency**:**

Pr. No.	**Practical Exercises** (Learning Outcomes in Psychomotor Domain)	Relevant CO	Approx. Hrs. required
1	Study of general safety precautions, IE Rules and Various tools required for electrical wiring and electrical work.	1	4
2	Study of electrical safety devices such as Hand-gloves, gumboot, insulating mats, line tester, arms panel, life safety materials with their specifications and testing as per IS code of practice	1	2
3	Sample collection of different electrical wires along with their specifications. **1**.Lead alloy sheathed wires **2.**TRS and CTS wires **3.**Weatherproof wires **4.**PVC wires **5**Flexible wires	2	4
4	Study of LT cables : Different types and their laying	2	2
5	Fabrication of switch board with one socket, one fan regulator and four switches along with indicator and fuse.	2	2
6	Demonstration on Methods of wiring. **1**.Cleat wiring **2.**Casing-cappingwiring **3**.TRS wiring **4**.Metal conduit and PVC conduit wiring **5.**Concealed wiring.	2	4
7	Comparison of various wiring systems.	2	2
8	Staircase wiring & Godown wiring.	2	4
9	Study of electric lamps: **1.**Incandescent lamp **2.**CFLlamp **3.** LED lamp **4.**Fluorescent tube light. **5.** Sodium vapour lamp **6**. Mercury vapour lamp.	3	4
10	Study of Home appliances such as automatic electric iron, immersion water heater, Geyser, food processor (mixer) with their specifications	4	4
11	Microproject planning & Execution as written in suggested microproject list		02
12	Microproject report writing		02
13	Suggested student activity report		02
	Total		38

Sr. No.	Performance Indicators	Weightage in %
a.	Arrangement of available equipment or model for testing	20
b.	Setting and operation	15
c.	Safety measures	20
d.	Observations and Recording	15
e.	Interpretation of result and Conclusion	15
f.	Submission of report in time	15
Total		**100**

6. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

The major equipment with broad specification mentioned here will usher in uniformity in conduct of practicals, as well as aid to procure equipment by authorities concerned**.**

Sr. No.	Equipment Name with Broad Specifications	Pr. No.
1	Electric iron	1,2,4
2	Immersion water heater	1,2,4
3	Food processor(mixer)	1,2,4
4	Geyser,	1,2,4
5	Sodium vapour lamp	1,2,3,4
6	Mercury vapour lamp	1,2,3,4
7	Fluorescent Tube Fixture	1,2,3,4

7. THEORY COMPONENTS : NIL

8. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN : NA

9. SUGGESTED STUDENT ACTIVITIES

Other than the laboratory learning, following are the suggested student-related ***co-curricular*** activities which can be undertaken to accelerate the attainment of the various outcomes in this course: Students should conduct following activities in group and prepare reports of about 5 pages for each activity, also collect/record physical evidences for their (student's) portfolio which will be useful for their placement interviews:

a) To Carry out Market Survey for technical specification, commercial name, cost & purpose of following different types wiring accessories:

1. Switches. **2**. Lamp holders. **3.** Ceiling roses 4. Mounting blocks
5. Socket outlets. **6.** Plugs. **7**. Wooden/ ply / modular boards
8. Main switches (**ICDP and ICTP**) **9.** Junction box of different sizes & MCB
10.Distribution fuse boards, **11**.Bus-bar for lighting & small power circuits.

b)Collect the samples following cables & wires and determine the specifications of each of them. Also state their use.

- Single core cable & multi core cable.
- Standard wires :-single strand wire, multi strand wire, shielded wire.
- Weather proof cables & Flexible wires.

c)To study circuit diagram of different electrical appliances.

10. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are sample strategies, which the teacher can use to accelerate the attainment of the various outcomes in this course:

a. Massive open online courses (***MOOCs***) may be used to teach various topics/sub topics.
b. About ***15-20% of the topics/sub-topics*** which is relatively simpler or descriptive in nature is to be given to the students for ***self-directed learning*** and assess the development of the COs through class room presentations (see implementation guideline for details).
c. Correlate subtopics with power plant system and equipments.
d. Use proper equivalent analogy to explain different concepts.
e. Use Flash/Animations to explain various components, operation.
f. Teacher should ask the students to go through instruction and Technical manuals

11. SUGGESTED MICRO-PROJECTS

Only one micro-project is planned to be undertaken by a student that needs to be assigned to him/her. In the first four semesters, the micro-projects are group-based. However, in the fifth and sixth semesters, it should be preferably be individually undertaken to build up the skill and confidence in every student to become problem solver so that s/he contributes to the projects of the industry. In special situations where groups have to be formed for micro-projects, the number of students in the group should not exceed three.

The micro-project could be industry application based, internet-based, workshop-based, laboratory-based or field-based. Each micro-project should encompass two or more COs which are in fact, an integration of PrOs, UOs and ADOs. Each student will have to maintain dated work diary consisting of individual contribution in the project work and give a seminar presentation of it before submission. The total duration of the micro-project should not be less than 16 (sixteen) student engagement hours during the course. The student ought to submit micro-project by the end of the semester to develop the industry oriented COs.

a) About 15-20% of the topics/sub-topics which is relatively simpler or descriptive in nature is to be given to the students for self directed learning and asses the development of the CO's through classroom presentations (see implementation guide for details)
b) Draw labeled lighting circuit diagram, list the accessories used with their specifications and complete wiring work of following simple electrical circuits on test board with appropriate testing under guidance of supervisor/teacher.
c) Circuit consist of suitable MCB, one lamp holder, one indicator, one 5A five pin socket and two 5A single pole switches.

12. SUGGESTED LEARNING RESOURCES

Sr. No.	Title of Book	Author	Publication	ISBN No.
1	Basic Electrical Engineering Volume-I	P.S. Dhohal	Tata mcgraw Hill publishing House	ISBN-0074515861
2	Electrical Workshop	R.P. Singh	I.K. International Publishing House Pvt.	ISBN-9789381141205
3	Electrical Materials & Wiring Practice	Sushant M. Nagare	Gigatech Publishing House	ISBN-8193808118
4	Electrical Practical Book	Ashish Kumar	Arihant Publications	ISBN-9789324198761
5	Basic Electrical Engineering	M.L. Anwani	Dhanpat Rai & Sons	ISBN-978-8177000191
6	Electrical Appliances	Grabam Dixon	Haynes Publications	ISBN-1859608000

13. SOFTWARE/LEARNING WEBSITES

_1_Electrical_Workshop_Practicals

14. PO - COMPETENCY- CO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	-	2	-	3	3	3
CO2	2	1	3	2	2	2	2
CO3	2	2	3	2	-	-	1
CO4	-	3	3	3	1	2	1

	PSO1	PSO2	PSO3	PSO4
CO1	2	2	1	3
CO2	3	-	1	2
CO3	1	1	-	3
CO4	3	3	1	1

Sign: Name: **1**. J.G. Momin **2**. Mrs. S.P.Phadnaik (Course Experts)	Sign: Name: Dr.S. S. Bharatkar/Shri.R. U. Shelke (Head of Department)
Sign: Name: Dr.S. S. Bharatkar/Shri.R. U. Shelke (Program Head) (Department of Electrical Engineering)	Sign: Name: Shri A.S.Zanpure (I/c CDC)

Government Polytechnic, Pune

'180OB' – Scheme

Programme	**Diploma in** ET/CE/**EE**//ME/MT/CM/IT/DDGM
Programme code	01/**02**/03/04/05/06/07/08/15/**16**/17/18/19/21/**22**/23/24/26
Name of Course	**Computational Laboratory**
Course Code	**EE2105**
Prerequisite course code and name	No
Class Declaration	No

1. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P)		Examination Scheme				
					Theory		Practical		Total Marks
L	T	P	C		ESE	PA	$ ESE	PA	
01	00	02	03	Marks			25	25	50
				Exam Duration	-	-	-		

Legends: L- lecture, T-Tutorial/teacher guided theory practice, P-practical, C-Credits, ESE-End semester examination, PA- Progressive Assessments(Test I, II/Term Work), * - Practical Exam, $ - Oral Exam. # - Online Exam., Each lecture/practical period is of one clock hour.

2. RATIONALE

For any engineering, computer software skills are mandatory. Computer has become important part of any learning process. Therefore, it is necessary for any engineering student to have basic idea about computer languages. 'C' is most widely used general purpose powerful, efficient and compact language. This subject covers C as a basic logic development language. SCILAB is said to be the language of engineers. It is widely used in mathematics, science and engineering. The SCILAB is used in this subject to solve common mathematical problems and to write simple program for analysis of electrical circuits and to plot simple response graph.

3. COMPETENCY

The aim of this course is to attend following industry identified competency through various teaching learning experiences:

- **Using C Programming and SCILAB Software to analysis the electrical circuit and build the mathematical model of electrical system**.

4. COURSE OUTCOMES (COs)

The practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry oriented COs associated with the above mentioned competency**:**

1:- Know the basic concepts of C progra0mming.
2:- Write C programs and execute.
3:- Debug different types of errors.
4:- Know the main features and importance of programming environment of the SCILAB.
5:- Draw plots and subplots of electrical different waveforms and response using SCILAB
6:- Apply working knowledge of SCI LAB simulink package to simulate and \ solve Electrical Circuits.

5. SUGGESTED PRACTICALS/ EXERCISES

The practicals in this section are PrOs (i.e. sub-components of the COs) to be developed and assessed in the student for the attainment of the competency**:**

<table>
<tr><th>Pr. No .</th><th>Unit No.</th><th>Practical Exercises
(Outcomes in Psychomotor Domain)</th><th>Relevant CO</th><th>Approximate Hours Required.</th></tr>
<tr><td>1</td><td>1</td><td>Write a Program to print the text “Welcome to C programming”</td><td>1 & 2</td><td rowspan="2">02</td></tr>
<tr><td>2</td><td>1</td><td>Write a program to find the area and circumference of a circle.</td><td>1 & 2</td></tr>
<tr><td>3</td><td>1 & 2</td><td>Write a program to calculate the instantaneous value of an AC quantity like v=V_m sinωt</td><td>1 & 2</td><td>02</td></tr>
<tr><td>4</td><td>1 & 2</td><td>Write a program to display the electrical units in the following format:<table><tr><td>Electrical quantity</td><td>Unit</td></tr><tr><td>Resistance</td><td>Ohm</td></tr><tr><td>Current</td><td>Ampere</td></tr><tr><td>Voltage</td><td>Volt</td></tr><tr><td>Power</td><td>Watt</td></tr></table></td><td>1,2 & 3</td><td>02</td></tr>
<tr><td>5</td><td>2 & 3</td><td>Write a program to find equivalent resistance when resistors are connected in series, equivalent capacitance when capacitors are connected in parallel.</td><td>1,2 & 3</td><td rowspan="2">02</td></tr>
<tr><td>6</td><td>2 & 3</td><td>Write a program to find impedance in series RLC circuit.</td><td>1,2 & 3</td></tr>
<tr><td>7</td><td>2 & 3</td><td>Write a program to generate the electricity bill according to the units consumed for lighting installation as per present tariff.</td><td>1,2 & 3</td><td>02</td></tr>
<tr><td>8</td><td>2 & 3</td><td>Write a program using switch – case to calculate</td><td>1,2 & 3</td><td>02</td></tr>
</table>

		i. Power dissipated in resistance ii. Energy stored in capacitor iii. Energy stored in inductor		
9	2 & 3	A. Using for loop find the current through a resistor, for voltage varying from 5V to 20V in steps of 5V, using Ohm's Law..	1,2 & 3	02
10	2 & 3	B. Using while loop find the current through a resistor, for voltage varying from 50V to 100V in steps of 10V, using Ohm's Law	1,2 & 3	
11	2 & 3	C. Using do….While loop find the current through a resistor, for voltage varying from 16V to 8V in steps of 4V, using Ohm's Law.	1,2 & 3	
12	2 & 3	Write a program to input 10 numbers to an array and display the greatest number.	1,2 & 3	02
13	4	Understand general, Directory, Workspace, Termination, Help commands in SCILAB, Such as General Commands, clock, date, ver Directory commands, wd,cd,dir,ls,path,mkdir Workspace commands , who, whos, clearall, clc, clf Termination commands. Ctrl C, quit, exit Help Commands , help, help topic, demo	4	02
14	5	Use SCILAB to enter a data in matrix and practice the functions such as sum, mean, length, max and min.	4	02
15	5	Understand special matrix functions such as zeros, eye, ones, det, inv and find in SCILAB.	4	02
16	5	Write commands to create two matrices of 3 * 3 size and perform addition, subtraction, multiplication, right division, left division using SCILAB.	4	02
17	6	Write a program in SCILAB to plot a curve given by equation y = sin(x), y=cos(x), y=x^2 (Use hold command)	5	02
18	6	Write a program in SCILAB to illustrate the use of subplot command.	5	02
19	7	Create a Simulink model to verify Ohm's Law in SCILAB	6	02
20	7	Create a Simulink model to analyze the performance of R L, RC, and RLC circuits	6	
21	1 to 7	Microproject planning, Execution & Report Writing as suggested in microproject list	1 to 6	02

		Total Hrs		**34**

S.No.	Performance Indicators	Weightage in %
1	Handle computer peripherals	05
2	Understand the concept of the program or command	10
3	Write syntactically correct program or command	20
4	Execute the programs or command	20
5	Debug and edit programs or commands	20
6	Interpret program output	10
7	Submission of report in time	15
	Total	**100**

6. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

The major equipment with broad specification mentioned here will user in uniformity in conduct of practical, as well as aid to procure equipment by authorities concerned**.**

Sr. No.	Major Equipment/ Instruments Required	Pr. No.
1	PC , 8GB RAM, 80 GB HDD, i5 Processor	1 to 20
2	C- Programming Software	1 to 12
3	SCILAB Software	13 to 20

7. THEORY COMPONENTS

The following topics/subtopic should be taught and assessed in order to develop UOs for achieving the COs to attain the identified competency**.**

Unit Outcomes (UOs) (in cognitive domain)	**Topics and Sub-topics**
UNIT 1. Basics of C	**(Hrs. - 3)**
1a. Learn the basic concepts of C programming. 1b. Distinguish different programming approaches.	1.1 History of C. 1.2 Steps involved in problem solving using Algorithms and Flowcharts. 1.3 Basic structure of C program, Steps to be followed for– Creation, Compilation and Execution of a C program, use of simple scanf( ) and printf( ) functions. 1.4 C Character set, keywords and identifiers, constants, variables, data types. 1.5 Operators and expressions, Library functions. (Arithmetic, Relational, Logical). 1.6 Managing input-output operations – using functions like getchar( ) – reading a character, putchar( ) –writing a character, scanf( ) – formatted input and printf( ) – formatted output

Unit Outcomes (UOs) (in cognitive domain)	**Topics and Sub-topics**
Unit 2 Decision Making	**(Hrs. - 2)**
2a. Distinguish different programming approaches. 2b.Write C programs and execute. 2c. Debug different types of errors.	2.1 Decision making & branching using If, If-Else, multi branch If, nested If statement, switch -case statement. 2.2 Decision making using loop statements like while, do-while, for.
UNIT 3 Arrays	**(** Hrs. - 2)
3a. Distinguish different programming approaches. 3b.Write C programs and execute. 3c.Debug different types of errors.	3.1Declaring one dimensional array. 3.2 Simple programs on arrays such as largest of array, sorting array. 3.3 Strings – initializing string, manipulating strings of charaters.
UNIT 4 SCILAB Environment	**(Hrs. - 2)**
4a. Learn the basic concepts of SCILAB/MATLAB.	4.1 Command window, Command history, Workspace, Edit window, Help window 4.2 SCILAB/MATLAB Basic: common operators, common functions, special constants, command line, data structures, string, saving and loading variables. 4.3. Commands, general, directory, workshop, termination
UNIT 5 Matrices in SCILAB	**(Hrs. - 2)**
5a. Distinguish different programming approaches. 5b Write programs and execute it. 5c Debug different types of errors.	5.1 Entering data in Matrices, calculating sum, mean, length, max and min. Matrix Subscripts, Colon operator. 5.2 Useful commands related to Matrices such as det, rank, trace, inv, norm, transpose, zeros, ones, eye, arithmetic operations on matrices and arrays. 5.3 Solving Linear system
Unit 6 Programming & Graphics in SCILAB	**(Hrs.- 2)**
6a Distinguish different programming approaches. 6b Write programs and execute it. 6c Debug different types of errors. 6d Distinguish different plotting approaches 6f Program based on plot and subplot command	6.1 Editor: Creating Function file and subprograms 6.2 PLOTS : printing labels, grid and axes box, entering text in a plot , axis control 6.3 Subplot, Multiple plots :using plot , hold ,line commands, Specialized 2 D plots using Polar, area, bar, pie, stem function
Unit 7 Fundamentals of Simulink in SCILAB using XCOS	**(Hrs. - 2)**
7a. Program to create simulink model by using XCOS.	7.1 Collecting blocks to create a model. 7.2 Modifying block parameters, labeling blocks. 7.3 Simulink the model.

8. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

NA

9. SUGGESTED STUDENT ACTIVITIES

Other than the classroom and laboratory learning, following are the suggested student-related ***co-curricular*** activities which can be undertaken to accelerate the attainment of the various outcomes in this course: Students should conduct following activities in group and prepare reports of about 5 pages for each activity, also collect/record physical evidences for their (student's) portfolio which will be useful for their placement interviews:

a. Prepare journals based on practical performed in laboratory.
b. Apply C programming language in general life
c. Apply SCILAB for the application of numerical and analysis of electrical circuits
d. Plot different responses of electrical components and circuits
e. Do simulation of electrical circuits.

10. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are sample strategies, which the teacher can use to accelerate the attainment of the various outcomes in this course:

a. Massive open online courses (***MOOCs***) may be used to teach various topics/sub topics.
b. About ***15-20% of the topics/sub-topics*** which is relatively simpler or descriptive in nature is to be given to the students for ***self-directed learning*** and assess the development of the COs through practically implementation.
c. With respect to item No.9, teachers need to ensure to create opportunities and provisions for ***co-curricular activities***.
d. Guide student(s) in undertaking micro-projects.
e. Teacher should ask the students to go through instruction and Technical manuals

11. SUGGESTED MICRO-PROJECTS

Only one micro-project is planned to be undertaken by a student that needs to be assigned to him/her in the beginning of the semester. The micro project should be preferably being individually undertaken to build up the skill and confidence in every student to become problem solver so that she/he contributes to the projects of the industry. In special situations where groups have to be formed for micro projects, the number of students in the group should not exceed three.

The micro-project could be application based, internet-based, and field based. Each micro-project should encompass two or more COs. Each student will have to maintain dated work diary consisting of individual contribution in the project work and give a seminar presentation of it before submission. The student ought to submit micro-project report by the end of the semester.

A suggestive list of micro-projects is given here. Similar micro-projects could be added by the concerned faculty:

a) Write any C Program on any electrical application.

b) Write any code in SCILAB the application of numerical and analysis of electrical circuits.
c) Plot different types of responses of electrical circuits.
d) Using XCOS simulate the electrical circuits.

12. SUGGESTED LEARNING RESOURCES

S.N.	Title	Author, Publisher, Edition and Year of publication	ISBN Number
1	The C Programming Language	Brian W. Kernighan, Dennis M. Ritchie, 2nd Edition, Prentice Hall of India	ISBN-81-203-0596-5
2	Let Us C	Yashavant P. Kanetkar , Twelfth edition , BPB Publications,	ISBN- 978-81-8333-163-0
3	Programming in Ansi C	E. Balagurusamy , Seventh Edition , Mc. Graw Hill Education	ISBN -978-93-392-1966-6 ISBN-93-392-1966-x
4	The spirit of C , An Introduction to Modern Programming	Henry Mullish, Herbert L. Cooper , Fifth Edition, Jaico Publishing House	ISBN- 81-7224-040-6
5	Scilab (A Free Software to Matlab)	Er Hema Ramachandran , Dr Achutsankar S. Nair, S. Chand & Co. Ltd.	ISBN: 9788121939706, 9788121939706
6	Introduction to Scilab: For Engineers and Scientists	Sandeep Nagar, Apress; 1st ed. edition (11 November 2017)	ASIN: B077GCH7KH

13. SOFTWARE/LEARNING WEBSITE

1. www.scilab.org
2. http://in.mathworks.com
3. https://www.scilab.org/resources/documentation/tutorials
4. http://fresh2refresh.com/cprogramming
5. http://www.learn-c.org
6. http://www.learnconline.com
7. www.nptel.com

14. PO - COMPETENCY- CO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	1	2	2	-	-	1	2
CO2	3	3	2	-	2	2	2
CO3	-	3	2	-	-	1	1
CO4	3	3	2	-	2	2	2
CO5	1	2	-	-	-	-	1
CO6	2	1	-	1	-	-	-

	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	-	1	-	-	-
CO2	1	2	-	-	-
CO3	1	-	-	-	-
CO4	1	-	-	-	-
CO5	1	-	-	-	-
CO6	-	2	-	-	-

Sign: Name: Dr. V. K. Jadhav	Sign: Name: Dr.S.S.Bharatkar/Shri.R.U. Shelke (Head of Department)
Sign: Name: Dr.S. S. Bharatkar/Shri.R. U. Shelke (Program Head) (Department of Electrical Engineering)	Sign: Name: Shri A. S. Zanpure (CDC Incharge)

GOVERNMENT POLYTECHNIC, PUNE

'180OB' – SCHEME

Programme	Diploma in Electrical Engineering
Programme code	01/**02**/03/04/05/06/07/08/15/**16**/17/18/19/21/**22**/23/24/26
Name of Course	**Electronic Components and Circuits**
Course Code	**ET2108**
Prerequisite	No
Class Declaration	No

1. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P)		Examination Scheme				
					Theory		Practical		Total Marks
L	T	P	C		ESE	PA	$ESE	PA	100
02	-	02	04	Marks	40	10	25	25	
				Exam Duration	2 Hrs	1 Hr	-	-	

Legends: L- lecture, T-Tutorial/teacher guided theory practice, P-practical, C-Credits, ESE-End semester examination, PA- Progressive Assessments(Test I, II/Term Work), * - Practical Exam, $ - Oral Exam. # - Online Exam., Each lecture/practical period is of one clock hour.

2. RATIONALE

Diploma engineers have to deal with the various electronic components while maintaining various electrical systems. The basic operating principles of various electronics devices will help them to troubleshoot electronics equipments used in electrical system. This course is developed in such a way that, students will be able to recognize broad electronic engineering application in electrical engineering field.

3. COMPETENCY

The aim of this course is to attend following industry identified competency through various teaching learning experiences:

- **Use electronic components and circuits in electrical equipments.**

4. COURSE OUTCOMES (COs)

The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry oriented COs associated with the above mentioned competency**:**

1. Use relevant diode in different electronic circuits.
2. Utilization of diode in rectifiers and filters.
3. Use BJT in electronics circuits
4. Build the DC regulated power supply using Zener diode & transistor.

5. SUGGESTED PRACTICALS/ EXERCISES

S. No.	Unit No.	Practical Exercises (Learning Outcomes in Psychomotor Domain)	Relevant CO	Approx. Hrs. required
1	1	Test the performance of PN junction diode	1	2
2	1	Test the performance of Zener diode	1	2
3	1	Test the performance of photo diode by varying the light intensity as well as the distance of the light source.	1	2
4	2	Build/ Test the half wave rectifier on bread board with and without filter	2	2
5	2	Build/ Test the full bridge rectifier using IC DF10 or any other suitable IC.	2	4
6	2	Use π filter with bridge rectifier to measure ripple factor	2	4
7	3	Test the performance of BJT working in CE mode	3	2
8	3	Test the performance of BJT working in CB mode	3	2
9	4	Test the performance of transistorized series voltage regulator for the given load regulation.	4	2
10	4	Build and Test regulated dc power supply using Zener diode.	4	2
11	4	Observe the regulation parameters such as line and load of voltage regulator IC78XX/79XX	4	2
12	4	Find out faults at different stages of regulated dc power supply.	4	2
13	All	Complete a Micro- project based on guidelines provided in sr.no. 11.	All	4
		Total Hrs		32

Note: All practicals are compulsory.

S.No.	Performance Indicators	Weightage in %
a.	Arrangement of available equipment / test rig or model	20
b.	Setting and operation	20
c.	Safety measures	10
d.	Observations and Recording	10
e.	Interpretation of result and Conclusion	20
f.	Answer to sample questions	10
g.	Submission of report in time	10
Total		**100**

6. MAJOR EQUIPMENT/ INSTRUMENTSREQUIRED

The major equipment with broad specification mentioned here will used in uniformity in conduct of practicals, as well as aid to procure equipment by authorities concerned**.**

S. No.	Equipment Name with Broad Specifications	Experiment Sr.No.
1	Variable DC power supply 0-30V, 2A, SC protection, display for voltage and current	1,2,3,7,6,10,11,12
2	CRO Dual Trace 20MHz, 1MegaOhm, Input Impedance	4,5,6
3	Function Generator 0-2MHz with sine ,square and triangular output with	4,5,6

S. No.	Equipment Name with Broad Specifications	Experiment Sr.No.
	variable frequency and amplitude	
4	Digital Multimeter: 3 ½ digit display, 9999 counts digital multimeter. Measure Vac , Vdc ,Aac,Adc	All
5	Different types of cables and connectors	All

7. THEORY COMPONENTS

Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
UNIT 1. Semiconductor Diode(Weightage-08 , Hrs- 06)	
1a .Describe the construction & working of principle of semiconductor diode 1b. Differentiate between conductor, Insulator, semiconductor 1c. Describe working principle, characteristics, and application of the given type of diode 1d. Describe effect of temperature on the given type of diode	1.1Difference between conductor, insulator, semiconductor 1.2 N type material, P type material 1.3 Different types of Semiconductor 1.4 Construction, Symbol, working principle , applications, Forward & reverse biasing & V-I characteristics of following diodes P-N junction diode & Zener diode, 1.5 Special diodes : LED, Photo diode, LASER diode, power diode
UNIT II. Rectifier and Filter(Weightage-10 , Hrs- 08)	
2a. Describe working of given Type of rectifier 2b.Calculate ripple factor, PIV, and efficiency of the given type of filter. 2c. Describe the need and working of rectifier filter 2d. Select clipper or clamper for obtaining the given waveform.	2.1 Types of Rectifier : Half wave, Full Wave, Bridge rectifier circuit and operation, Input-output waveform for voltage & current. 2.2 Parameters of rectifier: Average DC value, value of current & voltage, ripple factor, ripple frequency, PIVof diode, TUF. Efficiency of Rectifier 2.3 Types of Filters: Shunt capacitor, Series inductor, LC and CLC filter
UNIT III. Bipolar Junction Transistor(Weightage-14 , Hrs- 12)	
3a.Describe the working principle of the given type of transistor 3b.Compare configuration of transistors. 3c. Justify the need of biasing method. 3d. Describe the procedure to minimize the thermal runaway effect for the given type of transistor biasing circuit.	3.1 Different types of transistors construction and working : PNP, NPN transistor 3.2 Transistor configurations: CB, CE, CC Transistor characteristics (input, output,) in different transistor configuration 3.3 Transistor as a switch 3.4 Concept of power transistor
UNIT IV. Regulator and Power Supply(Weightage-08 , Hrs- 06)	
4a. Describe working of the given transistorized regulator 4b. Describe the working of the given block of the DC regulated power supply in the block diagram.	4.1 Basic block diagram of DC regulated power supply 4.2 Load and Line regulation 4.3 Zener diode voltage regulator 4.4 Transistorized series and shunt

Unit Outcomes (UOs) (in cognitive domain)	**Topics and Sub-topics**
4c.Calculate output voltage of the given Zener voltage regulator circuit. 4d. Calculate load and line regulation of the given transistorized regulator.	regulator - circuit diagram and working

8. SUGGESTED SPECIFICATION TABLE FORQUESTION PAPER DESIGN

Unit No.	**Unit Title**	**Teaching Hours**	**Distribution of Theory Marks**			
			R Level	**U Level**	**A Level**	**Total Marks**
I	Semiconductor Devices	06	2	4	2	08
II	Rectifier and Filter	08	2	4	4	10
III	Bipolar Junction Transistor	12	4	6	4	14
IV	Regulator and Power Supply	06	2	2	4	08
Total		**32**	**10**	**16**	**14**	**40**

9. SUGGESTED STUDENT ACTIVITIES

Other than the classroom and laboratory learning, following are the suggested student-related ***co-curricular*** activities which can be undertaken to accelerate the attainment of the various outcomes in this course: Students should conduct following activities in group and prepare reports of about 5 pages for each activity, also collect/record physical evidences for their (student's) portfolio which will be useful for their placement interviews:

a. Prepare Journals based on Practical performed in laboratory.
b. Test different diodes using CRO.
c. Give seminar on any relevant topic.
d. Library survey regarding different data books and manuals.
e. Undertake a market survey of different semiconductor components.
f. Trace various electronics components in electrical equipment.

10. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are sample strategies, which the teacher can use to accelerate the attainment of the various outcomes in this course:

a. Massive open online courses (***MOOCs***) may be used to teach various topics/sub topics.
b. About ***15-20% of the topics/sub-topics*** which is relatively simpler or descriptive in nature is to be given to the students for ***self-directed learning*** and assess the development of the COs through classroom presentations (see implementation guideline for details).
c. With respect to item No.9, teachers need to ensure to create opportunities and provisions for ***co-curricular activities***.
d. Guide student(s) in undertaking micro-projects.
e. Correlate subtopics with power plant system and equipments.
f. Use proper equivalent analogy to explain different concepts.
g. Use Flash/Animations to explain various components, operation and
h. Teacher should ask the students to go through instruction and Technical manuals

11. SUGGESTED MICRO-PROJECTS

Only one micro-project is planned to be undertaken by a student that needs to be assigned to him/her. In special situations where groups have to be formed for micro-projects, the number of students in the group should ***not exceed three.***

The micro-project could be industry application based, internet-based, workshop-based, laboratory-based or field-based. Each micro-project should encompass two or more COs which are in fact, an integration of PrOs, UOs and ADOs.(Affective Domain Outcomes) .Each student will have to maintain activity chart consisting of individual contribution in the project work and give a seminar presentation of it before submission.. The student ought to submit micro-project by the end of the semester to develop the industry oriented COs.

A suggestive list of micro-projects is given here. Similar micro-projects could be added by the concerned faculty:

a. Build a circuit to clip a positive half cycle at 1.5v of a waveform with input signal 5Vpp. And prepare the report.
b. Build a circuit to clamp a waveform at 3.0V using photo diaode and passive component.
c. Build a circuit to turn the relay on and off by using photo diode.
d. Build a circuit for half wave rectifier with capacitor filter.
e. Build a circuit for full wave rectifier with capacitor filter.
f. Build a circuit of DC regulated power supply.
g. Build a circuit of simple water level controller.
h. Build a rain alarm circuit.
i. Build a circuit for inverter using transistors.
j. Build a simple LED flash light circuit.

12. SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publisher, Edition ,Year of publication and ISBN Number
1	Applied Electronics	R.S.Sedha	S.Chand Publishing, 2008 ISBN -8121927838
2	Electronic Devices and Circuit Theory	Robert L. Boylestad, LouisNashelsky	Pearson Education ISBN – 978-0-13-262226-4
3	Principle of Electronics	V.K.Mehta	S.Chand Publishing ISBN -9789352838363
4	Basic Electronic Engineering	Sunil T. Gaikwad Vijay Baru, R. Kaduskar,	Dreamtech Press ISBN 978-9350040126

13. SOFTWARE/LEARNING WEBSITES

1. www.nptel.iitm.ac.in
2. www.khanacademy.com
3. www.williamson-labs.com
4. www.datasheetcafe.com

14.PO - COMPETENCY- CO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	2	--	--	2	--	1	--
CO2	--	2	3	2	2	1	2
CO3	2	--	2	2	--	1	--
CO4	--	3	3	2	3	3	2

	PSO1	PSO2	PSO3	PSO4
CO1	--	1	--	1
CO2	1	1	2	2
CO3	--	1	--	1
CO4	1	1	2	2

Sign: Name: Dr.V.K. Jadhav Smt. P.G.Gahukar Smt.V.S.Sabnis (Course Experts)	Sign: Name: Shri.R.N.Shikari (Head of Department)
Sign: Name: Dr. S. S. Bharatkar/Shri. R. U. Shelke (Program Head) (Department of Electrical Engineering)	Sign: Name : Mr.A.S.Zanpure (CDC Incharge)

Government Polytechnic, Pune

'180 OB' – Scheme

Programme	Diploma in CE/**EE**/**ET**/ ME/MT/CM/IT/DDGM
Programme code	01/**02**/**03**/04/05/06/07/08/15/**16**/**17**/18/19/21/**22**/**23**/24/26
Name of Course	**Engineering Graphics**
Course Code	**ME2104**
Prerequisite course code and name	No
Class declaration Course	No

1. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P)		Examination Scheme				
					Theory		Practical		Total Marks
L	T	P	C		ESE	PA	ESE	PA	
02	00	02	04	Marks	00	00	00	50	50
				Exam Duration	--	--	--	--	

Legends: L- Lecture, P- Practical, T- Tutorial, C- Credits, ESE-End Semester Examination, PA- Progressive Assessment (Test I, II/Term Work), *- Practical Exam, $- Oral Exam, #- Online Examination Each Lecture/Practical period is of one clock hour

2. RATIONALE:

Engineering drawing is the graphical language. It is used by engineers, designers, planners, supervisors and also the workers to express their thoughts, ideas and concepts. The expression by drawing is very accurate precise and brief. At a glance one can understand detailed description of any part to be manufactured or a dam to be built or an electric circuit to be used. For all technicians through understanding of principles of engineering drawing (Graphic Skills) is essential.

3. COMPETENCY

The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:
Interpret understand and prepare orthographic and isometric drawing of given component and prepare sectional mechanical working drawing /production drawing of given component and also draw projections of lines planes solids and free hand sketches

4. COURSE OUTCOMES (COs)

The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry oriented COs**:**

After studying this course, the student will be able to

1. Draw geometrical figures and Engineering Curves
2. Draw views of given object using principles of orthographic projections
3. Draw isometric view of a given object from orthographic projections
4. Draw free hand sketches of given engineering elements

5. SUGGESTED PRACTICALS/ EXERCISES

Sr. No.	**Unit No.**	**Sheet No.**	**Practical Exercises** (Learning Outcomes in Psychomotor Domain)	**Relevant CO**	**Approx. Hrs. required**
1	01	--	Draw horizontal, vertical, 30 degree, 45 degree, 60 and 75 degrees lines, different types of lines, dimensioning styles using Set squares/ drafter. (do this exercise in sketch book)	--	01
2	01	1	Line letters and numbers. Dimensioning technique. One problem on Redraw the figure (Sheet No.1).	--	02
3	02	2	Engineering curves --Three problems (Sheet No.2)	1	05
4	03	3	Draw a problem on orthographic projections using first angle method of projection having slanting surfaces, cylindrical surfaces, ribs.(Sheet No-3-Problem-1)	2	03
5	03	3	Draw a problem on orthographic projections using Third angle method of projection having slanting surfaces, cylindrical surfaces, ribs.(Sheet No-3-Problem-2)	2	03
6	04	4	Draw a problem on sectional orthographic projections using first angle method of projection having slanting surfaces, cylindrical surfaces, ribs.(Sheet No-4-Problem-1)	2	02
7	04	4	Draw a problem on sectional orthographic projections using Third angle method of projection having slanting surfaces, cylindrical surfaces, ribs.(Sheet No-4-Problem-2)	2	02
8	05	5	Draw one problems on Isometric view of simple objects having plain and slanting and cylindrical surfaces by using natural scale.(Sheet No.5-Problem-1)	3	04
9	05	5	Draw one problems on Isometric projection of simple objects having plain and slanting and cylindrical surfaces by using isometric scale. (Sheet No.5-Problem-2)	3	03

10	06	6	Draw neat and proportionate free hand sketches. Any six elements (Sheet No.6)	4	03
11	All	--	Complete a micro project based on guidelines provided in Sr. no. 11	1 to 4	04
			Total		**32**

Sr. No.	Performance Indicators	Weightage in %
1	Neatness, Cleanliness on drawing sheet	10
2	Uniformity in drawing and line work	10
3	Creating given drawing	40
4	Dimensioning the given drawing and writing text	20
5	Answer to sample questions	10
6	Submission of drawing in time	10
Total		**100**

6. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

The major equipment with broad specification mentioned here will usher in uniformity in conduct of practicals, as well as aid to procure equipment by authorities concerned**.**

Sr. No.	Major Equipment/ Instruments Required	Experiment Sr. No.
1	Drawing Table with Drawing Board of Full Imperial/ A1 size.	All
2	Models of objects for orthographic / isometric projections	3,4,5,6
3	Models/ Charts of objects mentioned in unit no. 7	-
4	Set of various industrial drawings being used by industries.	All
5	Drawing equipment's and instruments for class room teaching-large size: a. T-square or drafter (Drafting Machine) b. Set squares (45^0 and 30^0- 60^0) c. Protractor d. Drawing instrument box (containing set of compasses and dividers)	All
6	Interactive board with LCD overhead projector	All

7. THEORY COMPONENTS

Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
Unit I: Introduction of Drawing Instruments, Lines, Letters etc. (04 Hrs, 00 Marks)	
1a. Prepare drawing using drawing instruments. **1b.** Use IS SP-46 for dimensioning. **1c.** Use different types of lines. **1d.** Draw regular geometrical figures. **1e.** Draw figures having tangency	**1.1** Drawing Instruments and supporting material: method to use them with applications. **1.2** Standard sizes of drawing sheets (ISO-A series). I.S. codes for planning and layout.

Unit Outcomes (UOs) (in cognitive domain)	**Topics and Sub-topics**
constructions.	Letters and numbers (single stroke vertical) **1.3** Conventions of lines and their applications. Scale - reduced, enlarged and full size **1.4** Dimensioning techniques as per SP-46(Latest edition) – types and applications of chain, parallel and coordinate dimensioning.
UNIT II: Engineering Curve and Tangential Exercises (06 Hrs, 00 Marks)	
2a. Explain different engineering curves with areas of application. **2b.** Draw different conic sections based on given situation.	**2.1** Concept of focus, directrix, vertex and eccentricity. Conic sections. **2.2** To draw an ellipse by concentric circle method and Directrix focus method. **2.3** To draw a parabola by :- 1) Directrix focus method. **2.4** To draw a hyperbola by :- 1) Directrix focus method.
UNIT III: Orthographic Projections (06 Hrs, 00 Marks)	
3a. Explain methods of Orthographic Projections. **3b.** Draw orthographic views of given simple 2D entities containing lines, circles and arcs only. **3c.** Draw the orthographic views from given pictorial views.	**3.1** Projections-orthographic, perspective, isometric and oblique: concept and applications.(No question to be asked in examination). **3.2** Orthographic projection, First angle and Third angle method, their symbols. **3.3** Conversion of pictorial view into Orthographic Views – object containing plain surfaces, slanting surfaces, slots, ribs, cylindrical surfaces. (use First Angle and Third Angle Projection Method.)
Unit IV: Sectional orthographic views (04 Hrs, 00 Marks)	
4a. Classify various types of sectional views. **4b.** Explain sectioning and hatching conventions. **4c.** Convert pictorial views of given object into sectional orthographic views. **4d.** Interpret the given Drawing	**4.1** Cutting plane line **4.2** Types of sectional views: Full section, Half section, Partial or broken section, Revolved section, Removed section, offset section, Aligned section. **4.3** Sectioning conventions **4.4** Hatching or section lines **4.5** Conversion of pictorial views into sectional orthographic views
UNIT-V Isometric Projections (08 Hrs, 00 Marks)	
5a. Prepare isometric scale. **5b.** Draw isometric views of given simple 2D entities containing lines, circles and arcs only. **5c.** Interpret the given orthographic views.	**5.1** Isometric view **5.2** Isometric projection. **5.3** Isometric scale and Natural Scale. **5.4** Illustrative problems related to simple objects having plain, slanting, cylindrical surfaces

Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
5d. Draw Isometric views from given orthographic views.	and slots on slanting surfaces. **5.5** Conversion of orthographic views into Isometric view/Projection.
UNIT-VI Free Hand Sketches (04 Hrs, 00 Marks)	
6a. Sketch proportionate freehand sketches of given machine elements. **6b.** Select proper fasteners and locking arrangement for given situation.	**6.1** Free hand sketches of machine elements: Thread profiles, nuts, bolts, studs, set screws, washers, Locking arrangements.

8. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Introduction to Drawing instruments lines letters etc.	04	--	--	--	--
II	Curve and Tangential exercises	06	--	--	--	--
III	Orthographic Projection	06	--	--	--	--
IV	Sectional orthographic views	04	--	--	--	--
V	Isometric Views	08	--	--	--	--
VI	Free hand sketches	04	--	--	--	--
Total		32	**--**	--	--	--

9. SUGGESTED STUDENT ACTIVITIES

Following is the list of proposed student activities like:

a. Student should maintain a separate A3 size sketch book which will be the part of term work and submit it along with drawing sheets.
b. Students should collect Maps, Production drawings, Building Drawings, Layouts from nearby workshops/industries/builders/contractors and try to list
   i) types of lines used
   ii) lettering styles used
   iii) dimension styles used
   iv) IS code referred
c. List the shapes and curves you are observing around you in real life with name of place and item. (For Ex. ellipse, parabola, hyperbola, cycloid, epicycloids, hypocycloid, involute, spiral helix).

10. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are sample strategies, which the teacher can use to accelerate the attainment of the various outcomes in this course:

Massive open online courses (***MOOCs***) may be used to teach various topics/sub topics.

a. Guide student(s) in fixing the sheet and mini drafter on drawing board.
b. Show video/animation films to explain orthographic and Isometric projection.
c. Demonstrate engineering curves through actual cut sections of cone, pyramid, etc.
d. Demonstrate first and third angle method using model.
e. Use charts and industrial drawing to teach standard symbols Teacher should ask the students to go through instruction and Technical manuals
f. Encourage students to refer different websites to have deeper understanding of the subject.

11. SUGGESTED MICRO-PROJECTS

Only one micro-project is planned to be undertaken by a student that needs to be assigned to him/her. In special situations where groups have to be formed for micro-projects, the number of students in the group should ***not exceed three.***

The micro-project could be industry application based, internet-based, workshop-based, laboratory-based or field-based. Each micro-project should encompass two or more COs which are in fact, an integration of PrOs, UOs and ADOs (Affective Domain Outcomes). Each student will have to maintain dated work diary consisting of individual contribution in the project work and give a seminar presentation of it before submission. The student ought to submit micro-project by the end of the semester to develop the industry oriented COs.

A suggestive list of micro-projects is given here. Similar micro-projects could be added by the concerned faculty:

a. Helical springs: Each batch will collect 5 open coil and closed coil helical springs of various sizes. Each student will measure the significant parameters of one spring and draw corresponding helix curve in his sketch book.
b. Flat coil or spiral springs: Each batch will collect 10 spiral springs of various sizes. Each student will measure the significant parameters of one spring and draw corresponding helix curve in his sketch book.
c. Isometric views: Each student of the batch will try to collect at least one production drawings/ construction drawings/plumbing drawings from local workshops/builders /electrical and mechanical contractors and try to generate isometric views from the orthographic views given in the drawings.
d. Isometric views: Each student of a batch will select a household/industrial real item and will draw its isometric view in the sketch book.
e. Isometric and orthographic views: Each batch will collect a single point cutting tool from workshop and draw its Isometric and orthographic views with a ten times enlarged scale. In carpentry shop each batch will try to make wooden model from these views.
f. Isometric views: The teacher will assign one set of orthographic projections and ask the student to develop 3D thermocol models of the same.
g. Conic curves: Each batch will go to institute’s playground and one student standing on the boundary throws a ball to the wicket keeper who is 30 meters away from the thrower and the ball has reached a maximum height of 20 meters from the ground, draw the path of the ball and identify the type of conic curve it has traced in air.

12. SUGGESTED LEARNING RESOURCES

Sr. No.	Title of Book	Author	Publisher, Edition and Year of publication, ISBN Number
1	Elementary Engg. Drawing (Including plan and solid geometry)	N.D. Bhatt	Charotar Publication, Anand ISBN- 978-93-80358-17-8
2	Engineering Drawing	Mali, Chaudhary	Vrinda Prakashan, Jalgaon ISBN: 9789389251012.
3	--	I.S. 696 Latest version	B.I.S.
4	Engineering Drawing Practice for Schools and Colleges IS: SP-46	Bureau of Indian Standards.	Third Reprint, October 1998 ISBN No. 81-7061-091-2
5	Engineering Drawing and Graphics + AutoCAD	K. Venugopal	New Age International Publishers. ISBN : 9788122415452
6	Engineering Drawing	D. A. Jolhe	Tata McGraw Hill Edu. New Delhi, 2010, ISBN No. 978-0-07-064837-1
7	Engineering Drawing	R. K. Dhawan	S. Chand and Company New Delhi, ISBN No. 81-219-1431-0

13. SOFTWARE/LEARNING WEBSITES

i. https://www.youtube.com/watch?v=TJ4jGyD-WCw
ii. https://www.youtube.com/watch?v=dmt6_n7Sgcg
iii. https://www.youtube.com/watch?v=_MQScnLXL0M
iv. https://www.youtube.com/watch?v=3WXPanCq9LI
v. https://www.youtube.com/watch?v=fvjk7PlxAuo
vi. http://www.me.umn.edu/courses/me2011/handouts/engg%20graphics.pdf

14. PO - COMPETENCY- CO MAPPING (ELECTRICAL ENGINEERING)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	3	2	2	1	1	2
CO2	3	3	2	2	1	1	2
CO3	3	3	2	2	1	1	2
CO4	3	3	2	2	1	1	2
CO5	3	3	2	2	1	1	2

	PSO1	PSO2	PSO3	PSO3
CO1	2	3	2	2
CO2	2	3	2	2
CO3	2	3	2	2
CO4	2	3	2	2
CO5	2	3	2	2

15. PO - COMPETENCY- CO MAPPING (ELECTRONICS ENGINEERING)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	3	2	2	1	1	2
CO2	3	3	2	2	1	1	2
CO3	3	3	2	2	1	1	2
CO4	3	3	2	2	1	1	2
CO5	3	3	2	2	1	1	2

	PSO1	PSO2	PSO3
CO1	2	1	1
CO2	2	1	1
CO3	2	1	1
CO4	2	1	1
CO5	2	1	1

Sign: Name: Shri. M. R. Mundhe. Shri. M. W. Giridhar (Course Experts)	Sign: Name: Dr. N. G. Kulkarni. (Head of Department)
Sign: Name: Dr. S. S. Bharatkar/Shri. R. U. Shelke (Program Head) (Department of Electrical Engineering)	Sign: Name : Mr.A.S.Zanpure (CDC Incharge)

Government Polytechnic, Pune

'180 OB' – Scheme

Programme	**Diploma in Electrical Engineering**
Programme code	01/**02**/03/04/05/06/07/08/15/**16**/17/18/19/21/**22**/23/24/26
Name of Course	**Fundamentals Mechanical Engineering**
Course Code	**ME2107**
Prerequisite course code and name	No
Class Declaration	No

1. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P)		Examination Scheme				
					Theory		Practical		Total Marks
L	T	P	C		ESE	PA	ESE	PA	
02	-	02	04	Marks	80	20	-	25	125
				Exam Duration	3 Hrs	1 Hr	-		

Legends: L- Lecture, P- Practical, T- Tutorial, C- Credits, ESE-End Semester Examination, PA- Progressive Assessment (Test I, II/Term Work), *- Practical Exam, $- Oral Exam, #- Online Examination Each Lecture/Practical period is of one clock hour

2. RATIONALE

Electrical engineering is the basic engineering branch. Electric power supply is needed for running of mechanical equipment for which different electrical motors are used, so in mechanical industry, the electrical engineer has to take care of various electrical installations with its maintenance.

The electrical engineers have to look after various aspects related to electrical engineering in respect of mechanical equipment (Boiler, Turbine, Refrigeration and Air conditioning, pump).

There is the equipment that is used for generation of electric power. Electrical engineer has to play a key role in smooth functioning of mechanical industry.

3. COMPETENCY

The aim of this course is to attend following industry identified competency through various teaching learning experiences:

- **Apply principle of Mechanical Engineering to solve the broad- based Engineering problems**

4. COURSE OUTCOMES (COs)

The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry-oriented COs associated with the above-mentioned competency**:**

1. Check the broad based working of various types of Boilers
2. Check the broad based working of Diesel engine and Petrol engine
3. Check the broad based working of Refrigeration and air-conditioning system
4. Check the broad based working of Pelton and Francis Turbine
5. Check the broad based working of Centrifugal and Reciprocating Pump
6. Check the broad based working of Hydraulic and Pneumatic components

5. SUGGESTED PRACTICALS/ EXERCISES

Sr. No.	Unit No.	Practical Exercises (Outcomes in Psychomotor Domain)	Relevant CO	Approximate Hours Required.
1.	1	Identify the component of Boiler Model	1	02
2.		Demonstration of different Boilers	1	02
3.	2	Demonstration of working of a 2 stroke Petrol and 4 stroke Petrol and diesel Engine	2	04
4.	3	Observe Construction and working of a Domestic Refrigerator	3	02
5.		Identify the component of Refrigeration System	3	02
6.		Observe Construction and working of a Window Air Conditioner	3	02
7.		Identify the component of Air Conditioning System	3	02
8.		Observe Construction and working of an Ice Plant and water cooler	3	02
9.	4	Study of pelton turbine and francis turbine.	4	02
10.	5	Observe construction and working of centrifugal pump and find power and efficiency of Centrifugal Pump	5	04
11.		Study of reciprocating pump.	5	02
12.	6	Draw symbol used in Hydraulic and Pneumatic circuit	6	02
13	All	Complete a micro project based on guidelines provided in sr no. 11	1 to 5	04
		Total Hrs		**32**

Sr. No.	Performance Indicators	Weightage in %
a.	Arrangement of available equipment / test rig or model	20
b.	Setting and operation	20
c.	Safety measures	10
d.	Observations and Recording	10
e.	Interpretation of result and Conclusion	20
f.	Answer to sample questions	10
g.	Submission of report in time	10
Total		**100**

6. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

The major equipment with broad specification mentioned here will usher in uniformity in conduct of practical, as well as aid to procure equipment by authorities concerned**.**

Sr. No.	Major Equipment/ Instruments Required	PrO. No.
1	Models of fire and water tube boilers.	1,2
2	Models of 2 stroke Petrol and 4 stroke Petrol and diesel Engine	3
3	Domestic Refrigerator	4,5
4	Window air Conditioner	6,7
5	Ice plant Test Rig	8
6	Experimental Water Cooler	8
7	Model of Pelton Turbine and Francis Turbine	9
8	Centrifugal Pump	10
9	Reciprocating Pump	11
10	Hydraulic and Pneumatic circuit chart	12

7. THEORY COMPONENTS

Unit Outcomes (UOs) (in cognitive domain)	**Topics and Sub-topics**
Unit I: Boilers (05 Hrs, 12 Marks)	
1a. Identify water tube and fire tube boiler **1b.** Explain with sketches the construction and working of Babcock and Wilcox boiler **1c.** Identify Boiler Mountings and Accessories **1d.** Explain with sketches the construction and working of Lamont, and Loeffer	**1.1.** Introduction, Classification of boilers **1.2.** Fire Tube Boiler, Cochron boiler **1.3.** Water Tube Boiler: Babcock and Wilcox boiler, construction and working **1.4.** Comparison of Fire Tube and water Tube boiler **1.5.** Boiler Mountings and Accessories **1.6.** High pressure Boilers: Lamont, and Loeffer, construction and working
Unit II: Internal Combustion Engines (04 Hrs, 12 Marks)	
2a. Using sketches identify the specified component of the given I C Engine **2b.** Explain with sketches the construction and working of four stroke cycle petrol and diesel engine **2c.** Explain with sketches the construction and working of two stroke cycle petrol engine **2d.** Compare two stroke and four stroke engine	**2.1.** Introduction, Classification of I.C Engines, construction of I.C Engine, Its Terminology **2.2.** Working of four stroke cycle petrol and diesel engine, Working of two stroke cycle petrol engine **2.3.** Application of I.C engines **2.4.** Comparison between two stroke and four stroke engine, **2.5.** Comparison between Petrol engine and

Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
2e. Compare Petrol engine and Diesel engine	Diesel engine
Unit III: Refrigeration and Air Conditioning (06 Hrs, 14 Marks)	
3a. Describe the basic concept of refrigeration **3b.** Identify the component of typical refrigeration system in given diagram with justification **3c.** Explain with sketches the construction and working of Refrigerator, Water cooler and an Ice-plant **3d.** Explain with sketches the construction and working of Window air conditioner **3e.** Explain with sketches the construction and working of split air conditioner	**3.1.** Definition of refrigeration, Type of refrigeration system, Application **3.2.** Concept of COP, Refrigeration effect, Unit of Refrigeration, Refrigerant **3.3.** Basic Components of Vapor compression refrigeration systems and its working **3.4.** Construction and working of a Refrigerator, Water cooler and an Ice-plant, **3.5.** Construction and working of a Window air conditioner **3.6.** Construction of split air conditioner, Advantages and disadvantages
Unit IV: Turbines (05 Hrs, 12 Marks)	
4a. Explain with sketches the construction and working of Pelton turbine **4b.** Explain with sketches the construction and working of Francis turbine **4c.** Compare Impulse water turbine and reaction turbine **4d.** Interpret principle of operation of steam turbine **4e.** Explain with sketches the construction and working of a single stage impulse and reaction turbine	**4.1.** Hydraulic turbines: Classification **4.2.** Construction and working of Impulse water turbine -Pelton turbine, Construction and working of reaction turbine- Francis turbine **4.3.** Comparison between Impulse water turbine and reaction turbine **4.4.** Steam Turbines: Principle of operation of steam turbine **4.5.** Construction and working of a single stage impulse and reaction turbine, comparison, Advantages and disadvantages of steam turbine
Unit V: Pumps (06 Hrs, 18 Marks)	
5a. Explain with sketches the construction and working of centrifugal Pumps **5b.** Describe the basic concept of centrifugal Pumps **5c.** Identify the fault for given failure of component with justification. **5d.** Suggest remedies for fault **5e.** Explain with sketches the construction and working of single acting and Double acting reciprocating pump	**5.1.** Construction and working of a centrifugal Pumps, type of casings, type of impellers, concept of priming **5.2.** Discharge of centrifugal pump, Heads of a centrifugal pump, Losses in centrifugal pump, Efficiency of centrifugal pump without velocity triangle **5.3.** Installation and testing of centrifugal pump as per IS specification, Fault finding and remedies in working of centrifugal pump **5.4.** Classification of pump, construction of reciprocating pump, working of single

Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
	acting and Double acting reciprocating pump, application **5.5.** Comparison between reciprocating pump and centrifugal pump
Unit VI: Hydraulic and Pneumatic Components (08 Hrs, 12 Marks)	
6a. Identify Elements of Hydraulic and Pneumatic circuits **6b.** Suggest application of Hydraulic and Pneumatic element **6c.** Interpret control valve **6d.** Explain actuator	**6.1.** Elements of Hydraulic and Pneumatic circuits **6.2.** Classification, of Pumps, Classification of compressors, F.R.L. unit **6.3.** Pressure controls: Relief valve, Reducing valve Sequence valve. **6.4.** Direction controls: Check valve, 2/2, 3/2, 4/2 direction control valve **6.5.** Flow controls: Classification, Symbols and function **6.6.** Actuators: Classification, application **6.7.** Symbols used hydraulic and pneumatic circuits.

8. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Boilers	05	02	05	05	12
II	Internal combustion Engines	04	02	04	06	12
III	Refrigeration and Air conditioning	06	02	05	07	14
IV	Turbines	05	02	04	06	12
V	Pumps	06	04	06	08	18
VI	Hydraulic and Pneumatic Components	08	02	04	06	12
Total		**34**	**14**	**28**	**38**	**80**

9. SUGGESTED STUDENT ACTIVITIES

Other than the classroom and laboratory learning, following are the suggested student-related ***co-curricular*** activities which can be undertaken to accelerate the attainment of the various outcomes in this course: Students should conduct following activities in group and prepare reports of about 5 pages for each activity, also collect/record physical evidences for their (student's) portfolio which will be useful for their placement interviews:

a. Prepare journal based on practical performed in laboratory. Journal consists of drawing, observations, required equipment's, date of performance with teacher signature.
b. Prepare seminar on boilers used in power plants.
c. Prepare seminar on Application of I.C. Engine.
d. Make troubleshooting chart for Refrigerator and Air conditioners.
e. Collect manufacturer specification for various Refrigerator and Air conditioners
f. Prepare power point presentation for Hydraulics and Steam turbine.
g. Make troubleshooting chart for Centrifugal Pump.
h. Study different Hydraulic and Pneumatic circuit.

10. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are sample strategies, which the teacher can use to accelerate the attainment of the various outcomes in this course:

a. Massive open online courses (***MOOCs***) may be used to teach various topics/sub topics.
b. About 15-20% of the topics/sub-topics which is relatively simpler or descriptive in nature is to be given to the students for self-directed learning and assess the development of the COs through classroom presentations (see implementation guideline for details).
c. With respect to item No.8, teachers need to ensure to create opportunities and provisions for co-curricular activities.
d. Guide student(s) in undertaking micro-projects.
e. Correlate subtopics with power plant system and equipments.
f. Use proper equivalent analogy to explain different concepts.
g. Use Flash/Animations to explain various components, operation and
h. Teacher should ask the students to go through instruction and technical manuals

11. SUGGESTED MICRO-PROJECTS

Only one micro-project is planned to be undertaken by a student that needs to be assigned to him/her. In special situations where groups have to be formed for micro-projects, the number of students in the group should ***not exceed three.***

The micro-project could be industry application based, internet-based, workshop-based, laboratory-based or field-based. Each micro-project should encompass two or more COs which are in fact, an integration of PrOs, UOs and ADOs (Affective Domain Outcomes). Each student will have to maintain dated work diary consisting of individual contribution in the project work and give a seminar presentation of it before submission. The student ought to submit micro-project by the end of the semester to develop the industry-oriented COs.

A suggestive list of micro-projects is given here. Similar micro-projects could be added by the concerned faculty:

a. **Steam boiler and Turbines:** Draw electrical layout of any one power plant.
b. **I C Engine:** collect leaflet of diesel engine generator sets from the market. Analyze and compare the specifications**.**
c. **Hydraulic Turbine:** Prepare a chart showing parts of different type of commonly used hydraulic turbine from reference book.

d. **Refrigeration system:** student will make chart of wiring diagram of latest 02 each refrigeration/ Window air conditioner available in market.
e. **Refrigeration control: -** make model of refrigeration controls demonstrating their functioning (at least 02) in the institute / laboratory under the guidance of teacher.

12. SUGGESTED LEARNING RESOURCES

S.N.	Title	Author	Publisher, Edition and Year of publication ISBN Number
1	Element of Mechanical Engineering	Manglik V. K.	PHI Learning Pvt. Ltd.,New Delhi,2013 ISBN: 9788120346291
2	Basic Mechanical Engineering	Agrawal Basant and Agrawal C. M.	WILEY India Pvt. Ltd., New Delhi,2008 ISBN: 9788126518784

13. SOFTWARE/LEARNING WEBSITES

a. https://www.electrical4u.com/steam-boiler-working-principle-and-types-of-boiler/
b. https://edurev.in/studytube/INTERNAL-COMBUSTION-ENGINES-Complete-Notes--Engine/bc165059-2403-4aa1-abf4-77d5bbf0bba5_p
c. https://gradeup.co/i-c-engines-i-8c64a2c0-bc35-11e5-8dca-083e2fedfcb1
d. https://nptel.ac.in/downloads/112105129/
e. https://nptel.ac.in/courses/112104117/22
f. https://www.scribd.com/document/123626483/CENTRIFUGAL-PUMPS-notes-for-students
g. https://www.hydraulicspneumatics.com/other-technologies/chapter-5-pneumatic-and-hydraulic-systems

14. PO - COMPETENCY- CO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	1	1	2	1	1	2
CO2	3	1	1	2	1	1	2
CO3	3	1	1	2	1	1	2
CO4	3	1	1	2	1	1	2
CO5	3	1	1	2	1	1	2
CO6	3	1	1	2	1	1	2

	PSO1	PSO2	PSO3	PSO4
CO1	3	1	1	1
CO2	3	1	1	1
CO3	3	1	1	1
CO4	3	1	1	1
CO5	3	1	1	1
CO6	3	2	1	1

Sign: Name: Smt. V. G. Talkit (Course Expert)	Sign: Name: Dr. N G. Kulkarni (Head of Department)
Sign: Name: Dr. S. S. Bharatkar/Shri. R. U. Shelke (Program Head) (Department of Electrical Engineering)	Sign: Name : Mr.A.S.Zanpure (CDC Incharge)

Government Polytechnic, Pune

'180OB' – Scheme

Programme	Diploma in ET/CE/**EE**//ME/MT/CM/IT/DDGM
Programme code	01/**02**/03/04/05/06/07/08/15/**16**/17/18/19/21/**22**/23/24/26
Name of Course	**Workshop Practice (Electrical)**
Course Code	**WS2102**
Prerequisite course code and name	No
Class declaration Course	No

1. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P)		Examination Scheme				
					Theory		Practical		Total Marks
L	T	P	C		ESE	PA	*ESE	PA	
00	00	02	02	**Marks**	00	00	25	25	50
				Exam Duration	--	--	--	--	

Legends: L- Lecture, P- Practical, T- Tutorial, C- Credits, ESE-End Semester Examination, PA- Progressive Assessment (Test I, II/Term Work), *- Practical Exam, $- Oral Exam, #- Online Examination Each Lecture/Practical period is of one clock hour

2. RATIONALE

Workshop Practice is a basic practical engineering course. The knowledge of basic workshops such as wood working, fitting, welding, plumbing and sheet metal shop is essential for technician to perform his/her duties in industries. Students are able to perform various operations using hand tool equipment and machineries in various shops. Working in workshop develops the attitude of group working and safety awareness. This course provides miniature industrial environment in the educational institute.

3. COMPETENCY

The course should be taught and implemented with the aim to develop the course outcomes (COs) so that student demonstrates the following competency needed by the industry: Prepare simple jobs on the shop floor of the engineering workshop.

4. COURSE OUTCOMES (COs)

The practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry oriented COs associated with the above mentioned competency: a

After studying this course, the student will be able to

1 Select tools and machinery according to job.
2 Use hand tools in different shops for performing different operation.
3 Operate equipment and machinery in different shops.
4 Prepare job according to drawing.
5 Maintain workshop related tools, equipment and machinery.

5. SUGGESTED PRACTICALS/ EXERCISES

Sr. No.	Unit No.	**Practical Exercises** (Outcomes in Psychomotor Domain)	Relevant CO	Approximate Hours Required.
1	1	Prepare job with following operations: a. Marking operation as per drawing b. punching operation as per drawing c. filing operation as per drawing d. chamfering operation as per drawing e. sawing operation as per drawing f. drilling operation as per drawing g. tapping operation as per drawing	1,2,3,4	11
2	2	Prepare job with following operations: a. Prepare lap joint using gas welding as per given drawing b. Prepare butt joint using gas welding as per given drawing	1,2,3,4	10
3	3	Prepare utility job(like stool, benches, tables or similar jobs) involving arc welding and artificial wood as per given drawing a. Fabrication operation involve measuring, marking, cutting, edge preparation, welding b. Carpentry operation involve measuring, marking cutting and assembly with fabrication part.	1,2,3,4	11
Total Hrs				**32**

Sr. No.	Performance Indicators	Weightage in %
1	Setting of experimental set up	20
2	Operate equipment skillfully	30
3	Follow Safety measures	10
4	Work in team	10
5	Record Observations	10
6	Interpret Results to conclude	10
7	Answer to sample questions	05
8	Submit report in time	05
	Total	**100**

6. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

The major equipment with broad specification mentioned here will use in uniformity in conduct of practical, as well as aid to procure equipment by authorities concerned.

Sr. No.	Equipment Name with Broad Specifications	Exp. Sr. No.
1	Fire buckets of standard size.	1 to 3
2	Fire extinguisher A,B and C types	1 to 3
3	Wood Turning Lathe Machine, Height of Centre: 200mm, Distance between II Centers: 1200mm, Spindle Bore: 20mm with Taper, Range of Speeds: 425 to 2800 with suitable Motor Drive. with all accessories	3
4	Circular Saw Machine, Diameter of saw blade 200 mm, Maximum Depth of II Cut 50 mm, Table Size -350 x 450 mm, Table Tilting - 450	3
5	Wood working tools- marking and measuring tools, saws, claw hammer, II mallet, chisels, plans, squares,	3
6	Carpentry Vice 200 mm	3
7	Work Benches- size:1800 x 900 x 750 mm	1
8	Bench Drilling machine (upto 13 mm drill cap.) with ½ H.P. Motor 1000 III mm. Height	1
9	Power Saw machine 350 mm mechanical with 1 HP Motor & all III Accessories.	1
10	Bench Grinder 200 mm Grinding Disc diameter 200 mm. with 25 mm. bore III 32 mm. with ½ HP/1HP Motor.	1
11	Vernier height Guage 450 mm	1
12	Surface Plate 600 x 900 mm Grade I	1
13	Angle Plate 450 x 450 mm	1
14	Welding machine 20 KVA 400A welding current 300A at 50, 100, 200, 250, IV 300 with std. Accessories and Welding Cable 400 amp. ISI with holder	2
15	Oxygen and acetylene gas welding and cutting kit with cylinders and IV regulators	2
16	Fitting tools - hammers, chisels, files, hacksaw, surface plate, punch, v III block, angle plate, try square, marking block, steel rule, twist drills, reamers, tap set, die set.	1
17	Gas welding hand tools- welding torch, welding tip, pressure regulator, V oxygen and acetylene cylinders, spark lighter	4
18	Arc welding hand tools- electrode holder, cable connector, cable lugs, V chipping hammer, earthing clamp, wire brush.	4

7. THEORY COMPONENTS

Unit Outcomes (UOs) (in cognitive domain)	**Topics and Sub-topics**
NIL	NIL

8. SUGGESTED SPECIFICATION TABLE FORQUESTION PAPER DESIGN Not applicable

9. SUGGESTED STUDENT ACTIVITIES

Other than laboratory learning, following are the suggested student-related co-curricular activities which can be undertaken to accelerate the attainment of the various outcomes in this course:

a. Prepare work diary based on practical performed in workshop. Work diary consist of job drawing, operations to be perform, required raw materials, tools, equipments, date of performance with teacher signature. b.
b. Prepare journals consist of free hand sketches of tools and equipments in each shop, detail specification and precautions to be observed while using tools and equipment.
c. Prepare/Download a specifications of followings: a) Various tools and equipment in various shops. b) Precision equipment in workshop c) Various machineries in workshop.
d. Undertake a market survey of local dealers for procurement of workshop tools, equipment machineries and raw material. e. Visit any fabrication/wood working workshop and prepare a report.

10. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are sample strategies, which the teacher can use to accelerate the attainment of the various outcomes in this course:

a. Massive open online courses (MOOCs) may be used to teach various topics/sub topics.
b. Guide student(s) in undertaking micro-projects.
c. Arrange visit to nearby industries and workshops for understanding various manufacturing process.
d. Show video/animation films to explain functioning of various processes like shaping, lapping, honing, turning, milling, knurling etc.
e. Prepare maintenance charts various workshop machineries.

11. SUGGESTED MICRO-PROJECTS

Only one micro-project is planned to be undertaken by a student that needs to be assigned to him/her. In special situations where groups have to be formed for micro-projects, the number of students in the group should ***not exceed three.***
The micro-project could be industry application based, internet-based, workshop-based, laboratory-based or field-based. Each micro-project should encompass two or more COs which are in fact, an integration of PrOs, UOs and ADOs (Affective Domain Outcomes). Each student will have to maintain dated work diary consisting of

individual contribution in the project work and give a seminar presentation of it before submission. The student ought to submit micro-project by the end of the semester to develop the industry orientedCOs.
A suggestive list of micro-projects is given here. Similar micro-projects could be added by the concerned faculty:
a. Prepare a utility job using various wood working shop operations as per given drawing.
b. Prepare a utility job using various welding operations as per given drawing.

12. SUGGESTED LEARNING RESOURCES

Sr. No.	Title	Author	Publisher, Edition and Year of publication, ISBN Number
1	Elements of workshop technology - Vol. I	S. K. Hajara Chaudhari A.K. Hajara Chaudhari	Media Promoters and Publishers Pvt. Ltd., Mumbai-7 ISBN: 8185099146
2	Workshop Practice Manual	V. Kapoor	Dhanpat Rai and Sons, New Delhi-32. ISBN: 9788175154247
3	A course in workshop technology Vol.- I	B.S. Raghuwanshi	Dhanpat Rai and Sons, New Delhi-32. ISBN: 9788185099149

13. SOFTWARE/LEARNING WEBSITES

1.www.carpentryworkshop.com
2.www.weldingworkshop.com
3.www.fittingworkshop.com

14. PO - COMPETENCY- CO MAPPING (electrical engineering)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	3	3	3	2	2	3
CO2	3	3	3	3	2	2	3
CO3	3	3	3	3	2	2	3
CO4	3	3	3	3	2	2	3

	PSO1	PSO2	PSO3	PSO4
CO1	3	2	2	2
CO2	3	2	2	2
CO3	3	2	2	2
CO4	3	2	2	2

Sign: Name: Mr. M. R. Mundhe (Course Expert)	Sign: Name: Dr. N. G. Kulkarni. (Head of Department)
Sign: Name: Dr. S. S. Bharatkar/Shri. R. U. Shelke (Program Head) (Department of Electrical Engineering)	Sign: Name : Mr.A.S.Zanpure (CDC Incharge)

Level 2 - B Curriculum

Government Polytechnic, Pune

'180 OB' – Scheme

Programme	Diploma in ET/CE/**EE**//ME/MT/CM/IT/DDGM
Programme code	01/**02**/03/04/05/06/07/08/15/**16**/17/18/19/21/**22**/23/24/26
Name of Course	**Electrical Safety**
Course Code	**EE2106**
Prerequisite course code and name	No
Class Declaration	No

1. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P)		Examination Scheme				
					Theory		Practical		Total Marks
L	T	P	C		ESE	PA	ESE	PA	
03	00	00	03	Marks	80	20	-	-	100
				Exam Duration	3 Hrs	1 Hr	-	-	

Legends: L- lecture, T-Tutorial/teacher guided theory practice, P-practical, C-Credits, ESE-End semester examination, PA- Progressive Assessments(Test I, II/Term Work), * - Practical Exam, $ - Oral Exam. # - Online Exam., Each lecture/practical period is of one clock hour.

2. RATIONALE

Most of our modern devices, instruments, and appliances at work, at home, and for leisure are electricity powered either through electrical utilities, and/or through the use of batteries.It is a fact that hundreds of preventable electrical accidents occur each year in our country, many resulting in serious injury, and even death. Countless electrical incidents (e.g. minor electrical shocks) and unsafe acts involving electrically powered devices or electrical infrastructure go unreported each year. Hence Electrical safety is not just important for electricians and electrical workers,but it is also important for all who work with electrically powered devices or who are engaged in activities that may result in electrical hazards.Hence knowledge of this course is essential which will help the students in day to day life, while working in Industry or other related profession.

3. COMPETENCY

The aim of this course is to attend following industry/ professional work identified competency through various teaching learning experiences

" **Apply electrical safety while handling machines, equipment or apparatus in work place as well as in day to day life**."

Without a proper precaution, electricity is hazardous, though this is the part of modern society. Hence safety is the first priority in day to day life.

4. COURSE OUTCOMES (COs)

The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry-oriented COs associated with the above-mentioned competency**:**

The student should be able to:

1.Describe the terms related with electrical safety & state the importance of electrical safety.
2.Identify the type of electrical hazard & describe its causes & effects.

3.Follow various safe working practices to be adopted while working.

4. Describe the use of various personal & circuit protective elements.

5. Apply electrical safety standards/ norms & statutory provisions.

5 SUGGESTED PRACTICALS/ EXERCISES

6. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED : NA

7. THEORY COMPONENTS

The following topics/sub topics should be taught and assessed in order to develop UOs for achieving the COs to attain the identified competency**.**

Unit Outcomes (UOs) (in cognitive domain)	**Topics and Sub-topics**
UNIT- 1: Basics of Electrical safety	**(Hours- 6, Marks-10)**
1a.Explain the importance of electrical safety. 1b.Explain the issues (statistics associated) with poor electrical safety in the work places.	**1.1 Why Electrical Safety?** Showing statistics Form 19 and 20, Explaining different categories and classification, e.g. Human / Animal, Fatal / non-Fatal, **1.2 Hazard- General – Effects** Types – Electrocution, Flashover, Static, Fire Effects – Involves human life, disabilities, survival rate very less, (refer statistics), Devastation in fire cases, loss of property in crores, (show statistical figures), down time, production loss, Burns

Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
1c.Define key electrical terms related to electrical safety	**1.3 Common Terms and definitions related to Electrical Safety** Voltage, Current, Earth, Leakage current, Body resistance, conductor, insulator, cables, switchgears, protections, lightning, PPE, workplace safety, designated / authorized person, clearances, touch and step potential, fuse / breaker, Residual Current Device, electrical design, CEA (Central Electricity Authority), BIS, IEC, IEEE, NFPA, CEI, EI, Electricity Act, Regulations, overhead lines (OH), underground cables (UG), feeder pillar, electrical installation, fire point, flash point, ingress protection (IP)
UNIT-2 Types of hazards and its effects	**(Hours- 8 Marks-14)**
2a.State the types, causes and effects of electrical hazards – 1. Electrocution 2. Fire 3. Flashovers 4. Static Electricity Avoiding situations leading to hazards. 2b.Describe effects of electrocution on human body 2c.Describe probable places / equipment / appliances prone for hazard due to electrocution. 2d.Avoiding situations leading to hazards due to electric fire	**2.1 Hazards – Electrocution** **How occurs – analysis** Common examples, Effects on body, A.C., D.C. Leakage current, different paths through body, body resistance- human & animal, circuit, biological effect, severity – current and time Effect of wet areas, water leakages / splash, effect of saturation of water on skin / wood, conductor snapping, Back-feed from generators **2..2 What happens** Effect on human body, safe limits, table showing severity with increase in limit, severity related to path of current through body. Burns due to electrocution, difference in burns due to electrical cause (depth) and general fire (superficial) **2.3 Places, equipment, appliances prone to** Domestic appliances, electrical accessories, metal enclosures of electrical cables, electrical poles, streetlight poles, damp walls, bathrooms, routes of OH / UG electrical lines, any metal directly or indirectly in contact with any part of electrical installation, portable tools. **2.4 Hazards – Fire**

Unit Outcomes (UOs) (in cognitive domain)	**Topics and Sub-topics**
2e.Describe effects of fire 2f.Describe probable places prone for hazard due to electric fire. 2g.Avoiding situations leading to hazards due to flashover 2h.Describe effects of flashover 2i.Describe probable places prone for hazard due to flashover	**How occurs:** Fire triangle, three components, initiation of fire, loose contacts / joints, heating, sparking, short circuit, Batteries – Charging / discharging and hydrogen, capacitor bursting **2.5 What happens / effects:** Spread & Devastation, Smoke due to fire, visibility, toxicity, water and toxic smoke combination and its effect on structural stability, battery service-life bulged batteries, bursting **2.6 Installation, equipment prone to:** Wiring / cabling routes, ducts, appliances, capacitors, batteries **2.7 Hazards – Flashovers** **How occurs:** Loose contacts, moving contacts, heating, use of tools, Ingress Protection (IP), Dust, Flora, Fauna **2.8What happens, effects:** Burns due to flashover, blast, metal particles, measurement of intensity (cal/cm2 or kJ/m2), vision and hearing loss **2.9 Places equipment prone to:** Control panels, bus, transformers **Hazards – Static Electricity:** How occurs: Possible dangers Places equipment prone to
UNIT-3 Possible causes / reasons	**(Hours- 8 Marks-16)**
Describe possible causes in different situations of work like at - 3a. design stage, 3b.choosing material for installation work 3c.Selection of protective devices,	**3.1 Design:** Capacity design, Single Line Diagram – importance, components, earthing, circuits, protections, sample drawing &single line diagram (SLD) **3.2 Material & specifications:** Wires, conductor size, earth wire, insulation types – PVC, FR (fire resistant), FRLS (fire resistant low smoke), HFFR (Halogen free flame retardant), FS (Fire survival), Conduits / trunkings, cables – armoured, unarmoured, PVC, XLPE (Cross link poly-ethylene) , Fuses, MCBs, DBs, Switchgears and Breakers, Transformers **3.3 Appliances:** Flexible cords, three pin plug, service life **3.4 Execution of installation:**

Unit Outcomes (UOs) (in cognitive domain)	**Topics and Sub-topics**
3d.Choosing ratings of cords, plugs for appliances etc.	Method of construction, bunching of wires, Importance of clearances & accessibility, Equipotential bonding **3.5 Testing and commissioning:** Insulation resistance test, earth test, BDV, inspection, Portable Appliance Testing (PAT) **3.6 Operation:** Authorized person, precautions **3.7 Maintenance: Types –** routine / periodic, predictive, breakdown, importance, checklists, tests; and lapses therein
UNIT-4 Prevention	**(Hours- 10 Marks -16)**
4a.Interpret how to implement measures for protection in different stages of working conditions such as domestic, industries, & other commercial work places. 4b.Selection of appropriate protective devices in different applications. 4c.State various safe working practices to be adopted while working in industry or at residence	**4.1 Stages:** Design, Installation, supervision, Testing, maintenance **4.2 Measures – protections: (Mention of names of following protections)** Circuit protections – Fuse, Breakers (MCB, MCCB,ACB,VCB),Surge protections (SPD), Arc Flash detector (AFD) / Arc Flash Circuit Interrupter AFCI), Transformer protections, Static electricity – method to control OH lines – guarding, clearances Earthing – systems, importance Residual Current Device (RCD), importance, function Electrical Safety Audit –Benefits of safety audit, Checklist ,formats **4.3 Electrical Safety at home:** Trouble shooting and limitations to work on, safety tips to handle domestic appliances **Work-Place Safety:** Designated persons – Authority, Safe work practices – Work Permit issue and return, Lockout / Tagout (LOTO), Training for resuscitating person suffering from electric shock Electrical Safety at Academic and Research Institutes Electrical Safety on utility distribution systems **4.4 Passive measures:** Restricted areas, Danger Notice, Signs, Shock treatment chart, First Aid, PPE and tools – insulated tools, clothing, goggles, face mask / hood /

Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
4d. Describe the use of various personal & circuit protective elements.	balaclava, arc flash suite, gloves, shoes, ladders, earthing rod / chain use **4.5 Fire Prevention:** Fire Prevention and Life Safety Act – provisions, fire extinguishers & classes, Smoke Detection System
UNIT-5 Safety Standards and Statutory Provisions (Hours-10 Marks-14)	
5a. Study Various Acts, Regulations, Amendments and Notifications 5b. State electrical safety standards/ norms & statutory provisions.	**5.1 Electricity Act: Introduction** **5.2 Standards for safety** BIS: Introduction – Bureau of Indian Standards IES: International Electro technical Commission IEEE: Institute of Electrical and Electronics Engineer NFPA 70, 70E : National Fire Protection Association National Electrical Code, Work-Place Safety **5.3 CEA Regulations:** Introduction – Central Electricity Authority, powers, different Regulations, website, Responsibilities of users, owners, Electric Supply Co., Contractor, Supervisors, Licensing, Inspections **5.4 Electrical Inspector:** Authority, Functions **5.5 Chartered Electrical Safety Engineer:** Introduction – Functions, job opportunities **5.6 Accidents:** Classification, Procedure to be followed Statutory obligations, intimation, powers of EI
Unit -6 Case studies (Hours-6 Marks-10)	
6a. Study given case 6b. Analyse the situation and draw inferences. Define the causes of accidents in given case and recommend measures to avoid such accident in future.	**6.1 Investigation:** Typical case studies for different types of accident - Domestic – 2, Industrial -2, Distribution system – 1, Public Place – 1, Cinema hall / theatre / Seminar hall / Classroom – 1 **6.2 Analyzing:** Inference /conclusion **6.3 Reporting:** Cause of Accident / measures to avoid recurrence

8. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
1	Basics of Electrical safety	6	4	6	-	10
2	Types of hazards and its effects	8	4	4	6	14
3	Possible causes / reasons	8	4	12	-	16
4	Prevention	10	4	8	4	16
5	Safety Standards and Statutory Provisions	10	4	6	4	14
6	Case studies	6	-	4	6	10
Total		**48**	**20**	**40**	**20**	**80**

9. SUGGESTED STUDENT ACTIVITIES

Other than the classroom and laboratory learning, following are the suggested student-related ***co-curricular*** activities which can be undertaken to accelerate the attainment of the various outcomes in this course: Students should conduct following activities in group and prepare reports of about 5 pages for each activity, also collect/record physical evidences for their (student's) portfolio which will be useful for their placement interviews

Students can complete on line training programs on electrical safety. Following are some useful links for completion of Online courses

https://www.yet5.com

https://greenwgroup.co.in/training-courses/diploma-in-electrical-safety/

https://firstaidsafetytraining.ca/online-safety-courses/electrical-safety-online-course/

https://www.oshaeducationcenter.com/electrical-certificate/

http://www.nsc.org.in/

10. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are sample strategies, which the teacher can use to accelerate the attainment of the various outcomes in this course:

a. Massive open online courses (***MOOCs***) may be used to teach various topics/sub topics.
b. About ***15-20% of the topics/sub-topics*** which is relatively simpler or descriptive in nature is to be given to the students for ***self-directed learning*** and assess the development of the COs through classroom presentations (see implementation guideline for details).

c. With respect to item No.8, teachers need to ensure to create opportunities and provisions for ***co-curricular activities***.
d. Guide student(s) in undertaking micro-projects.
e. Use proper equivalent analogy to explain different concepts.
f. Use Flash/Animations to explain various components, operation and
g. Teacher should ask the students to go through instruction and Technical manuals

11. SUGGESTED MICRO-PROJECTS
(Only for Class Declaration Courses)

Not Applicable

12. SUGGESTED LEARNING RESOURCES

Sr. No	Title of Book	Author	Publication	ISBN NO
1	Electrical Safety, Fire Safety Engineering and Safety Management	Sunil S. Rao, R. K. Jain, H.L.Saluja	Khanna Publication	ISBN-13: 978-8174093066
2	Electrical Safety	D.R . Nagpal	Standard Publishers Distributors	ISBN-13: 978-8180141058
3	Handbook on Industrial Safety, Electrical Safety And Fire Protection (in HINDI)	D.P.B. Publications	Bhartiya Technical Publications	ASIN: B07NSCJD5C
4	Manual of Fire Safety	Sesha Prakash	CBS	ISBN-13: 978-8123919904

13. SOFTWARE/LEARNING WEBSITES

https://www.esfi.org/
https://www.nfpa.org/Public-Education/Fire-causes-and-risks/Top-fire-causes/Electrical
https://www.lanl.gov/safety/electrical/docs/elec_hazard_awareness_study_guide.pdf
http://www.ibew38.org/pdf/Safety_Handbook.pdf

14. PO - COMPETENCY- CO MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	2	2	3	2	1	1	3
CO2	2	2	1	2	2	2	3
CO3	2	3	1	2	3	2	3
CO4	2	1	1	2	2	1	2
CO5	2	1	1	2	2	1	3

CO	PSO1	PSO2	PSO3	PSO4
CO1	3	2	2	3
CO2	1	1	2	3
CO3	2	2	2	3
CO4	2	2	2	3
CO5	3	2	2	3

Sign: Name: 1. Smt. M.A..Chigteri 2. Mrs.A.N.Duraphe (Course Experts)	Sign: Name: Dr.S.S.Bharatkar/Shri.R. U. Shelke (Head of Department)
Sign: Name: Dr. S. S. Bharatkar/Shri.R. U. Shelke (Program Head) (Department of Electrical Engineering)	Sign: Name: Shri A.S.Zanpure (CDC In-charge)

Government Polytechnic, Pune

'180 OB' – Scheme

Programme	Diploma in ET/CE/**EE**//ME/MT/CM/IT/DDGM
Programme code	01/**02**/03/04/05/06/07/08/15/**16**/17/18/19/21/**22**/23/24/26
Name of Course	**MATHEMATICS III**
Course Code	SC2103
Prerequisite	SC1102
Class Declaration	No

1.TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P)		Examination Scheme				
					Theory		Tutorials		Total Marks
L	T	P	C		ESE	PA	ESE	PA	
03	00	00	03	**Marks**	80	20	00	00	100
				Exam Duration	3 Hrs	1 Hr	--	--	—

Legends: L- lecture, T-Tutorial/teacher guided theory practice, P-practical, C-Credits, ESE-End semester examination, PA- Progressive Assessments(Test I, II/Term Work), * - Practical Exam, $ - Oral Exam. # - Online Exam., Each lecture/practical period is of one clock hour.

2. RATIONALE

The student shall learn various techniques in integration and differential equations and use these techniques to solve Electrical Engineering related problems.

3. COMPETENCY

The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- **Solve various engineering related problems using the principles of mathematics**

4. COURSE OUTCOMES (COs)

The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry oriented COs associated with the above mentioned competency**:**

1. Solve the given problems of integration using suitable methods.
2. Apply the concept of integration to find Mean value and Root Mean Square value.
3. Solve the differential equation of first order and first degree using suitable methods.
4. Using the general form of complex number find the all roots of complex number.
5. Use Laplace transform to solve first order first degree differential equations.
6. Use the concept of dot and cross product to calculate Work done and Moment of force about a point & line respectively

5. SUGGESTED PRACTICALS/ EXERCISES

NA

6. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

NA

7. THEORY COMPONENTS

The following topics/subtopics should be taught and assessed in order to develop UOs for achieving the COs to attain the identified competency.

Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
Units 1 : Integration	
1.a. Obtain the given simple integral(s) using substitution method. 1.b. Integrate given simple functions using the integration by parts. 1.c. Evaluate the given simple integral by partial fractions.	1.1Methods of Integration: a) Integration by substitution. b) Integration by parts c) Integration by partial fractions.
Unit 2: Definite Integrals	
2 .a. Solve given simple problems based on properties of definite integration. 2.b. Utilize the concept of definite integration to find mean value of the function 2.c. Invoke the concept of definite integration to find root mean square value of function	2.1 Definite Integration: a) Simple examples b) Properties of definite integral (without proof) and simple examples. 2.2 Applications of definite integral : a) Mean value. b) Root mean square value.
Unit 3: Differential Equations	
3.a. Find the order and degree of given differential equations 3.b. Form simple differential equation for given simple engineering problems. 3.c. Solve given differential equations using the method of variable separable 3.d Solve the given linear differential equation	3.1 Concept of differential equation. 3.2 Order, degree and formation of Differential equations 3. 3 Solution of differential equation Equations a. Variable separable form. b. Linear differential equation. 3.4 Application of differential equations and related engineering problem(s).
Unit 4: Complex Number	
4.a. Solve given problems based on complex number. 4.b Solve examples on complex number using De Moivre's theorem 4.c.Find roots of complex number.	4.1 Cartesian, polar and exponential form of a complex number. 4.2 Algebra of complex number. 4.3 De Moivre's theorem 4.4 General form of complex number
Unit 5:Laplace Transform	
5.a Solve the given problems based on Properties on Laplace Transform. 5.b. Solve the given problems based on Properties on Inverse Laplace Transform. 5.c Invoke the concept of Laplace transform to solve first order first degree differential equations.	5.1 Laplace Transform of standard functions (without proof). 5.2 Properties of Laplace Transform such as linearity, first and second shifting properties(without proof). 5.3 Inverse Laplace Transform using partial fraction method, first and second shifting properties (without proof). 5.4 Laplace transform of derivatives and solution of first order first degree differential equation.
Unit6: Vectors	

Unit Outcomes (UOs) (in cognitive domain)	**Topics and Sub-topics**
Units 1 : Integration	
6.a.Define different types of vectors 6.b. Find dot and cross product of vectors. 6.c. Find work done and moment of force about the point and line.	6.1 Definition of vector, position vector, Algebra of vectors (Equality, addition, subtraction and scalar multiplication) 6.2 Dot (Scalar) product with properties. 6.3 Vector (Cross) product with properties. 6.4 Work done and moment of force about a point & line.

8. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
01	Integration	09	08	08	08	16(24)
02	Definite integration	09	02	04	12	12(18)
03	Differential equation	12	04	12	08	16(24)
04	Complex number	06	06	08	04	12(18)
05	Laplace Transform	06	06	08	04	12(18)
06	Vectors	06	06	04	08	12(18)
		Total	**32**	**44**	**44**	**80(120)**

9. SUGGESTED STUDENT ACTIVITIES

Other than the classroom and laboratory learning, following are the suggested student-related ***co-curricular*** activities which can be undertaken to accelerate the attainment of the various outcomes in this course:

a. Identify engineering problems based on real world problems and solve with the use of free tutorials available on internet.
b. Use graphical software's:EXCEL,DPLOT and GRAPH for related topics.
c. Use Mathcad as Mathematical Tool and solve the problems on Calculus.
d. Indentify problems based on applications of differential equations and solve these problems.

10. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are sample strategies, which the teacher can use to accelerate the attainment of the various outcomes in this course:

a. Massive open online courses (***MOOCs***) may be used to teach various topics/sub topics.
b. About ***15-20% of the topics/sub-topics*** which is relatively simpler or descriptive in nature is to be given to the students for ***self-directed learning*** and assess the development of the COs through classroom presentations (see implementation guideline for details).
c. Use Flash/Animations to explain various components, operation.
d. Teacher should ask the students to go through instruction and Technical manuals

11. SUGGESTED MICRO-PROJECTS

(Only for Class Declaration Courses)

N.A.

12. SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication	ISBN Number
1	Higher Engineering Mathematics	Grewal B.S	Khanna Publications, New Delhi	ISBN: 978-81-933284-9-1
2	AText Book of Engineering Mathematics	Dutta D	New Age Publications, New Delhi	ISBN: 8122414184
3	Advance Engineering Mathematics	H.K. Das	S. Chand & Co. Ltd. Delhi	ISBN 9789352533831
4	Advance Engineering Mathematics	Krezig,Ervin	Wiley Publications New Dehli.	ISBN 9788121903455

13. SOFTWARE/LEARNING WEBSITES

a. *www.scilab.org/ -SCI Lab*
b. *www.mathworks.com/product/matlab/ -MATLAB*
c. *Spreadsheet Applications*
d. *www.dplot.com*
e. *https://www.khanacademy.org/math?gclid=CNqHuabCys4CFdOJaddHoPig*

14. PO - COMPETENCY- CO MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	2	2	1	-	-	-	1
CO2	3	3	1	-	-	1	2
CO3	3	3	-	-	-	-	1
CO4	3	3	1	1	-	-	1
CO5	3	3	1	1	-	-	1
CO6	3	3	1	1	-	-	1
AVERAGE	**3**	**3**	**1**	**1**	**-**	**1**	**2**

CO	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	1	1	1	1
CO2	1	1	1	1
CO3	1	1	1	1
CO4	2	2	2	2
CO5	1	1	1	1
CO6	2	2	2	2
Average	**2**	**2**	**2**	**2**

PREPARED BY:

Sign: Name: 1.Shri V.B.Shinde 2.Mrs.P.R.Nemade (Course Experts)	Sign: Name: Mrs. N.S. Kadam (Head of Department)
Sign: Name: Dr. S. S. Bharatkar/Shri. R. U. Shelke (Program Head) (Department of Electrical Engineering)	Sign: Name : Mr.A.S.Zanpure (CDC Incharge)

Level 3 Curriculum

Government Polytechnic, Pune

'180OB' – Scheme

Programme	Diploma in ET/CE/**EE**//ME/MT/CM/IT/DDGM
Programme code	01/**02**/03/04/05/06/07/08/15/**16**/17/18/19/21/**22**/23/24/26
Name of Course	**Electrical CAD**
Course Code	**EE3101**
Prerequisite course code and name	No
Class Declaration	No

1. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P)		Examination Scheme				
					Theory		Practical		Total Marks
L	T	P	C		ESE	PA	* ESE	PA	
00	00	02	02	Marks	--	--	25	25	50
				Exam Duration	--	--	-		

Legends: L- lecture, T-Tutorial/teacher guided theory practice, P-practical, C-Credits, ESE-End semester examination, PA- Progressive Assessments(Test I, II/Term Work), * - Practical Exam, $ - Oral Exam. # - Online Exam., Each lecture/practical period is of one clock hour.

2. RATIONALE

In any commercial, power and industrial sector the drawing of their manufactured equipment, their installation, operation and maintenance is required. To work in such industries a technician must possess the skill of reading, interpreting different drawings and simulating electrical and electronics circuit for most of the activities. With the evolution of various computer software's, the role of earlier draftsman is now taken over by Computer software. The Computer Aided Drawing (CAD) and simulation software's like PSpice, Electronic workbench or any other similar software is included in this course. It is also helpful for better understanding of various concepts already studied by the students in earlier courses.

3. COMPETANCY

The aim of this course is to attend following industry identified competency through various teaching learning experiences:

- **Draw various circuits and diagrams using AutoCAD software.**

4. COURSE OUTCOMES (COs)

The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry-oriented COs associated with the above-mentioned competency**:**

1 – Draw different circuits using CAD
2 – Develop new designs of machines using CAD
3 -- State the procedure to build simple simulation circuits using PSPICE.
4 – Understand utility of CAD

5. SUGGESTED PRACTICALS/ EXERCISES

Pr. No.	**Practical Exercises** (Learning Outcomes in Psychomotor Domain)	**Relevant CO**	**Approx. Hrs. required**
1	Demonstration of use of AutoCAD	1	4
2	Draw electrical and electronic symbol using CAD and take print out. (Switch, three pole switch, lamp, Resistance, Inductance, Capacitance, Transformer, Diode, Zener Diode, Transistor (PNP, NPN), Gates: AND, OR, NOT, NOR, NAND, Ex-OR)	1 & 2	4
3	Draw a circuit of verification of Ohm's law	1 & 2	2
4	Draw RLC series circuit.	1 & 2	2
5	Draw D.C.machine parts using CAD	1, & 4	4
6	Draw single line diagram of any one power plant.	1, 2 & 4	4
7	Draw bridge rectifier circuit using CAD	1, 2 & 4	2
8	Introduction of P-SPICE software	3	2
9	Draw and observe the rise and decay of current in inductance by using P-SPICE	3	4
10	Draw the Charging of capacitor through resistance using P-SPICE.	3	4
11	Microproject planning & Execution as written in suggested microproject list		2
12	Microproject report writing		2
13	Suggested student activity report		2
Total			**38**

Sr. No.	**Performance Indicators**	**Weightage in %**
a.	Arrangement of available equipment / test rig or model	10
b.	Setting and operation	10
c.	Safety measures	20
d.	Observations and Recording	15
e.	Interpretation of result and Conclusion	20
f.	Answer to sample questions	10
g.	Submission of report in time	15
Total		**100**

6. MAJOR EQUIPMENT/ INSTRUMENTSREQUIRED

The major equipment with broad specification mentioned here will usher in uniformity in conduct of practical's, as well as aid to procure equipment by authorities concerned**.**

Sr. No.	Equipment Name with Broad Specifications	Pr. No.
1	Computer with AutoCAD software	1,2,3,4,5,6,7
2	Computer with P-SPICE software	8,9,10

7. THEORY COMPONENTS- Not Applicable

8. SUGGESTED SPECIFICATION TABLE FORQUESTION PAPER DESIGN- Not Applicable

9. SUGGESTED STUDENT ACTIVITIES

Other than the classroom and laboratory learning, following are the suggested student-related ***co-curricular*** activities which can be undertaken to accelerate the attainment of the various outcomes in this course. Students should conduct following activities in group and prepare reports of about 5 pages for each activity, also collect/record physical evidences for their (student's) portfolio which will be useful for their placement interviews:

a. Prepare journal based on practical performed in Computer laboratory. Journal consists of drawing, observations,required equipment's, date of performance with teacher signature.
b. Collect information on different available electrical CAD software.
c. Read at least three different Electrical drawing other than those covered in the practical.

10. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are sample strategies, which the teacher can use to accelerate the attainment of the various outcomes in this course:

a. Massive open online courses (***MOOCs***) may be used to teach various topics/sub topics.
b. About ***15-20% of the topics/sub-topics*** which is relatively simpler or descriptive in nature is to be given to the students for ***self-directed learning*** and assess the development of the COs through classroom presentations (see implementation guideline for details).
c. With respect to item No.8, teachers need to ensure to create opportunities and provisions for ***co-curricular activities***.
d. Guide student(s) in undertaking micro-projects.
e. Correlate subtopics with power plant system and equipment.
f. Use proper equivalent analogy to explain different concepts.
g. Use Flash/Animations to explain various components, operation.
h. Teacher should ask the students to go through instruction and technical manuals.

11. SUGGESTED MICRO-PROJECTS– SUGGESTED MICRO-PROJECTS:

12. Only one micro-project is planned to be undertaken by a student that needs to be assigned to him/her. In the first four semesters, the micro-projects are group-based. However, in the fifth and sixth semesters, it should be preferably be individually undertaken to build up the skill and confidence in every student to become problem solver so that s/he contributes to the projects of the industry. In special situations where groups have to be formed for micro-projects, the number of students in the group should not exceed three.

The micro-project could be industry application based, internet-based, workshop-based, laboratory-based or field-based. Each micro-project should encompass two or more COs which are in fact, an integration of PrOs, UOs and ADOs. Each student will have to maintain dated work diary consisting of individual contribution in the project work and give a seminar presentation of it before submission. The total duration of the micro-project should not be less than 16 (sixteen) student engagement hours during the course. The student ought to submit micro-project by the end of the semester to develop the industry-orientedCOs.

A Suggestive list of microproject are given here. Similar microproject could be added by the concerned faculty:

a. 2D Transmission: Each batch will identify fasteners, couplings; joints used in electric motors and using CAD software prepare drawings. The figures should be labeled and dimensioned using software.

b. 2D Electric circuit Components: Each batch will identify electric circuit components and using CAD software and prepare drawings. The figures should be labeled and dimensioned using software

c. 2D transformer Components: Each batch will identify transformer components and using CAD software and prepare drawings. The figures should be labeled and dimensioned using software.

d. 2D Electric motor Components: Each batch will identify Electric motor components and using CAD software and prepare drawings. The figures should be labeled and dimensioned using software.

e. 2D Transmission: Each batch will identify fasteners, couplings; joints used in electric machines and using CAD software and prepare isometric drawings. The figures should be labeled and dimensioned using software.

f. 2D Electric Machine components: Each batch will identify electric machine components and using CAD software and prepare isometric drawings. The figures should be labeled and dimensioned using software.

g. Digital Drawings: Each batch will identify manual drawings of electric machine components using CAD software and create digital drawings using relevant software

h. Draw the layout of the earthing system using electrical CAD software.

j. Draw circuit diagram of electrical components using electrical CAD software

k. P Spice software: Using P Spice software draw the Different Electrical, Electronic circuits.

l. SLD using CAD: Each batch will draw the Single line diagram (SLD) for any one Substation.

13. SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication	ISBN
1	Electrical Drawing	Narang K.L.	Styaprakashan, New Delhi	ISBN : 8176841501
2	Computer Aided Electrical Drawing	Yogesh, Nagaraja,Nandan	PHI Publication	ISBN 9788120349537
4	AutoCad 2016 exercise workbook for windows	Shrock, Cheryl R, and Heather Steve	Industrial Press Inc. South Norwalk, USA, First, 2016	ISBN : 9788120349537
5	Electrical Engineering Drawing	S.K.Bhattacharya	New Age International, New Delhi	ISBN : 8122408559

14. SOFTWARE/LEARNING WEBSITES

i) AutoCAD software
ii) http://www.faveodesign.co.uk/CAD_Drawings.htmal
iii) http://cad.about.com/od/Learn_CAD/a/The-Fundamentals-of-Drawing.html
iv) http://transport.itu.edu.tr/PDF/iml332e/Fundamentals%20of%20CAD.pdf

15. PO - COMPETENCY- CO MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
1	2	-	2	1	1	1	3
2	3	1	2	2	1	2	3
3	2	1	2	2	1	2	2
4	2	1	1	2	2	2	2

CO	PSO1	PSO2	PSO3	PSO4
1	-	2	3	-
2	1	2	3	1
3	1	2	2	-
4	1	1	1	1

Sign: Name: **1**. Smt. U. S. Tulangekar **2**. Dr.V. K. Jadhav (Course Experts)	Sign: Name:Dr.S.S.Bharatkar/Shri.R.U. Shelke (Head of Department)
Sign: Name: Dr.S.S.Bharatkar/Shri.R.U. Shelke (Program Head) (Department of Electrical Engineering)	Sign: Name: Shri A. S. Zanpure (CDC Incharge)

Government Polytechnic, Pune

'180 OB'– Scheme

Programme	Diploma in ET/CE/**EE**//ME/MT/CM/IT/DDGM
Programme code	01/**02**/03/04/05/06/07/08/15/**16**/17/18/19/21/**22**/23/24/26
Name of Course	**Electrical Circuit Analysis**
Course Code	**EE3102**
Prerequisite course code and name	No
Class Declaration	No

1. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P)		Examination Scheme				
					Theory		Practical		Total Marks
L	**T**	**P**	**C**		**ESE**	**PA**	*** ESE**	**PA**	150
03	01	02	06	**Marks**	80	20	25	25	
				Exam Duration	3 Hrs	1 Hr	-		

Legends: L- lecture, T-Tutorial/teacher guided theory practice, P-practical, C-Credits, ESE-End semester examination, PA- Progressive Assessments(Test I, II/Term Work), * - Practical Exam, $ - Oral Exam. # - Online Exam., Each lecture/practical period is of one clock hour.

2. RATIONALE

It is essential for every electrical engineer to know the behavior of resistance, capacitance, inductance and related concepts in AC and DC systems. This course intends to teach the analysis of D.C. circuits using network theorems. It also covers the analysis of single phase, three phase AC circuit and transient analysis. This course is not only a prerequisite to learn the advanced electrical courses and develop the skills but also enable the students to apply the principle of A.C. circuits to troubleshoot electrical circuits in industries/Power System. This is one of the most important core engineering course for electrical engineers . Hence students should try to develop mastery over concepts of A.C. circuits and network theorems for effective working as an electrical engineer.

3. COMPETENCY

The aim of this course is to attend following industry identified competency through various teaching learning experiences:

Maintain electrical systems applying AC and DC circuit fundamentals.

4. COURSE OUTCOMES (COs)

The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry oriented COs associated with the above mentioned competency**:**

1. Apply basic principles of AC circuits in Electrical systems.
2. Analyze the behavior of series resonant circuits.
3. To analyze the behavior of parallel AC circuits.
4. Analyze the 3 phase circuits in electrical engineering.
5. Solve the complex networks and A.C./ D.C. circuits by applying suitable Theorems

5. SUGGESTED PRACTICALS/ EXERCISES

Pr. No.	**Unit No.**	**Practical Exercises** (Learning Outcomes in Psychomotor Domain)	**Relevent CO**	**Approx. Hrs. required**
1	2	To observe the response of pure R,pure L and pure C on CRO	1,2	02
2	2	To find resistance and inductance of choke coil.	1,2	02
3	2	To find current and p.f. in R-C-Series circuit	2	02
4	2	Draw a phasor diagram of R-L-C series circuit for following conditions, a) Lagging P.F. b) Leading P.F. c) Unity P.F.	3	02
5	3	Draw a phasor diagram of R-L and C parallel circuit & determine P.F. circuit current, & power.	2	02
6	4	To find the relationship between line voltage and phase voltage and line current and phase current in three phase star connected circuit.	4	02
7	4	To find the relationship between line voltage and phase voltage phase voltage and line current and phase current in three phase Delta connected circuit.	4	02
8	5	Verification of superposition Theorem	2	02
9	5	Verification of Thevenin Theorem	2	02
10	5	Verification of Norton Theorem	2	02
11		Microproject planning & Execution as written in suggested microproject list		02
12		Microproject report writing		02
13		Suggested student activity report		02

Sr. No.	Performance Indicators	Weightage in %
a.	Arrangement of available equipment / test rig or model	10
b.	Setting and operation	10
c.	Safety measures	20
d.	Observations and Recording	15
e.	Interpretation of result and Conclusion	20
f.	Answer to sample questions	10
g.	Submission of report in time	15
Total		**100**

6. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

The major equipment with broad specification mentioned here will usher in uniformity in conduct of practicals, as well as aid to procure equipment by authorities concerned**.**

Sr. No.	Equipment Name with Broad Specifications	Pr. No.
1	R,L& C components, CRO, AC supply	1
2	Ammeter, Voltmeter, lamp, choke coil,capacitor	2,3,4
3	Ammeter, Voltmeter, 3 ph lamp load	5,6
4	Ammeter, Voltmeter, circuit board	7,8,9,10

7. THEORY COMPONENTS

Unit Outcomes (UOs) (in cognitive domain)	**Topics and Sub-topics**
UNIT 1. AC Fundamentals and Phasor Algebra HRS - 08 MARKS-12	
1a A.C. Fundamentals 1b Represent an alternating quantity in polar and rectangular form 1c What is an operator j? Explain its Significance 1d Convert the phasor given in rectangular form into polar form or vice versa 1e Perform the operations like Addition, subtraction, Multiplication and division of vector quantity and express the result in rectangular and polar form.	1.1 Generation of alternating voltage by simple generator. Derivation of EMF equation Terminologies like Amplitude, Frequency, Period, Cycle, Instantaneous values RMS value ,Average value, Form Factor, Amplitude factor. 1.2 Concept of polar and rectangular form of an alternating quantity and their utility. 1.3 Significance of operator 'j'. 1.4 Conversion of polar to rectangular and vice versa. (Numerical). 1.5 Addition, subtraction, Multiplication and division of vector quantity.
UNIT-2 Single Phase A.C. Series Circuits HRS -10 MARKS-18	

Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
2a Explain the behavior of AC voltage, current and power through pure resistance, pure inductance and pure capacitance with sketches. 2b Explain behavior of AC voltage, Current and power through RL, RC and RLC series circuit with circuit diagram, phasor diagram and waveforms.	2.1 Basic concept of A.C. Circuit. Derivation of expression for current. Phasor diagram, wave form of voltage and current for Pure resistance (R),Pure inductance (L),pure Capacitor (C). Average power consumed in pure inductive and pure capacitive circuit. 2.2 Concept of Inductive and capacitive reactance, Impedance, power factor. A.C .through R-L, R-C, and R-L-C series circuit. Calculation of current, power and power factor. Phasor diagram, waveform. Impedance Triangle, Power Triangle.
2c Define resonance in RLC series and draw phasor diagram for resonance in RLC series circuit. 2d Derive an expression of resonant frequency, Quality factor of series resonance circuit. 2e Draw the graphs showing variation of R, X_L, X_C,X, Z & I versus Frequency 2f Solve numerical on resonance in RLC series circuit	2.3 Resonance of R-L-C series circuit. Phasor diagram for resonance in RLC series circuit. Derivation of resonant frequency, Quality factor of series resonance circuit. 2.4 Graphical representation, effect of frequency on R,X_L, X_C, X , Z, p.f. & I. 2.5 Numerical.
UNIT-3 Single Phase A.C. Parallel Circuits	**HRS – 08 MARKS-14**
3a Define the terms admittance, susceptance and conductance and Calculation of current, power, power factor in R-L, RC,R-L-C parallel circuits using rectangular and polar methods. 3b Explain admittance method, phasor methods used to solve parallel circuits. 3c Define resonance in parallel circuit and derive expression for resonant frequency, Quality factor 3d Compare series and parallel resonance circuits 3e Solve numerical on resonance in parallel circuit	3.1 Concept of parallel circuit. Concept of admittance, susceptance and conductance. Calculation of current, power, power factor in R-L, RC,R-L-C parallel circuits using rectangular and polar methods. 3.2 Use of admittance method, phasor method to solve parallel circuit. 3.3 Study of parallel resonance, Derivation of resonant frequency, quality factor. 3.4 Comparison of series and parallel resonance. 3.5 Numerical
UNIT-4 Poly-phase A.C. Circuits	**HRS - 10 MARKS-18**
4a State the Advantages of 3 phase system over 1 phase system. 4b Describe the principle of 3-phase emf generation and draw its waveform and phasor diagram 4c Define phase sequence for polyphase system and state possible	4.1 Advantages of 3 phase system over 1 phase system for the transfer of same power. 4.2 Principle of 3-phase emf generation and its waveform, and phasor diagram. 4.3Concept of phase sequence, Positive and Negative phase sequences for

Unit Outcomes (UOs) (in cognitive domain)	**Topics and Sub-topics**
phase sequences for three phase system. 4d Explain types of interconnections of three phase systems 4e State and derive relationship between line and phase quantities for star and delta connection.	three phase system. symmetrical system . Balanced and Unbalanced load. Neutral shifting in balanced load. 4.4Star Connection system and delta connection systems- Connection diagram advantages, disadvantages and applications of each types. 4.5 Relation between phase and line current, phase and line voltage in Star connected and Delta connected balanced system. Phasor diagram. Calculation of current, power, power factor in a 3 Phase balanced load (Numerical).
UNIT-5 D.C./A.C. Circuits and Theorems HRS -12 MARKS-18	
5a Define electric network and its types and define source, load. 5b State, explain and apply different laws and theorems for analyzing d.c. circuits. 5c Apply theorems to AC circuits	5.1 Definitions- Source, Load, Unilateral and Bilateral circuits. Linear and Non Linear circuits. 5.2 Statement, Explanation and application of following laws and theorems for given DC/AC circuits and numerical. a) Superposition Theorem b) Thevenin's Theorem c) Norton's Theorem d) Maximum Power Transfer Theorem Simple numerical. 5.3 Application of superposition theorem only to AC circuit.

8. SUGGESTED SPECIFICATION TABLE FORQUESTION PAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	**AC Fundamentals and Phasor Algebra**	08	4	4	4	12
II	**Single Phase A.C. Series Circuits**	12	2	4	12	18
III	**Single Phase A.C .Parallel Circuits**	08	2	4	8	14
IV	**Poly-phase A.C. Circuits**	10	2	6	10	18
V	**D.C./A.C. Circuits and Theorems**	10	2	6	10	18
Total		**48**	**12**	**24**	**44**	**80**

9. SUGGESTED STUDENT ACTIVITIES

Other than the classroom and laboratory learning, following are the suggested student-related ***co-curricular*** activities which can be undertaken to accelerate the attainment of the various outcomes in this course: Students should conduct following activities in group and prepare reports of about 5 pages for each activity, also collect/record physical evidences for their (student's) portfolio which will be useful for their placement interviews:

a. Visit any 33/11 kV substation nearby to your house and take the help of sub station incharge to know the three phase circuit and occurrence of fault.
b. Write report on accidental power off /shutdown problem in hostel/building.
c. Library/Internet survey of electrical circuits and networks.
d. Analyse circuit response to diagnose faults in the electric circuits.

Prepare journal based on practical performed in Electrical laboratory. Journal consists of drawing, observations, required equipment's, date of performance with teacher signature.

10. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are sample strategies, which the teacher can use to accelerate the attainment of the various outcomes in this course:

a. Massive open online courses (***MOOCs***) may be used to teach various topics/sub topics.
b. About ***15-20% of the topics/sub-topics*** which is relatively simpler or descriptive in nature is to be given to the students for ***self-directed learning*** and assess the development of the COs through classroom presentations (see implementation guideline for details).
c. With respect to item No.8, teachers need to ensure to create opportunities and provisions for ***co-curricular activities***.
d. Guide student(s) in undertaking micro-projects.
e. Correlate subtopics with power plant system and equipments.
f. Use proper equivalent analogy to explain different concepts.
g. Use Flash/Animations to explain various components, operation and
h. Teacher should ask the students to go through instruction and Technical manuals

11. SUGGESTED MICRO-PROJECTS –

Only one micro-project is planned to be undertaken by a student that needs to be assigned to him/her. In the first four semesters, the micro-projects are group-based. However, in the fifth and sixth semesters, it should be preferably be individually undertaken to build up the skill and confidence in every student to become problem solver so that s/he contributes to the projects of the industry. In special situations where groups have to be formed for micro-projects, the number of students in the group should not exceed three.

The micro-project could be industry application based, internet-based, workshop-based, laboratory-based or field-based. Each micro-project should encompass two or more COs which are in fact, an integration of PrOs, UOs and ADOs. Each student will have to maintain dated work diary consisting of individual contribution in the project work and give a seminar presentation of it before submission. The total duration of the micro-project should not be less than 16 (sixteen) student engagement hours during the course. The student ought to submit micro-project by the end of the semester to develop the industry oriented COs.

a) Single Phase A.C. series and parallel Circuits : Prepare series and parallel LED lamp load (R,L,C) circuit. Measure the response and draw vector diagram. Calculate power factor for the circuit.
b) Three Phase Balanced Circuit : Prepare three phase network of balanced load at 230 volts and determine phase and line quantities and also calculate active and reactive power for the given load.
    a. Star Connection
    b. Delta Connection
c) Three Phase Unbalanced Circuits : Prepare the three phase network of unbalanced load and determine phase and line quantities and also calculate active and reactive power for given load.
    i) Star Connection
    ii) Delta Connection
d) Principles of circuit analysis and network theorem : Prepare power point presentation on source transformation, star delta transformation, mesh and nodal analysis, network theorems for the given network.

12. SUGGESTED LEARNING RESOURCES

S. N.	Title of Book	Author	Publication	ISBN Number
1	Electrical Technology Vol .I	B.L.Theraja	S .Chand Publication ,Delhi	**ISBN**: 8121924405
2	Basic Electrical Engineering	V.N.Mittle	Tata McGraw Hill Publishing Company Ltd. ,New Delhi.	ISBN 978-0-07-0088572-5
3	Electrical Technology	Edward Hughes	Low Price Edition	ISBN 13- 978-0582405196
4	Electrical Engineering	H. Cotton	CBS *Publishers*& Distributors	**ISBN: 9788123909288**

13. SOFTWARE/LEARNING WEBSITES

www.electrical4u.com/electrical-engineering-articles/measurement/
www.iskra.eu/en/Electrial-Measuring -Instruments/

14. PO - CO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	2	2	1	--	--	2
CO2	3	2	2	1	--	--	2
CO3	2	2	2	1	--	--	2
CO4	3	2	2	1	--	--	2
CO5	1	1	1	1	--	--	1

	PSO1	PSO2	PSO3	PSO4
CO1	2	2	1	1
CO2	2	2	1	1
CO3	2	2	1	1
CO4	2	2	1	1
CO5	1	2	1	1

Sign- Name-1)Smt.U.S.Tulangekar) 2) Shri S P. Date (Course Experts)	Sign- Name- Dr. S.S. Bharatkar/Shri.R.U. Shelke (Head of Department)
Sign: Name:Dr.S.S.Bharatkar/Shri.R.U. Shelke (Program Head) (Department of Electrical Engineering)	Sign- Name- Shri. Anant. S. Zanpure (CDC Incharge)

Government Polytechnic, Pune

'180 OB'– Scheme

Programme	Diploma in ET/CE/**EE**//ME/MT/CM/IT/DDGM
Programme code	01/**02**/03/04/05/06/07/08/15/**16**/17/18/19/21/**22**/23/24/26
Name of Course	**Electrical Measurements& Instruments**
Course Code	**EE3103**
Prerequisite course code and name	No
Class Declaration	No

1. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P)		Examination Scheme				
					Theory		Practical		Total Marks
L	**T**	**P**	**C**		**ESE**	**PA**	**$ ESE**	**PA**	
03	00	02	05	**Marks**	80	20	25	25	150
				Exam Duration	3 Hr	1 Hr	-	--	

Legends: L- lecture, T-Tutorial/teacher guided theory practice, P-practical, C-Credits, ESE-End semester examination, PA- Progressive Assessments(Test I, II/Term Work), * - Practical Exam, $ - Oral Exam. # - Online Exam., Each lecture/practical period is of one clock hour.

2. RATIONALE

Diploma holders have to carry many tests on electrical machines and equipment. For testing, meters and instruments are required to be used, operated and handled. Construction, working principle and operation of such meters, instruments equipment should be known to electrical technicians. This course consists of :

1. Measurement methods of resistance, inductance and capacitance.
2. Measurement of active & reactive power , Energy in 1-phase & 3-phase circuits
3. Calibration methods of various meters
4. Construction, working principle & operation of all types of AC & DC meters which is required lifelong in student's job profile.

3. COMPETENCY

The aim of this course is to attend following industry identified competency through various teaching learning experiences:

- **Use and calibrate different types of electrical measurement systemsand instruments used in the industry and power systems**

4. COURSE OUTCOMES (COs)

The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry oriented COs associated with the above mentioned competency**:**

The student should be able to:

1 :Know various electrical measuring instruments and working of

PMMC, MI and dynamometer type instruments.
2 : Measure electric circuit parameters by different methods.
3 : Know working and use of instrument transformers & wattmeter.
4 : Use energy meter & various special measuring instruments considering the construction & working.

5. SUGGESTED PRACTICALS/ EXERCISES

Pr. No	Unit No.	Practical Exercises (Learning Outcomes in Psychomotor Domain)	Relevent CO	Approx Hrs. required
1	1	Symbols used for identifying different types of analog instruments.	1	02
2	2	Disassemble the MI & PMMC type instruments & show the different parts of instruments. Also write functions & materials used for the same.	1	02
3	2	Calibration of Ammeter and Voltmeter	1	02
4	3 5	a) Measurement of Resistance, Voltage, Current in A.C & D. C. Circuit by using digital multimeter. b) Measurement of A.C. Current by Clip-on ammeter (Tong Tester).	1	04
5	4	Measurement of Medium resistance by Whetstone's bridge or Kelvin's double bridge.	2	02
6	3	Measurement of Earth Resistance by Earth Tester	2	02
7	3	Measurement of Insulation Resistance by Megger.	2	02
8	5	Extension range of meters using CT and PT.	3	02
9	6	Measurement of active and reactive power in three phase balanced load by single wattmeter method.	3	02
10	6	Measurement of active and reactive power in three phase balanced load by two wattmeter method and observe the effect of Power Factor variation on Wattmeter reading.	3	02
11	7	Calibration of Energy meter at various power factors & load as per IS with standard energy meter or wattmeter & stopwatch.	4	02
12	8	Measurement of power factor of single phase and three phase load by PF meter and verifying through I, V and P measurement.	4	02
13	8	Measurement of Circuit Parameters by LCR meter.	4	02
14	8	Determination of phase sequence of three phase supply using phase Sequence Indicator.	4	02
15		Microproject planning & Execution as written in suggested microproject list		02
16		Microproject report writing		02
17		Suggested student activity report		02
TOTAL				**38**

Sr. No.	Performance Indicators	Weightage in %
a.	Arrangement of available equipment or model for testing	20
b.	Setting and operation	15
c.	Safety measures	20
d.	Observations and Recording	15
e.	Interpretation of result and Conclusion	15
f.	Submission of report in time	15
Total		**100**

6. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

The major equipment with broad specification mentioned here will keep uniformity in conduct of practical, as well as aid to procure equipment by authorities concerned.

Sr. No.	Equipment Name with Broad Specifications	Pr. No
1	Different (analog) measuring instruments	1
2	DC Ammeters, Voltmeters	1,2
3	Ammeter - 1 standard and 1 to be calibrated	3
4	Rheostat , AC supply , multimeter, clip on ammeter	3,4
5	Wheatstone's bridge & Kelvin's double bridge	5
6	Earth Tester	6
7	Megger	7
8	CT, PT, ammeter & voltmeter	8
9	Wattmeter , balanced load	9,10,11
10	Energy meter, wattmeter and stop watch	12
11	LCR meter	13
12	Phase sequence indicator	14

7. THEORY COMPONENTS

Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
UNIT- 1: Fundamentals Of Measurement	**HRS -04 Marks-08**
1a. Describe the necessity of measurement and electrical measuring Instruments 1b.State the different qualities of instruments and define the terms sensitivity, accuracy, Precision, reliability, stability. 1c.Differentiate between direct and indirect methods of measurement. 1d.Give the classification of instruments and discriminate between Indicating, integrating and recording, absolute and secondary instrument.	1.1 Need of measurement and electrical measuring instruments 1.2 Qualities of electrical measuring instruments: sensitivity, accuracy, precision, reliability, stability 1.3 Methods of measurement: Direct and indirect measurement 1.4 Classification of instruments based on : a) Methods of measurement as absolute and secondary instruments. b) Limits of percentage error (Instrument

Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
1e.Differentiate between deflecting, controlling and damping torques. 1f.Different types of errors with examples.	classes Standard and sub-standard instruments). c) Principle of operation. Nature of operation as indicating, recording and integrating type. 1.5 Essential torques in indicating instruments:- Deflecting, Controlling and damping torques. 1.6 Types of errors.
UNIT-2: Ammeters And Voltmeters	**HRS -06 Marks-10**
2a. Explain the Working of Galvanometer. 2b.State the different types of Ammeter and Voltmeter and explain the principle of operation, construction, merits and demerits of each type of meter. 2c.Differentiate between different types of ammeter and voltmeter 2d.Describe the conversion of galvanometer to ammeter and voltmeter 2e.Illustrate the use of shunts and multipliers for range extension of ammeter and voltmeter. 2f. To Calibrate given ammeter and voltmeter.	2.1 Review of construction & principle of Galvanometer (PMMC Type). 2.2 Types of Ammeter and Voltmeter :- PMMC, MI, & dynamometer type 2.3 Construction, principle of operation, merits and demerits of above types of meters. 2.4 Differentiate between different types of ammeters and voltmeters 2.5 Conversion of galvanometer to ammeter using shunt. 2.6 Conversion of galvanometer to voltmeter using multiplier. 2.7 Extension of range of voltmeter and ammeter using multiplier & shunt respectively 2.8 Calibration of ammeter & voltmeter using Standard meters
UNIT-3: Measurement Of Resistance	**HRS -04 Marks-08**
3a.Classify different types of Resistances. 3b.Explain the procedure to measure low resistance. 3c.Explain the procedure and different methods used to measure medium resistance 3d.Draw the block diagram of digital multimeter and state its Advantages and Applications. 3e.What is Megger? How measurement of high resistance is carried out using Megger. 3f.Explain the Measurement of earth resistance using earth tester	3.1 Classification of electrical resistances based on magnitude range as low, medium & high. 3.2 Methods and procedure used for measurement of low resistance. 3.3 Methods and procedure used for measurement of medium resistance by a) Whetstone's bridge method b) Ammeter-voltmeter method. c) Ohmmeter 3.4 Digital Multimeter:-Block Diagram, Advantages and Applications. 3.5 Measurement of insulation resistance by Megger. 3.6 Measurement of earth resistance by : earth tester.
UNIT-4: Measurement Of Inductance And Capacitance	**HRS -05 Marks-08**
4a. Select an A.C. bridge 4b.Determine inductance and capacitance and explain their working.	4.1 Measurement of Inductance and capacitance using a)Maxwell's Inductance Bridge b) Anderson's bridge c) Schering Bridge

Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
	4.2 Precautions & limitations of A.C. bridges (No derivation ,No phasor Diagram) only formula & simple numerical.
UNIT-5: Instrument Transformers	**HRS -04 Marks-06**
5a. Illustrate the use of an Instrument transformer like C.T and P.T with constructional details. 5b. State and explain different types of errors in CT and PT. Describe the methods to be adopted to minimise these errors. 5c. Describe the ways to extend the ranges of meters using CT and PT 5b. Describe the construction& working of Clip-on ammeter	5.1 C.T. & P.T. – Construction, types & requirements. 5.2 Terminology of CT & PT such as ratio, burden & phase angle error 5.3 Precautions to be taken in their use. 5.4 Specification & Classes of C.T. & P.T. 5.5. Extension of range A.C. Ammeter and A.C. Voltmeter using CT and PT. 5.5 Advantages of CT and PT over shunt and multiplier 5.6 Clip-on ammeter –construction & working.
UNIT-6 : Measurement Of Power	**HRS -08 Marks-14**
6a.Explain the use of dynamometer type wattmeter. 6b. Determine the Error due to pressure coil connections 6c. Carry out Calibration of wattmeter. 6d. Polyphase wattmeter 6d. Select the appropriate method for measurement of power in three-phase circuit.	6.1 Principle of operation, construction of dynamometer type wattmeter. 6.2 Low P.F. Wattmeter (Electrodynamometer type) and its use. 6.3 Error due to pressure coil connections 6.4 Procedure for Calibration of wattmeter 6.5 Construction and operation of polyphase watt-meter. 6.6 Measurement of active & reactive power in three phase circuits for balanced and unbalanced loads using Two wattmeter method calculation of p.f. from wattmeter readings, effect of p.f. variation on wattmeter readings. 6.7 Measurement of active &reactive power in three phase balanced load by using one wattmeter method.
UNIT-7: Measurement Of Electrical Energy	**HRS -09 Marks-14**
7a. Describe the construction and working of single phase and three phase energy meter (Induction Type) 7b. Describe different errors occurring during measurement of energy. Also describe the methods reducing these errors. 7c.Carry out calibration of Energy meter 7d.Know the recent trends in energy meters 7e.Procedure of energy meter testing	7.1 Principle of operation & Construction of single phase and three-phase induction type energy meter. 7.2 Errors and their correction. 7.3 Procedure for Calibration of energy meter as per I.S 7.4 Digital Energy meter, Smart Energy meter, and Tri-vector meter. 7.5 Testing of energy meter (induction and digital energy meter) as per I.S.
UNIT-8: Special Measuring Instruments	**HRS -08 Marks-12**
8a. Know the special measuring	8.1 Construction and working principle of single

Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
Instruments. Describe the construction, working and applications.	phase electrodynamometer type P.F. meter. 8.2 Construction & working principle of moving iron type p.f. meter. 8.3 Weston type synchroscope. 8.4 L.C.R. Meter. 8.5 Phase sequence indicator-Static type and rotating type. 8.6 Frequency meter (Weston & Ferro dynamic type)

8. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Fundamentals of Measurements	04	04	02	02	08
II	Ammeter and Voltmeter	06	04	02	04	10
III	Measurement of resistance	04	02	02	04	08
IV	Measurement of Inductance &Capacitance	05	02	04	02	08
V	Instrument Transformer	04	02	02	02	06
VI	Measurement of Power	08	04	04	06	14
VII	Measurement of Electrical Energy	09	04	06	04	14
VIII	Special Measuring Instruments	08	04	04	04	12
Total		**48**	**26**	**26**	**28**	**80**

9. SUGGESTED STUDENT ACTIVITIES

Other than the classroom and laboratory learning, following are the suggested student-related ***co-curricular*** activities which can be undertaken to accelerate the attainment of the various outcomes in this course: Students should conduct following activities in group and prepare reports of about 5 pages for each activity, also collect/record physical evidences for their (student's) portfolio which will be useful for their placement interviews:

a. Prepare chart showing real-life examples indicating various types of electrical measuring equipment.
b. Collect photographs of PMMC and MI instrument showing internal parts.
c. Prepare power point presentation for different types of wattmeter.
d. Collect photographs of Digital energy meter and prepare breadband circuit models of simple Digital energy meter.
e. Collect photographs of CRO and see the practical utilization.
f. Collect photographs of Tri-vector meter and see the practical utilization in HT/LT consumers,

Prepare journal based on practical performed in Electrical laboratory. Journal consists of drawing, observations, required equipment's, date of performance with teacher signature.

10. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are sample strategies, which the teacher can use to accelerate the attainment of the various outcomes in this course:

a. Massive open online courses (***MOOCs***) may be used to teach various topics/sub topics.
b. About ***15-20% of the topics/sub-topics*** which is relatively simpler or descriptive in nature is to be given to the students for ***self-directed learning*** and assess the development of the COs through classroom presentations (see implementation guideline for details).
c. With respect to item No.8, teachers need to ensure to create opportunities and provisions for ***co-curricular activities***.
d. Guide student(s) in undertaking micro-projects.
e. Correlate subtopics with power plant system and equipment.
f. Use proper equivalent analogy to explain different concepts.
g. Use Flash/Animations to explain various components, operation and
h. Teacher should ask the students to go through instruction and Technical manuals

11. SUGGESTED MICRO-PROJECTS –

Only one micro-project is planned to be undertaken by a student that needs to be assigned to him/her. In the first four semesters, the micro-projects are group-based. However, in the fifth and sixth semesters, it should be preferably be individually undertaken to build up the skill and confidence in every student to become problem solver so that s/he contributes to the projects of the industry. In special situations where groups have to be formed for micro-projects, the number of students in the group should not exceed three.

The micro-project could be industry application based, internet-based, workshop-based, laboratory-based or field-based. Each micro-project should encompass two or more COs which are in fact, an integration of PrOs, UOs and ADOs. Each student will have to maintain dated work diary consisting of individual contribution in the project work and give a seminar presentation of it before submission. The total duration of the micro-project should not be less than 16 (sixteen) student engagement hours during the course. The student ought to submit micro-project by the end of the semester to develop the industry oriented COs.

a. Dismantle any one wattmeter, ammeter and voltmeter. See all parts carefully such as, coil magnet etc. Resemble them carefully.
b. Make a PowerPoint presentation on various measuring instruments in your institute's measurement laboratory.
c. Study different types of CTs and PTs. Make powerpoint presentation on them.
d. Prepare a detailed report on all measuring instruments available in laboratory along with photos, detailed specifications, use etc.

12. SUGGESTED LEARNING RESOURCES

S.No.	Title of Book	Author	Publication
1	A Course in Electrical and Electronic Measurements and Instrumentation	A.K.Sawhney	Dhanpatrai and Co.Pvt.Ltd.Delhi ISBN 9788177001006
2	Electrical measurement and Measuring Instruments	E.W .Golding and F.C.Widdis	AH Wheeler & Company ISBN 9788185614311
3	Electrical Measurements and Measuring Instruments	N.V.Suryanarayana	Tata McGraw-Hill Publishing Company Ltd. ISBN 9780074517512
4	Electrical Measurements & Measuring Instruments	M.L.Anand	S. K. Kataria& Sons ISBN 9789350143636

13. SOFTWARE/LEARNING WEBSITES

www.electrical4u.com/electrical-engineering-articles/measurement/
www.iskra.eu/en/Electrial-Measuring -Instruments/

14. PO - COMPETENCY- CO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	2	2	1	2	1	2	3
CO2	2	2	1	2	1	2	3
CO3	2	3	1	2	1	2	3
CO4	2	3	1	2	1	2	3

	PSO1	PSO2	PSO3	PSO4
CO1	3	2	1	2
CO2	2	2	1	2
CO3	3	2	1	2
CO4	3	2	1	2

Sign: Name: **1**. Shri. J.G. Momin **2**. Smt. S.P. Phadnaik (Course Experts)	Sign: Name: Dr. S. S. Bharatkar/Shri.R. U. Shelke (Head of Department)
Sign: Name: Dr. S. S. Bharatkar/Shri.R. U. Shelke (Program Head) (Department of Electrical Engineering)	Sign: Name: Shri. A.S.Zanpure (CDC In-charge)

Government Polytechnic, Pune

'180 OB' – Scheme

Programme	Diploma in ET/CE/**EE**//ME/MT/CM/IT/DDGM
Programme code	01/**02**/03/04/05/06/07/08/15/**16**/17/18/19/21/**22**/23/24/26
Name of Course	**Generation of Electrical Power**
Course Code	**EE3104**
Prerequisite course code and name	No
Class Declaration	No

1. TEACHING AND EXAMINATION SCHEME

<table>
<tr><th colspan="3">Teaching Scheme (In Hours)</th><th>Total Credits (L+T+P)</th><th></th><th colspan="5">Examination Scheme</th></tr>
<tr><th colspan="3"></th><th></th><th></th><th colspan="2">Theory</th><th colspan="2">Practical</th><th>Total Marks</th></tr>
<tr><th>L</th><th>T</th><th>P</th><th>C</th><th></th><th>ESE</th><th>PA</th><th>ESE</th><th>PA</th><th rowspan="2">125</th></tr>
<tr><td rowspan="2">03</td><td rowspan="2">01</td><td rowspan="2">00</td><td rowspan="2">04</td><td>Marks</td><td>80</td><td>20</td><td>-</td><td>25</td></tr>
<tr><td>Exam Duration</td><td>3 Hrs</td><td>1 Hr</td><td>-</td><td>-</td><td></td></tr>
</table>

Legends: L- lecture, T-Tutorial/teacher guided theory practice, P-practical, C-Credits, ESE-End semester examination, PA- Progressive Assessments(Test I, II/Term Work), * - Practical Exam, $ - Oral Exam. # - Online Exam., Each lecture/practical period is of one clock hour.

2. RATIONALE

Generation of electrical power is the heart of electrical power system. With growing demand for electric power at one hand and depleting fossil fuel resources it has become more necessary to generate electric power more efficiently and with the help of renewal energy resources. With advancement in technology it has become possible to generate electric power commercially using wind and solar energy. It is necessary to understand the constructional details, working and performance of different power stations such as Thermal (Coal), Hydro, Nuclear, Diesel, gas and other renewal energy sources. This course deals with the basic knowledge required to take appropriate decisions to maintain the various generating and auxiliary equipment of power plants. It covers the safety precautions required to be followed by the engineering diploma holders in various power plants.

3. COMPETENCY

The aim of this course is to attend following industry identified competency through various teaching learning experiences:
Take appropriate decisions to maintain the various generating and auxiliary equipment of power plants

4. COURSE OUTCOMES (COs)

The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry oriented COs associated with the above mentioned competency**:**
The student should be able to:

1 -Know the advancement in technology to generate electrical power commercially using wind and solar energy
2- Identify components of various power plants
3- Select site for a given power plant
4- State major power generating stations in Maharashtra State
5- Understand the role of Load Dispatch Centre

5. SUGGESTED ASSIGNMENTS/ EXERCISES

Pr. No	**Unit No.**	**Exercises** (Learning Outcomes in Psychomotor Domain)	**Relevent CO**	**Approx. Hrs. required**
1	2	Draw layout of Thermal Power Station (T.P.S.) & explain the working of T. P. S..	2,3,4	02
2	2	Prepare technical report of visit to a nearby T.P.S./Prepare a report on thermal power stations in Maharashtra by collecting data from Internet.	2,3,4	02
3	3	Draw layout of Hydro Power Station (H.P.S.) and state the function of each component.	2,3,4	02
4	3	Prepare technical report of visit to a nearby H.P.S./Prepare a report on Hydro power stations in Maharashtra by collecting data from Internet.	2,3,4	02
5	4	Draw the schematic diagram of Nuclear power station & state the function of each component.	2,3,4	02
6	5	Prepare technical report of visit to a nearby Diesel Power Plant	2,3	02
7	6	Collect the data from nearest sub-station and draw the load curve..	4	02
8	6	Collect information of LDC in Maharashtra State	CO 5	02
		Total		16

S.No.	Performance Indicators	Marks in %
a.	Arrangement of available equipment	10
b.	Setting and operation	10
c.	Safety measures	20
d.	Observations and Recording	15
e.	Interpretation of result and Conclusion	20
f.	Answer to sample questions	10
g.	Submission of report in time	15
Total		**100**

6. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED- NA

7. THEORY COMPONENTS

Unit Outcomes (UOs) (in cognitive domain)	**Topics and Sub-topics**
UNIT- 1: Introduction	**Marks-04 , Hrs- 02**
1a. List the various sources of Energy and give comparison between them.	1.1 Importance of Electrical Energy. 1.2 Sources of Energy: conventional and renewable 1.3 Comparison of Energy Sources. 1.4 Types of fuels: solid, liquid and gaseous, their calorific values, advantages and disadvantages of these fuels.
UNIT-2: Thermal Power Station	**Marks-14 , Hrs- 12**
2a.State the factors governing selection of site for Thermal station. 2b.Draw the block diagram of thermal power plant and explain the function of each block. 2c.Describe the Flue gas flow diagram of thermal Power plant with function of each part 2d. State the best practices to be compiled with TPS 2e.State Major TPS in Maharashtra with their generating capacities 2f.Enlist the advantages and disadvantages of Thermal power stations	2.1 Factors governing selection of site for Thermal station. Constituents of steam power plant and their function. 2.2 Schematic block diagram of Thermal power plant. 2.3 Coal handling unit (Various stages in coal handling unit). 2.4 Boiler (Fire tube and water tube boilers). 2.5 Super-heater and re-heater 2.6 Steam prime movers (turbines). 2.7 Condensers 2.8Spray ponds and cooling towers. 2.9Turbo alternator (salient features)... 2.10 Flue gas flow diagram of thermal Power plant with function of each part 2.11Draught Systems: Natural draught, Mechanical draught, Forced, induced and balanced draught: definition and working only 2.12Economizer 2.13Feed water heater

Unit Outcomes (UOs) (in cognitive domain)	**Topics and Sub-topics**
	2.14Ash precipitators. 2.15Best Practices of TPS regarding operation and maintenance, safety and health and environment. 2.16 Major TPS in Maharashtra with their generating capacities. Advantages and disadvantages of Thermal power stations.
UNIT-3 Hydro Power Station	**Marks-12 , Hrs-10**
3a. State the factors governing selection of site for Hydro Electric power plant. 3b. Define the terms and explain their significance in capacity of power plant 3c. Give the classification of Hydro Electric power plants with respect to water flow regulation, load, to head, Pumped Storage Power Plant 3d. Draw the schematic block diagram of hydro electric power plant and explain the function of each block. 3e. Name the major HPS in Maharashtra with their capacities. State advantages and disadvantages of hydropower station.	3.1 Factors governing selection of site for Hydro Electric power plant. Definition of the terms and their significance in capacity of power plant: Hydrology, surface Runoff, Evaporation and precipitation. 3.3 Classification of Hydro Electric power plants: According to water flow regulation According to load. According to head. 3.4 Pumped Storage Power Plant 3.5 Schematic arrangement of Hydro Electric Power Plant and function of Elements listed below: Storage Reservoir, Dam, Forebay, Spillway, Surge tank, Penstock, Trash rack, Tail Race, Prime movers or water turbines. 3.6 Types of hydro turbines: Reaction and Impulse 3.7 Comparison between Francis and Kaplan turbine. 3.8 Salient features of Hydro generator. 3.9 Hydro power stations in Maharashtra with their generating capacities. 3.2 3.10 Advantages of Hydro Power Plants and their effect on ecology/environment.
UNIT-4: **Nuclear Power Stations**	**Marks-12 , Hrs-06**
4a. Define the terms Radioactive isotopes, mass energy equivalence, binding energy and mass defect, nuclear chain reaction, multiplication factor, critical size. 4b. State the factors governing Selection of site for the nuclear power plant 4c. Explain working of nuclear power station with schematic arrangement. 4d. Describe various types of reactors.	4.1 A brief review of atomic physics Radioactive isotopes, mass energy equivalence, binding energy and mass defect, nuclear chain reaction, multiplication factor, critical size. Nuclear Fuels 4.2 Factors governing Selection of site for the nuclear power plant 4.3 Schematic arrangement of Nuclear Power Plant. 4.4 Main parts of reactors and their Function:

Unit Outcomes (UOs) (in cognitive domain)	**Topics and Sub-topics**
4e. How disposal of Nuclear waste is carried out and describe Nuclear Shielding. 4f. Name the major NPS in Maharashtra with their capacities. 4g. State advantages and disadvantage of NPS.	Nuclear fuels ,reactor core, moderator, shielding, control rods, reflectors, coolant, and reactor vessel. 4.5 Classification of nuclear reactors: operation and constructional features: Gas Cooled Reactor (GCR) Boiling Water Reactor (BWR) Pressurized water reactor (PWR) 4.6 Fast Breeder Reactor (FBR) 4.7 Disposal of Nuclear waste and Nuclear Shielding. 4.8 Nuclear power stations in Maharashtra with their generating capacities. 4.9 Advantages and disadvantages of Nuclear Power Station.
Unit-5 Diesel and Gas Turbine Power Stations	**Marks-14 , Hrs- 06**
5a. Draw layout of a medium size Diesel Electric Power Plant and identify 5b. Elements of diesel Electric Power Plant and write their functions Enlist the advantages, disadvantages and Applications of diesel power plants 5c. Describe Captive Power Generation with their different types 5d. What is Co-generation and Distributed power generation. 5e. Draw the layout of Gas turbine power plant 5f. State the factors governing selection of site, Advantages and disadvantages of Gas Turbine Power Plant. 5g. State Major Gas turbine power plants in Maharashtra with their generating capacities	5.1 Layout of a medium size Diesel Electric Power Plant, 5.2 Elements of diesel Electric Power Plant With their functions: Diesel engine, Fuel system, Air Intake System, Exhaust system, cooling system, lubrication system, Engine Starting system. 5.3 Applications of diesel power plants. 5.4 Advantages and disadvantages of Diesel Electric Power Plant. 5.5 Captive Power Generation 5.6 Types of captive power plants. 5.7 Advantages and disadvantages of Captive Power Plant. 5.8 Co-generation 5.9 Distributed power generation. 5.10 Layout of Gas turbine power plant. 5.11Factors governing selection of site. 5.12 Types of fuels 5.13 Advantages and disadvantages of Gas Turbine Power Plant. 5.14 Major Gas turbine power plants in Maharashtra with their generating capacities.
UNIT-6 Performance of Power Stations	**Marks-16 , Hrs-08**
6a. Explain the factors affecting economics of power generation 6b. Explain the importance of load curve and load duration curve . 6c. Define the terms connected load, maximum demand, Demand factor,	6.1 Factors affecting economics of power generation, Load curve and load duration curve 6.2 Importance of high load factor and diversity factor choice of size and number of generator units

Unit Outcomes (UOs) (in cognitive domain)	**Topics and Sub-topics**
Average load ,load factor, diversity factor ,capacity factor , utilization factor. 6d Differentiate between base load and peak load power plants	for a given load 6.3 Curve and operation schedule (Numerical). Average demand, maximum demand, Demand factor, diversity factor, load factor, plant capacity factor, utilization factor (Numerical) 6.4 Base load and peak load power stations – meaning, types, and comparison. Combined operation of power stations.
UNIT-7Interconnected Power System	**Marks-08 , Hrs- 04**
7a. Explain the concept of grid and advantages &disadvantages of interconnected Power system. 7b. Explain operation and control of interconnected power stations. 7c. Explain the working of Load dispatch centre (LDC) 7d. Define smart grid and describe it's working.	7.1 Inter connection of power stations at state and national and international (State and National grid). 7.2 Advantages and disadvantages of interconnected system. Function of Load dispatch centre. 7.3 Operation and control of interconnected power system. 7.4 Function of Load dispatch centre. Concept and working of smart grid

8. SUGGESTED SPECIFICATION TABLE FORQUESTION PAPER DESIGN

Unit No.	**Unit Title**	**Teaching Hours**	**Distribution of Theory Marks**			
			R Level	**U Level**	**A Level**	**Total Marks**
1	**Introduction**	02	02	02	--	04
2	**Thermal Power Station**	10	04	02	06	12
3	**Hydro Power Station**	10	04	04	04	12
4	**Nuclear Power Stations**	08	04	02	04	10
5I	**Diesel and Gas Turbine Power Stations**	06	04	04	06	14
6	**Performance of Power Stations**	08	04	06	08	18
7	**Interconnected Power System**	04	02	04	04	10
	Total	**48**	**24**	**24**	**32**	**80**

9. SUGGESTED STUDENT ACTIVITIES

Other than the classroom and laboratory learning, following are the suggested student-related ***co-curricular*** activities which can be undertaken to accelerate the attainment of the various outcomes in this course: Students should conduct following activities in group and prepare reports of about 5 pages for each activity, also collect/record physical evidences for their (student's) portfolio which will be useful for their placement interviews:
Prepare journal based on practical performed in Electrical laboratory. Journal consists of drawing, observations, required equipment's, date of performance with teacher signature.

10. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are sample strategies, which the teacher can use to accelerate the attainment of the various outcomes in this course:

a. Massive open online courses (***MOOCs***) may be used to teach various topics/sub topics.
b. About ***15-20% of the topics/sub-topics*** which is relatively simpler or descriptive in nature is to be given to the students for ***self-directed learning*** and assess the development of the COs through classroom presentations (see implementation guideline for details).
c. With respect to item No.8, teachers need to ensure to create opportunities and provisions for ***co-curricular activities***.
d. Guide student(s) in undertaking micro-projects.
e. Correlate subtopics with power plant system and equipments.
f. Use proper equivalent analogy to explain different concepts.
g. Use Flash/Animations to explain various components, operation and
h. Teacher should ask the students to go through instruction and Technical manuals

11. SUGGESTED MICRO-PROJECTS:

Not Applicable

12. SUGGESTED LEARNING RESOURCES

S.No.	Title of Book	Author	Publication	ISBN code
1	Principles of PowerSy stem	V.K.Mehata	S.ChandCo. , Delhi	ISBN: 812190096 4
2	Course of Electrical Power system	Soni, Gupta Bhatnagar	DhanpatRaiandSon's., Delhi	ISBN **: 10-8177000209**
3	Electric Power	S.L.Uppal	KhannaPublisher,Delh i	ISBN: 978-81-7409-238-0

13. SOFTWARE/LEARNING WEBSITES

www.electrical4u.com/electrical-engineering-articles/measurement/
www.iskra.eu/en/Electrial-Measuring -Instruments/

14. PO - COMPETENCY- CO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	1	2	2	1	1	1	1
CO2	1	3	2	3	3	2	1
CO3	2	2	1	1	2	2	2
CO4	1	1	2	3	2	3	2
CO5	1	1	1	1	1	2	2

	PSO1	PSO2	PSO3	PSO4
CO1	2	2	2	2
CO2	3	3	1	2
CO3	1	2	2	2
CO4	1	1	2	3
CO5	2	3	3	1

Sign: Name: **1**. Mr. B.R. More **2**. Mr. J.G. Momin (Course Experts)	Sign: Name: Dr. S. S. Bharatkar/Shri.R. U. Shelke (Head of Department)
Sign: Name: Dr. S. S. Bharatkar/Shri.R. U. Shelke (Program Head) (Department of Electrical Engineering)	Sign: Name: Shri A.S. Zanpure (CDC In-charge)

Government Polytechnic, Pune

'180 OB'– Scheme

Programme	Diploma in ET/CE/**EE**//ME/MT/CM/IT/DDGM
Programme code	01/**02**/03/04/05/06/07/08/15/**16**/17/18/19/21/**22**/23/24/26
Name of Course	**DC Machines & Transformer**
Course Code	**EE3105**
Prerequisite course code and name	**EE2101 (Basic Electrical Engineering)**
Class Declaration	**No**

1. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			**Total Credits (L+T+P)**		**Examination Scheme**				
					Theory		**Practical**		**Total Marks**
L	**T**	**P**	**C**		**ESE**	**PA**	***ESE**	**PA**	150
03	01	02	06	**Marks**	80	20	25	25	
				Exam Duration	3 Hrs	1 Hr	-		

Legends: L- lecture, T-Tutorial/teacher guided theory practice, P-practical, C-Credits, ESE-End semester examination, PA- Progressive Assessments(Test I, II/Term Work), * - Practical Exam, $ - Oral Exam. # - Online Exam., Each lecture/practical period is of one clock hour.

2. RATIONALE

This course belongs to basic technology group which intends to know about concept and working principles of D.C. machines (both Generator & Motor) and transformer (single phase and three phase).
This course tells about performance and characteristics of above machines by performing various tests.

3. COMPETENCY

The aim of this course is to attain following industry identified competency through various teaching learning experiences:

- **Select and use appropriate DC motors& transformers in practice**.

4. COURSE OUTCOMES (COs)

The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry oriented **COs** associated with the above mentioned competency**:**

1: To outline the principle of operation, construction & working of various types of DC motors & single & three phase Transformer
2: To calculate the losses in DC machines & Transformers to improve their efficiency by conducting various tests.
3: To select & use DC Machines &single phase transformer for specific applications.
4: To select & use the appropriate three phase transformer connection as per requirement.
5: To analyse the use of single winding transformer for particular application.

5. SUGGESTED PRACTICALS/ EXERCISES

Pr. No.	Unit No.	**Practical Exercises** (Learning Outcomes in Psychomotor Domain)	Relevant CO	Approx. Hrs. required
1	1	To identify the constructional parts of D. C. machine with their function & material used.	1	04
2	2	Study the parts of D. C. 3 - Point Starter	1	02
3	2	To control the speed of d. c. shunt motor above and below normal speed	3	04
4	2	To reverse the direction of rotation of D.C. Shunt motor	3	02
5	3	To calculate the voltage ratio & current ratio of single-phase transformer & to verify the relation between them.	3	04
6	3	To carry out direct load test on single phase transformer and determine its efficiency and regulation.	2	02
7	3	To perform O.C. and S.C. test on single phase transformer and calculate efficiency, regulation of transformer.	2	02
8	3	To perform O.C. and S.C. test on single phase transformer and draw its equivalent circuit.	5	04
9	3&4	Study of constructional features of single phase and three phase transformers	1	02
10	4	To carry out different connections of three phases transformer and determine voltage & current ratio.	4	04
11	3	Connect the single phase autotransformer in step up & step-down modes noting the input & output.	5	02
12		Microproject planning & Execution as written in suggested microproject list		02
13		Microproject report writing		02
14		Suggested student activity report		02
		Total Hrs		**38**

Sr. No.	Performance Indicators	Weightage in %
a	Arrangement of available equipment / test rig or model	10
b	Setting and operation	10
c	Safety measures	20
d	Observations and Recording	15
e	Interpretation of result and Conclusion	20
f	Answer to sample questions	10
g	Submission of report in time	15
Total		**100**

6. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

The major equipment with broad specification mentioned here will usher in uniformity in conduct of practicals, as well as aid to procure equipment by authorities concerned.

Sr. No.	Equipment Name with Broad Specifications	Pr. No.
1	D.C Shunt motor, rheostats, D.C Ammeter, D.C Voltmeter, tachometer.	1, 2, 3
2	D.C Machine, connecting wires.	All
3	Single phase transformer, autotransformer, Ammeter, Voltmeter, lamp load, wattmeter	5,6,7,8,11
4	Three phase transformer	9,10

7. THEORY COMPONENTS

Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
UNIT 1. DC Generator	**HRS - 04 Marks - 06**
1a. Describe function of different parts of DC machine with sketches. 1b. Differentiate between the types of armature. 1c. Explain the working of DC generator. 1d. State E.M.F equation	1.1 Construction of DC machine. 1.2 Functions of various parts of DC machine. 1.3 Simplex lap winding and wave 1.4 Concept of number of parallel paths only. 1.5 DC Generator – working principle 1.6 E.M. F Equation
UNIT 2. DC Motor	**HRS- 10 Marks-14**

Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
2a. Explain working of DC motor 2b. State the significance of back emf & state its equation. 2c. Describe how to find & reverse the direction of rotation of motor 2d. Derive power and torque equation of DC motor. 2e. Justify the need of DC motor starter and explain its working. 2f. Classify different types of DC motor 2g. Compare performance of different types of DC motors 2h. List the applications of various types of DC motors. 2i. Explain the meaning of rating of a DC motor 2j. Explain the need & methods of speed control of DC motor 2k.Calculate the losses and efficiency of dc motor. 2l. Derive the condition for maximum efficiency of a motor. 2m.State the necessity , working & Applications of Brushless DC motor	2.1 Working principle of DC Motor. 2.2 Back emf Equation: - Significance & equation 2.3 Voltage equation. 2.4 Back emf as a regulating mechanism. 2.5 Direction of rotation of motor. 2.6 Fleming's left hand rule. 2.7 Reversal of rotation of motor 2.8 Power equation 2.9 Condition for maximum power 2.10 Torque equation, 2.11 Types of torques & their equations. 2.12 Numerical. 2.13 Necessity of starter. 2.14 Working of Three-point starter. 2.15 Types of DC Motors: -Series, Shunt and Compound DC Motor. 2.16 Voltage current relationships 2.17 Performance characteristics of DC Series, Shunt and Compound Motor. 2.18 Torque & speed equations 2.19 Applications of DC Series, Shunt and compound motor. 2.20 Rating of DC motor. 2.21 Speed control of DC series and shunt motor. 2.22 Methods, advantages, limitations. 2.23 Losses in DC motors and its computation. 2.24 Power flow diagram 2.25 Efficiency 2.26 Condition for maximum efficiency 2.27 Necessity of brushless DC (BLDC) Motor 2.28 Working of BLDC 2.29 Advantages of BLDC 2.30 Applications of BLDC
UNIT 3. Single Phase Transformer	**Hrs-20 Marks-36**
3a. Explain the function of various parts single phase transformer and working of a single-phase transformer. 3b. Explain the effect of DC supply voltage on the performance of a transformer. 3c. Differentiate between core and shell type transformer with sketches 3d. Derive EMF equation of transformer and define ratios of	3.1 Construction, function & materials used for different parts of Single-phase transformer 3.2 Working principle of Single-phase transformer. 3.3 Performance of the transformer if DC supply is used for transformer. 3.4 Types of Transformer: -Core and shell type of transformers. 3.5 Comparison between core type shell type transformer. 3.6 EMF equation and transformer ratios, voltage transformation, voltage, current, turns ratio. 3.7 Numerical.

Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
transformer. 3e. Explain why rating of the transformer is expressed in KVA. 3f. State the properties of an ideal transformer. 3g. Draw and explain the phasor diagram of ideal transformer and practical transformer on no load. 3h. Describe the effect of winding resistances & leakage reactance. 3i. Explain the concept of Practical transformer on load. 3j. Draw & explain the phasor diagram of practical transformer on load. 3k. Draw the equivalent circuit of a single-phase transformer. 3l. Describe the significance of voltage regulation 3m.State the various losses in transformer. 3n. Derive expression for efficiency and the condition for maximum efficiency of a single-phase transformer 3o. State the need for conducting different types of tests on single phase transformers. 3p. Determine the various parameters of equivalent circuit from OC /SC test 3q. Describe working of an autotransformer with sketches. 3r. Find the transformation ratio of autotransformer. 3s. Distinguish between an autotransformer and two winding transformer. 3t. Find the expression of copper saving in case of autotransformer than that of two winding transformer. 3u. State the method of converting a two-winding transformer to an autotransformer by using appropriate polarity. 3v. List the advantages, limitations & applications of an	3.8 Rating of the transformer. 3.9 Properties of an ideal transformer 3.10 Ideal Transformer on no-load with phasor diagram. 3.11 Practical transformer on no load with Phasor diagram. 3.12 Effect of winding resistances, expression for equivalent resistance. 3.13 Effect of leakage reactance, expression for equivalent reactance & equivalent impedance. 3.14 Numerical. 3.15 Phasor diagram of practical transformer on purely resistive, inductive & capacitive load. 3.16 Equivalent circuit of single-phase transformer. 3.17 Exact equivalent circuit referred to primary. 3.18 Approximate equivalent circuit referred to primary. 3.19 Approximate voltage drop in a transformer. 3.20 Voltage regulation: Definition, computation of voltage regulation for different types of loads. 3.21 Expression for voltage regulation of a transformer. 3.22 Numerical. 3.23 Losses in transformer: Iron loss, Copper loss. 3.24 Efficiency: - Definitions of Commercial Efficiency, all day Efficiency 3.25 Expression for efficiency and the condition for maximum efficiency of a single-phase transformer. 3.26 Numerical. 3.27 Different types of tests and their necessity: - Direct load test, OC and SC test and along with connection diagrams to calculate efficiency and regulation of transformer. 3.28 Determine Parameters of equivalent circuit of transformer from OC /SC test. 3.29 Numerical. 3.30 Construction and working of an autotransformer 3.31 Transformation ratio of an autotransformer. 3.32 Distinguish between autotransformer and two winding transformer. 3.33 Copper saving. 3.34 Use of two winding transformer as an autotransformer. 3.35 Additive polarity & subtractive polarity. 3.36 Advantages, limitations& applications of an autotransformer.

Unit Outcomes (UOs) (in cognitive domain)	**Topics and Sub-topics**
autotransformer.	
UNIT 4. Three Phase Transformer	**HRS -10 Marks-14**
4a. Describe function of different parts of Three Phase Transformer 4b. Explain the working of a three-phase transformer with sketches 4c. Compare 3 phase transformer with a bank of 3 single phase transformers. 4d. Describe the significance of windings connection of three phase transformer. 4e. Use and functioning of on-load Tap-Changer	4.1 Construction of 3 phase transformer. 4.2 Working principle of three phase transformer. 4.3 A bank of 3 single phase transformers. 4.4 Comparison between three phase transformer and bank of 3 single phase transformers. 4.5 Windings connections of 3 phase transformer. 4.6 Advantages & limitations of star-star, Delta-Delta, Star-Delta, Delta-Star winding connections. 4.7 Voltage & current ratios, for above connections. 4.8 Applications of above winding connections. On-load Tap-Changer
UNIT 5. Parallel Operation of Transformers	**HRS -04 Marks-10**
5a. State the need and condition for parallel operation of single phase and three phase transformers. 5b. Explain the parallel operation & determine the load sharing of single phase and three phase transformer.	5.1 Need of Parallel Operation of single-phase transformer and three phase transformer. 5.2 Condition of Parallel Operation of single-phase transformer and three phase transformer. 5.3 Parallel operation and load sharing of single phase and three phase transformer with phasor diagram. 5.4 Numerical on equal voltage ratios only.

8. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

Unit No.	**Unit Title**	**Teaching Hours**	**Distribution of Theory Marks**			
			R Level	**U Level**	**A Level**	**Total Marks**
I	D.C. Generator	04	3	3	--	06
II	D.C. Motor	10	4	4	6	14
III	Single phase transformer	20	8	14	14	36
IV	Three phase Transformer	10	4	6	4	14
V	Parallel Operation of Transformers	04	02	04	04	10
Total		48	17	41	22	80

9. SUGGESTED STUDENT ACTIVITIES

Other than the classroom and laboratory learning, following are the suggested student-related ***co-curricular*** activities which can be undertaken to accelerate the attainment of the various outcomes in this course: Students should conduct following activities in group and prepare reports of about 5 pages for each activity, also collect/record

physical evidences for their (student's) portfolio which will be useful for their placement interviews:
Prepare journal based on practical performed in Electrical laboratory. Journal consists of drawing, observations, required equipment's, date of performance with teacher signature.
Following is the list of proposed student activities:
a. Assignments on solving numerical
b. Identify different types of dc machine based on their winding arrangement
c. Identify different types of transformer based on application
d. Prepare chart displaying the various parts of dc machine
e. Prepare chart displaying the various parts of transformer
f. Prepare chart displaying the various parts of a three point dc motor starter.

10. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are sample strategies, which the teacher can use to accelerate the attainment of the various outcomes in this course:

a. Massive open online courses (***MOOCs***) may be used to teach various topics/sub topics.
b. About ***15-20% of the topics/sub-topics*** which is relatively simpler or descriptive in nature is to be given to the students for ***self-directed learning*** and assess the development of the COs through classroom presentations (see implementation guideline for details).
c. With respect to item No.8, teachers need to ensure to create opportunities and provisions for ***co-curricular activities***.
d. Guide student(s) in undertaking micro-projects.
e. Correlate subtopics with power plant system and equipment.
f. Use proper equivalent analogy to explain different concepts.
g. Use Flash/Animations to explain various components, operation and
h. Teacher should ask the students to go through instruction and Technical manuals

11. SUGGESTED MICRO-PROJECTS –

Only one micro-project is planned to be undertaken by a student that needs to be assigned to him/her. In the first four semesters, the micro-projects are group-based. However, in the fifth and sixth semesters, it should be preferably be individually undertaken to build up the skill and confidence in every student to become problem solver so that s/he contributes to the projects of the industry. In special situations where groups have to be formed for micro-projects, the number of students in the group should not exceed three.
The micro-project could be industry application based, internet-based, workshop-based, laboratory-based or field-based. Each micro-project should encompass two or more COs which are in fact, an integration of PrOs, UOs and ADOs. Each student will have to maintain dated work diary consisting of individual contribution in the project work and give a seminar presentation of it before submission. The total duration of the micro-project should not be less than 16 (sixteen) student engagement hours during the course. The student ought to submit micro-project by the end of the semester to develop the industry oriented Cos
1. Prepare a report on market survey of different electric motors.
2. Prepare a report on market survey of various three phase transformers with the

details of specification, name of the manufacturer, application & cost.

3. Prepare a model of three phase transformer.
4. Prepare a chart of various types of D.C. motors, their characteristics & industrial applications.
5. Prepare power point presentation related to various types of transformers with their photographs, symbols , characteristics & applications.

12. SUGGESTED LEARNING RESOURCES

Sr.No	Title of Book	Author	Publication
1	ElectricalTechnologyVol.II	B.L.TherajaA.K.Theraja	S.ChandandCo.,NewDelhi ISBN 9788121924375
2	Electrical Machine	S. K. Bhattarcharya	Mcgraw Hill ISBN9789332902855
3	Electrical Machine-I	J. B. Gupta	S. K. Kataria& sons, New Delhi, ISBN 9789350140550
4	Electrical Machines- I	U.A.Bakshi, M.V.Bakshi	Technical Publications,Pune ISBN 9788184317756
5	Electrical machines - Theory and Practice	M.N. Bandopadhyay	PHI publication. ISBN 812032997X, 9788120329973
6	Principles of Electrical Machines	V.K.Mehtha	S.Chand and Co., New Delhi

13. SOFTWARE/LEARNING WEBSITES

https://www.iare.ac.in/sites/default/files/lecture_notes/DC%20M%26T%20_%20LECTURE_NOTES.pdf
https://nptel.ac.in/courses/108105017/
https://www.youtube.com/watch?v=NZQX4zQm-4M
www.electricaltechnology.com
https://books.google.co.in/books/about/ELECTRICAL_MACHINES.html?id=oiwN1mjMKMkC&redir_esc=y

14. PO - COMPETENCY- CO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	03	02	02	01	01	02	02
CO2	03	03	03	03	02	02	02
CO3	01	03	02	01	02	02	03
CO4	02	03	02	02	02	02	03
CO5	02	02	03	02	02	02	03

	PSO1	PSO2	PSO3	PSO4
CO1	03	03	01	02
CO2	03	03	01	03
CO3	01	03	01	02
CO4	03	03	01	02
CO5	03	01	01	01

Sign: Name: 1. Mrs A . N. Duraphe 2. Mrs. S. P. Phadnaik (Course Experts)	Sign: Name: Dr.S. S. Bharatkar/Shri.R. U. Shelke (Head of Department)
Sign: Name: Dr.S. S. Bharatkar/Shri.R. U. Shelke (Program Head) (Department of Electrical Engineering)	Sign: Name: Shri A. S. Zanpure (CDC Incharge)

Government Polytechnic, Pune

'180 OB' – Scheme

Programme	Diploma in ET/CE/**EE**//ME/MT/CM/IT/DDGM
Programme code	01/**02**/03/04/05/06/07/08/15/**16**/17/18/19/21/**22**/23/24/26
Name of Course	**Transmission & Distribution of Electrical Power**
Course Code	**EE3106**
Prerequisite course code and name	No
Class Declaration	No

1. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P)		Examination Scheme				
					Theory		Practical		Total Marks
L	**T**	**P**	**C**		**ESE**	**PA**	**ESE**	**PA**	
03	01	00	04	**Marks**	80	20	--	25	125
				Exam Duration	3 Hr	1 Hr	-	--	

Legends: L- lecture, T-Tutorial/teacher guided theory practice, P-practical, C-Credits, ESE-End semester examination, PA- Progressive Assessments(Test I, II/Term Work), * - Practical Exam, $ - Oral Exam. # - Online Exam., Each lecture/practical period is of one clock hour.

2. RATIONALE

Diploma Electrical Engineers which works as technicians in the field of transmission & distribution of Electrical Power, it is necessary that they should know about components used in transmission & distribution systems, types of transmission lines & their performance etc.. This course will explain construction, operation, analytical performance to find values of derived parameters such as efficiency & regulations of transmission lines & distribution lines. .

3. COMPETENCY

The aim of this course is to attain following competency through various teaching learning experiences:

1. Describe the construction of transmission lines, distribution lines and line supports.
2. Analyze the performance of Transmission and Distribution lines.

4. COURSE OUTCOMES (COs)

The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry oriented COs associated with the above mentioned competency**:**

1. Select the type of transmission line as per need and describe advantages & disadvantages of each type.
2. Identify the main components of transmission lines, line supports, insulators, cables used in transmission line.
3. Analyze the performance of short, medium & long transmission line.
4. Identify the main components of various distribution systems and analyze the voltage drop calculation in distribution system.
5. Describe the causes of low power factors
6. Select the type of substation as per requirement and describe the operation of each type of substation.

5. SUGGESTED PRACTICALS/ EXERCISES : NA

6. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED: NA

7. THEORY COMPONENTS-

Unit Outcomes (UOs) (in cognitive domain)	**Topics and Sub-topics**
UNIT 1. Basics of Transmission	**HRS - 06 MARKS- 12**
1a. State the features of different transmission systems. 1b. State the advantages and disadvantages of AC and DC transmission.	1.1 A.C. and D.C. transmission system: features, comparison between A.C. and D.C .transmission. 1.2 Primary and Secondary transmission.
1c. Classify the lines based on their length and voltage rating	1.3 Transmission line classification based on length of transmission line and voltage level
1d. Compare overhead and underground systems.	1.4 Overhead and Underground transmission system :features, Comparison between Overhead and Underground transmission system.
1e. State the advantages and disadvantages of EHV AC transmission.	1.5 Advantages and disadvantages of using high voltages for transmission of electric power.
UNIT 2. Components of Transmission Line	**HRS - 16 MARKS-24**
2a. Identify the main components of Transmission line State the features of different types of line supports.	2.1 Types of line supports: wooden poles, steel poles, R.C.C poles, steel towers (single circuit and double circuit).
2b. State the need and function of different transmission line components	2.2 Need and function of following transmission line components – Cross arm, Stay sets, Ground wire, Lightning arrestors, Fuses and isolating

Unit Outcomes (UOs) (in cognitive domain)	**Topics and Sub-topics**
2c. State the features of different types of insulators. 2d. State the causes of failure of insulators. 2d. Derive the expression for string efficiency for a string of three insulators. 2e. Solve simple numerical problems on string efficiency. 2f. Explain the methods of improving the string efficiency. 2g. Explain the criteria for spacing of conductors. 2h. Explain the meaning of span and sag. 2i. State the factors on which sag depends. 2j. State the need of underground cables. 2k. Explain the construction of cable with a neat sketch. 2l. State the classification of cables based on voltage rating and number of cores.	switches. 2.3 Line insulators: • Requirements • Types:-pin, suspension, shackle, strain type • Causes of failure of insulators. 2.4 Potential distribution over a string of disc 2.5 Numerical on string efficiency 2.6 String efficiency and methods of improving string efficiency. 2.7 Spacing between conductors, span length 2.8 Concept of sag (No Numerical). 2.9 Requirement of underground cables 2.10 General construction of cable. 2.11 Classifications of cable 2.12 Cable specifications
UNIT 3. Performance Of Transmission Lines HRS - 10 MARKS-16	
3a. Explain the effects of R, L and C on 1-ph and 3-ph transmission line. 3b. Explain skin effect, proximity effect, Ferranti effect, corona and transposition of transmission line. 3c.State the advantages and disadvantages of corona. 3d. State the methods of minimizing corona. 3e. Define efficiency and regulation of transmission line. 3f. Solve simple numerical problems on efficiency and regulation of transmission line. 3g. Differentiate the features of the short, medium and long transmission lines. 3h. Draw and explain the 'T' and 'π' model for medium transmission line. 3i Concept of Long transmission line and A,B,C,D constants.	3.1 Concept of transmission line parameters like R,L,C(no formula only numerical) 3.2 Skin effect 3.3 Proximity effect 3.4 Ferranti effect 3.5 Transpositionof3-phaselines. 3.6 Corona–Formation of corona, advantages and disadvantages, methods of minimizing effects of corona. 3.7 Losses, Efficiency and Regulation of short transmission line(numerical). 3.8 Features of medium transmission lines, and their equivalent circuits(end condenser method, nominal 'T' and 'π' method(no numerical). 3.9 Introduction to A,B,C,D constants for Long transmission line.

Unit Outcomes (UOs) (in cognitive domain)	**Topics and Sub-topics**
UNIT 4.Distribution System Components	**HRS - 10 MARKS-16**
4a. State the need for distribution system. 4b. Describe with sketches the various connection schemes of the distribution system. 4c. Solve simple numerical problems on voltage drop calculation of feeder fed at one end. 4d. State the causes of low power factor and disadvantages of low power factor 4e. State the advantages of improved power factor and explain the methods to improve it. 4f. Solve simple numerical problems on power factor improvement.	4.1 Necessity of distribution system, Primary and secondary distribution. 4.2 Types of distribution systems 4.3 AC distribution and its requirements, connection schemes of distribution system: Ring, Radial etc., 4.4 Voltage drop calculations for feeder fed at one end. 4.5 Causes of low power factor. Effect of harmonics on pf. 4.6 Disadvantages of low power factor 4.7 Advantages of improved power factor 4.8 Methods of improving power factor – By use of i) Static condenser ii) Synchronous condensers. iii) Automatic p.f. Improvement iv) Phase advancers (Numerical)
UNIT 5. Sub-Station	**HRS – 06 MARKS-12**
5a. State the need for electrical substations. 5b. Classify sub-stations based on service requirements and construction. 5c. Compare Indoor and Outdoor sub-stations. 5d. Sketch the symbols for sub-station equipment. 5e. State the need and function of sub-station equipment. 5f. Explain different bus-bar arrangements. 5g. Draw single line diagram of typical transformer sub-station.	5.1 Classification of Sub-Stations: according to service requirement, according to constructional features. 5.2 Comparison between indoor and outdoor substations. 5.3 Symbols for equipment in sub-stations. 5.4 Equipment in transformer sub-stations: Bus-bars, Insulators, Isolators, Circuit breakers, Power transformers, Instrument transformers, Metering and indicating instruments, Carrier current equipment, Batteries. 5.5 Bus bar arrangement: Single bus-bar system, Duplicate bus-bar system. 5.6 Single line diagram of typical transformer sub-station.

8. SUGGESTED SPECIFICATION TABLE FORQUESTION PAPER DESIGN-

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	**U Level**	**A Level**	**Total Marks**
I	Basics of transmission line	6 hrs	04	04	04	12
II	Components of transmission line	16 hrs	06	06	12	24
III	Performance of transmission line	10 hrs	04	06	06	16
IV	Distribution system components	10 hrs	04	06	06	16
V	Substation	6 hrs	04	04	04	12
VI						
Total		48	**22**	**26**	**32**	**80**

9. SUGGESTED STUDENT ACTIVITIES

Other than the classroom and laboratory learning, following are the suggested student-related ***co-curricular*** activities which can be undertaken to accelerate the attainment of the various outcomes in this course: Students should conduct following activities in group and prepare reports of about 5 pages for each activity, also collect/record physical evidences for their (student's) portfolio which will be useful for their placement interviews:
a.- Observe the transmission line of components.
b. - Observe the distribution line of components
c. - Draw schematic diagrams of different distribution system

10. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are sample strategies, which the teacher can use to accelerate the attainment of the various outcomes in this course:

These are sample strategies, which the teacher can use to accelerate the attainment of the various outcomes in this course:

a. Massive open online courses (***MOOCs***) may be used to teach various topics/sub topics.
b. About ***15-20% of the topics/sub-topics*** which is relatively simpler or descriptive in nature is to be given to the students for ***self-directed learning*** and assess the development of the COs through classroom presentations (see implementation guideline for details).
c. With respect to item No.8, teachers need to ensure to create opportunities and provisions for ***co-curricular activities***.
d. Guide student(s) in undertaking micro-projects.
e. Correlate subtopics with power plant system and equipment.
f. Use proper equivalent analogy to explain different concepts.
g. Use Flash/Animations to explain various components, operation and
h. Teacher should ask the students to go through instruction and Technical manuals

11. SUGGESTED MICRO-PROJECTS

NA

12. SUGGESTED LEARNING RESOURCES

Sr. No.	Title of Book	Author	Publication
1	Transmission & Distribution of Electrical Power	J. B. Gupta	S. K. Kataria& Sons ISBN : 9788185749570
2	Electric Power Transmission and Distribution	S. Sivanagaraju	Pearson Education India, ISBN : 9788131707913
3	Electrical Power Systems	C.L.Wadhwa	New Age International Pvt Ltd ISBN: 9788122428391
4	Electric Power Generation: Transmission & Distribution	S. N. Singh	Prentice Hall of India Pvt Ltd ISBN: 9788120335608
5	Transmission & Distribution of Power	K.R.Siddhapura& D. B. Raval	Vikas Publishing House Pvt Ltd ISBN: 9789325986640

13. SOFTWARE/LEARNING WEBSITES

https://www.youtube.com/watch?v=WUHcVXjfsxs
https://www.youtube.com/watch?v=Fqk0G1yDjeY
https://www.youtube.com/watch?v=EZszSVZ9G6s
https://www.youtube.com/watch?v=4Lje07848bE
https://www.youtube.com/watch?v=tyuOgA1lX2Y
https://www.youtube.com/watch?v=k78GHf-aT7M
https://www.youtube.com/watch?v=FldL8adG_gI

14. PO - COMPETENCY- CO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	2	2	2	2	1	1	3
CO2	2	1	1	1	1	1	1
CO3	3	3	2	2	2	1	2
CO4	2	1	1	1	1	1	3
CO5	2	1	1	1	1	1	2
CO6	2	2	2	1	1	1	3

	PSO1	PSO2	PSO3	PSO4
CO1	2	3	1	2
CO2	2	3	1	2
CO3	1	3	1	1
CO4	2	3	1	2
CO5	2	2	1	3
CO6	2	2	1	3

Sign: Name: 1. Smt.U. S. Tulangekar 2. Shri. B.R. More (Course Experts)	Sign: Name:Dr. S.S.Bharatkar/Shri. R.U. Shelke (Head of Department)
Sign: Name: Dr. S. S. Bharatkar/Shri.R. U. Shelke (Program Head) (Department of Electrical Engineering)	Sign: Name: Shri A. S. Zanpure (CDC Incharge)

Government Polytechnic, Pune

'180OB' – Scheme

Programme	Diploma in ET/CE/**EE**//ME/MT/CM/IT/DDGM
Programme code	01/**02**/03/04/05/06/07/08/15/**16**/17/18/19/21/**22**/23/24/26
Name of Course	**Instrumentation & Control**
Course Code	**EE3107**
Prerequisite course code and name	No
Class Declaration	No

1. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P)		Examination Scheme				
					Theory		Practical		Total Marks
L	T	P	C		ESE	PA	$ ESE	PA	
03	00	02	05	**Marks**	80	20	25	25	150
				Exam Duration	3 Hrs	1 Hr	-	-	

Legends: L- lecture, T-Tutorial/teacher guided theory practice, P-practical, C-Credits, ESE-End semester examination, PA- Progressive Assessments(Test I, II/Term Work), * - Practical Exam, $ - Oral Exam. # - Online Exam., Each lecture/practical period is of one clock hour.

2. RATIONALE

In industry, engineering diploma holders are expected to handle basic instruments for the measurement of various process parameters such as temperature, pressure, flow and level in different types of industries and electrical utilization system. The technologists should be able to select proper instruments or meters for the measurement of physical and electrical parameters and also maintain these instruments and meters for proper functioning in different application. This course has been therefore designed to develop this competency and related outcomes.

3. COMPETENCY

The aim of this course is to attend following industry identified competency through various teaching learning experiences:

- **Maintain different sensor and transducers are used for measurement of various physical parameters.**

4. COURSE OUTCOMES (COs)

The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry oriented COs associated with the above mentioned competency**:**

1 -Know the basic of instrumentation system, transducer need and classification and selection of the relevant transducers.

2-Apply the knowledge of transducers in the measurement of displacement, temperature, pressure, flow and level.

3- Know the working and application of signal conditioning circuits in the instrumentation system

4-Interpret the necessity of different data acquisition circuits in the instrumentation system

5-Illustrate the use of display, recorders and telemetering in the instrumentation system.

6- Identify and describe the basic components of control system, controllers and its application.

5. SUGGESTED PRACTICALS/ EXERCISES

Pr. No.	**Unit No.**	**Practical Exercises** (Outcomes in Psychomotor Domain)	**Relevant CO**	**Approximate Hours Required.**
1.	1	Use potentiometer to measure the linear displacement and plot characteristics	1, 2	02
2.		Use LVDT to measure linear displacement and plot relation between linear displacement and output voltage.	1, 2	04
3	2	Use RTD- PT-100 to measure temperature of the water and plot characteristics of resistance verses temperature	1, 2	02
4.		Use thermister to measure temperature of the water and plot characteristics of resistance verses temperature	1, 2	02
5.		Use thermocouple to measure temperature of water	1, 2	02
6.		Use strain gauge to measure applied pressure	1, 2	02
7.		Study measurement of flow by using rotameter, venture tube and orifice	1, 2	02
8.	3	Perform Inverter / Non- inverter/ Adder/Substractor using Op-Amp	3	02
9.		Perform Instrumentation amplifier using three Op-Amps	3	02
10.	4	Test the performance of Portable Data Acquisition system	4	02
11	5	Study digital and analog display system	5	02
12.	6	To perform temperature control of water	6	02
13.		To perform water level control	6	02
14		To Study PID controller	6	04
15		Microproject planning & Execution as written in suggested microproject list		02
16		Microproject report writing		02
17		Suggested student activity report		02
Total Hrs				**38**

Sr. No.	Performance Indicators	Weightage in %
a.	Arrangement of available equipment / test rig or model	20
b.	Setting and operation	20
c.	Safety measures	10
d.	Observations and Recording	10
e.	Interpretation of result and Conclusion	20
f.	Answer to sample questions	10
g.	Submission of report in time	10
	Total	**100**

6. MAJOR EQUIPMENT/ INSTRUMENTSREQUIRED

The major equipment with broad specification mentioned here will usher in uniformity in conduct of practical, as well as aid to procure equipment by authorities concerned**.**

Sr. No.	Major Equipment/ Instruments Required	Pr. No.
1	DC Regulated power supply (0-300V, 0-10A)	1 to 4
2	DC Regulated Dual power supply (0-30V,0-2A)	1 to 4
3	Cathode Ray Oscilloscope- Dual trace, 25 MHz with isolation transformer , attenuator probe for CRO	2.
4	Digital Multimeter- 31 /2 digit, 0-800 volts ,0-10A, micro-ammeters 0-100 µA	1 to 4
5	Instrumentation kits	1 to 4
6	Different types of cables and connectors	1 to 4
7	Op-Amp and its kits	3

7. THEORY COMPONENTS

The following topics/sub topics should be taught and assessed in order to develop UOs for achieving the COs to attain the identified competency**.**

Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
UNIT 1. Introduction to Instrumentation and Transducer	**(Marks -12 , Hrs- 6)**
1a. Describe the function of each blocks of instrumentation system. 1b. Explain static and dynamic characteristics of instruments 1c. Define sensor, transducer and classify it. 1d. Describe the construction and working of linear and angular potentiometer 1e. Describe the construction and working of bounded and unbounded strain gauge 1f. Define poisson's ratio, strain and	**1.1 Introduction** Generalized block diagram of Instrumentation system. Function of each block of Instrumentation system. 1.2 Static and dynamic characteristics of Instruments. 1.3 Sensors and Transducer: basic definition, difference, and classification of sensors, thermal, optical, magnetic and electric sensors 1.4 Transducer: Need, Classification

Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
gauge factor 1g. Derive the expression of gauge factor of strain gauges. 1h. Describe the construction and working of LDR and its application 1i. Describe with neat sketches, the construction and working of LVDT with its characteristics and also write its advantages and disadvantages. 1j. Describe the construction and working of active transducer with its application. 1k.Write selection criteria of transducer.	1.5 Electrical Passive Transducers: a. Resistive type transducer, linear and angular potentiometer, strain gauges, light dependent resistor (LDR). b. Inductive type transducer, Linear variable differential transformer (LVDT), Rotational variable differential transformer (RVDT). c. Capacitive transducers 1.5 Electrical active Transducers, Piezoelectric transducer, Photo voltaic cell. 1.6 Selection criteria of transducer.
UNIT 2 Transducer Applications	**(Marks - 24 , Hrs- 18)**
2a.Explain measurement of linear displacement by using potentiometer or LVDT. 2b. State different temperatures scales and conversion of these scales. 2c. Describe the construction, working principle and characteristics of thermister , thermocouple & RTD . 2d. Define Seebeck effect and Peltier effect. 2e. Explain with circuit diagram of pyrometer. 2f. Describe direct and indirect methods for measurement of level. 2g.Classify pressure measuring devices and describe measurement of pressure by using wet and dry type sensors. 2h.Describe the construction and working principle of different types of flow meters.	**2.1 Measurement of Linear displacement** Linear displacement using potentiometer and LVDT **2.2 Measurement of Temperature** Temperature and its Units. Temperature scales and conversions. 2.2.1 Classification of Temperature measuring transducers: a. Resistant Dependent Detector (RTD, PT-100, 2/3 wire) b. Thermistor. c. Thermocouple – Law of intermediate temperature, law of intermediate metals, Seebeck effect and Peltier effect. Construction and working principle, common thermocouples and their parameters. 2.2.3 Pyrometer – Optical method, Radiation method. 2.2.4 Typical specifications of Thermistor, RTD and Thermocouple. 2.2.5 Calibration of temperature measuring transducer. **2.3 Measurement of Level** Level and its units, Classification of level measurement methods. 2.3.1 Direct methods- Slight glass, Bob sling method and float method. 2.3.2 Indirect methods: Capacitive type, Ultrasonic level detector, Radiation level detector, and air bubbles method. **2.4 Measurement of Pressure** Pressure and its units, Types Absolute, Gauge, Atmospheric Vacuum.

Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
	2.4.1 Classification of Pressure measuring devices 2.4.1.a Wet type sensor (i) Manometer (ii) Barometer 2.4.1.b Dry type elastic pressure transducer: Bourdon tube, Bellows, Diaphragm 2.4.1.c Bourdon tube with LVDT, Diaphragm with strain Gauges 2.4.2 Specification of electrical pressure transducer **2.5 Measurement of Flow** Flow and its units, mass flow rate, volumetric flow rate 2.5.1 (a) Restriction type , Variable differential pressure constant area method (i) Orifice plate (ii) Venture tube (iii) Flow nozzle (b) Constant differential pressure variable , Rotameter 2.5.2 Volumetric flow rate measurement using Electromagnetic flow meter, Turbine flow meter, Ultrasonic flow meter- Time difference and Doppler type, Hot wire anemometer, Vortex flow meter. 2.5.3 Specification of Various flow meters
UNIT 3 Signal Conditioning Circuits	**(Marks - 14 , Hrs- 8)**
3a. State the importance of signal conditioning circuit in the instrumentation system. 3b. Describe the construction and working of different signal circuits in the instrumentation system.	3.1 Signal Conditioning : Definition, importance of signal Conditioning, Signal Conditioning Elements 3.2 Operational Amplifier and its parameters. Op-Amp IC's 741 pin diagram and pin function. Virtual ground concept. 3.3 Op-amp basic Circuits, inverting amplifier, non-inverting amplifier, inverter, adder, subtractor, integrator, differentiator. 3.4 Application of Op-amp, instrumentation amplifier, voltage to current converter, current to voltage converter, comparator, zero crossing detector, phase detector. 3.5 Basic definition of filters, passive and active filter, low pass, high pass, band pass and band stop filter. 3.6 DC & AC signal conditioning circuits
UNIT 4 Data Acquisition System (Marks - 12 , Hrs- 06)	
4a. Explain the necessity of data acquisition system in the instrumentation system. 4b. Describe the different circuits of DAS in the instrumentation system.	4.1Necessity of data processing in instrumentation, data acquisition system (DAS) , classification of DAS, single channel and multi channel

Unit Outcomes (UOs) (in cognitive domain)	**Topics and Sub-topics**
	4.2 Signal converter, analog to digital converter (ADC), Digital to analog converter (DAC), sample and hold circuit. 4.3Basic definition of Multiplexer and de - multiplexer, TDM & FDM 4.4Basic definition of modulation and demodulation
UNIT 5 Display and Recording System	**(Marks - 04 , Hrs- 02)**
5a. Describe the construction and working of display and recording system of different circuits of DAS in the instrumentation system.	5.1 Display, analog and digital, 7 segments and 14 segments display. 5.2 Recorders , graphic recorder, strip-chart recorders and x-y recorders 5.3. Telemetering , electrical telemetering , voltage , current, position telemetering systems
UNIT 6 Basic Concept of Control System	**(Marks - 14 , Hrs- 08)**
6a. Explain the basic concept of control system and its components and application. 6b. Explain different automatic controllers. 6c. Explain the function and working of different actuators in control system.	6.1Control system, types of control system , close loop and open loop control system 6.2 Automatic controller, basic function. Classified controller according to their control action, two position, proportional (P), integral (I), proportional plus integral (PI), proportional plus derivative (PD), proportional plus integral plus derivative (PID). Explain all controllers using Op-amp. 6.3 Electric actuators, electro- mechanical actuators, solenoid ,DC motor, stepper motor, servo motor 6.4 Application of instrumentation and control system Water level control system, temperature control system, speed control of DC motor, position control system

8. SUGGESTED SPECIFICATION TABLE FORQUESTION PAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	**Introduction to Instrumentation and Transducer**	06	04	08	-	12
II	**Transducer Applications**	18	04	08	12	24
III	**Signal Conditioning Circuits**	08	04	06	04	14
IV	**Data Acquisition System**	06	04	04	04	12
V	**Display and Recording System**	02	00	04	00	04
VI	**Basic Concept of Control System**	08	04	04	06	14
Total		48	**20**	**34**	**26**	**80**

9. SUGGESTED STUDENT ACTIVITIES

Other than the classroom and laboratory learning, following are the suggested student-related ***co-curricular*** activities which can be undertaken to accelerate the attainment of the various outcomes in this course: Students should conduct following activities in group and prepare reports of about 5 pages for each activity, also collect/record physical evidences for their (student's) portfolio which will be useful for their placement interviews:

a. Prepare journals based on practical performed in laboratory.
b. Study the specification of sensor and transducers
c. Collect information of transducers and prepare charts of the same.
d. Prepare posters to illustrate the use of transducers and control system.

10. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are sample strategies, which the teacher can use to accelerate the attainment of the various outcomes in this course:

a. Massive open online courses (***MOOCs***) may be used to teach various topics/sub topics.
b. About ***15-20% of the topics/sub-topics*** which is relatively simpler or descriptive in nature is to be given to the students for ***self-directed learning*** and assess the development of the COs through classroom presentations (see implementation guideline for details).
c. With respect to item No.8, teachers need to ensure to create opportunities and provisions for ***co-curricular activities***.
d. Guide student(s) in undertaking micro-projects.
e. Correlate subtopics with power plant system and equipments.
f. Use proper equivalent analogy to explain different concepts.
g. Use Flash/Animations to explain various components, operation and
h. Teacher should ask the students to go through instruction and Technical manuals

11. SUGGESTED MICRO-PROJECTS : SUGGESTED MICRO-PROJECTS :

Only one micro-project is planned to be undertaken by a student that needs to be assigned to him/her. In the first four semesters, the micro-projects are group-based. However, in the fifth and sixth semesters, it should be preferably be individually undertaken to build up the skill and confidence in every student to become problem solver so that s/he contributes to the projects of the industry. In special situations where groups have to be formed for micro-projects, the number of students in the group should not exceed three.

The micro-project could be industry application based, internet-based, workshop-based, laboratory-based or field-based. Each micro-project should encompass two or more COs which are in fact, an integration of PrOs, UOs and ADOs. Each student will have to maintain dated work diary consisting of individual contribution in the project work and give a seminar presentation of it before submission. The total duration of the micro-project should not be less than 16 (sixteen) student engagement hours during the course. The student ought to submit micro-project by the end of the semester to develop the industry oriented COs.

A suggestive list of micro-projects is given here. Similar micro-projects could be added by the concerned faculty:

a) Use RTD/Thermistor/Thermocouple for indication of temperature
b) Use level transducer for indicating and controlling the level of water tank.
c) Use float type level sensor for indication of level of water tank
d) Use strain gauge for weight measurement in simple platform.
e) Perform water level controller.
f) Perform mathematical operation by using Op-Amp.

12. SUGGESTED LEARNING RESOURCES

S.N.	Title	Author, Publisher, Edition and Year of publication	ISBN Number
1	Industrial Instrumentation and Control	S. K. Singh, Tata, McGraw-Hill Publishing Company Limited, New Delhi.	ISBN O-07-048290-X
2	Introduction to Instrumentation and Control	A.K. Ghosh, Prentice-Hall of India Private Limited, New Delhi	ISBN-81-203-1626-6
3	Electrical and Electronic Measurements and Instrumentation	A K Sawheny, Nineteenth edition, Dhanpat Rai & Sons, New Delhi, 2005	ISBN-13- : 9788177000160
4	Electronic Instrumentation	H. S. Kalsi , McGraw Hill, New Delhi, 2010	ISBN-13-9780070702066
5	Modern Electronic Instrumentation and Measurement Techniques	A. D. Helfrick , W. D. Cooper , Pearson Education India, Ist Edition , New Delhi, 2005	ISBN-13-978-9332556065

13. SOFTWARE/LEARNING WEBSITES

1. www.nptel.com
2. www.instrumentioncontrolbox.com
3. www.myklassroom.com/Engineering /Electronics & Instrumentation Engineering
4. www.en.wikibooks.org/wiki/Electronics/Measuring _Instruments
5. www.capabilitydevelopment.org
6. www.tatasteelelearning.com

14. PO - COMPETENCY- CO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	3	-	3	1	-	3
CO2	3	2	2	3	1	1	-
CO3	2	2	-	2	-	-	1
CO4	1	3	-	-	1	-	2
CO5	-	2	1	2	1	2	1
CO6	-	2	2	-	2	1	1

	PSO1	PSO2	PSO3	PSO4
CO1	2	-	-	-
CO2	2	3	-	2
CO3	1	1	-	-
CO4	1	1	-	-
CO5	1	1	-	-
CO6	2	3	-	2

Sign: Name: 1) Dr. V. K. Jadhav 2) Shri. S. P. Date (Course Experts)	Sign: Name:Dr. S. S. Bharatkar/Shri.R. U. Shelke (Head of Department)
Sign: Name:Dr S. S. Bharatkar/Shri.R. U. Shelke (Program Head) (Department of Electrical Engineering)	Sign: Name: Shri A. S. Zanpure (CDC Incharge)

Government Polytechnic, Pune

'180OB' – Scheme

Programme	**Diploma in Electrical Engineering**
Programme code	01/**02**/03/04/05/06/07/08/15/**16**/17/18/19/21/**22**/23/24/26
Name of Course	**Digital Techniques and Applications**
Course Code	**ET3101**
Prerequisite course code and name	**ET2108 Electronics components Circuits**
Class Declaration	No

1. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P)		Examination Scheme				
					Theory		Practical		Total Marks
L	T	P	C		ESE	PA	*ESE	PA	
03	00	02	05	Marks	80	20	25	25	150
				Exam Duration	3 Hrs	1 Hr	-	-	

Legends: L- lecture, T-Tutorial/teacher guided theory practice, P-practical, C-Credits, ESE-End semester examination, PA- Progressive Assessments(Test I, II/Term Work), * - Practical Exam, $ - Oral Exam. # - Online Exam., Each lecture/practical period is of one clock hour.

2. RATIONALE

Now a day's application of digital circuits like computers,mobiles, automation and control circuits are extensively used in the field of electrical engineering and electrical power systems. The knowledge of basic logic gates, combinational and sequential logic circuits using discrete gates as well as digital ICs will enable the students to interpret the working of equipment and maintain them .So the digital technique has been introduced as a subject in electrical engineering curriculum. This course covers digital circuits logic gates, Flip-flop, data converter, memory and their applications. After completion of the course,students will be able to develop digital based application.

3. COMPETENCY

The aim of this course is to attend following industry identified competency through various teaching learning experiences:

- **Maintain electronic circuits comprising of discrete electronic components**.

4. COURSE OUTCOMES (COs)

The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry oriented COs associated with the above mentioned competency**:**

1.Use number system and codes for interpreting working of digital system.
2. Use Boolean expressions to realize logic circuits.
3. Build simple combinational and sequential circuits.
4. Describe architecture and operation of microprocessor 8085
5.Understand the functions of various data converters and memories

5. SUGGESTED PRACTICALS/ EXERCISES

Sr. No.	**Unit No.**	**Practical Exercises** (Outcomes in Psychomotor Domain)	**Relevant CO**	**Approximate Hours Required.**
1	2	To check different IC's using IC tester	All	2
2		Verify Truth table of basic logic gates ,universal gate	2	2
3		Verify NAND and NOR gate as universal logic gate.	2	2
4		Verify De Morgan's Theorem	2	2
5	3	Design half Adder & half subtractor	3	2
6		Verify the operation of Multiplexer IC 74151	3	2
7		Verify the operation of Demultiplexer IC 74155	3	2
8		Construct and test BCD to seven segment decoder using IC 7447/7448	3	4
9		Verify truth table of Encoder &Decoder	3	2
10	4	Realize and verify RS flip flop using NAND gate	3	2
11		Test function of master slave JK Flip-Flop using IC 7476	3	2
12		Realize T and D flip flop and verify its truth table.	3	2
13	6	Implement 3 bit R-2R D/A converter	5	4
14		Verify the operational features of ADC – IC 0809/IC 0808 and DAC 0800	5	2
15	All	Complete a Micro- project based on guidelines provided in sr.no. 11.	All	04
		Total Hrs		**32**

Note: Any 12 practicals from sr. no. 1 – 14 can be performed and 15 is compulsory.

Sr.No.	Performance Indicators	Weightage in %
a.	Arrangement of available equipment / testing or model	20
b.	Setting and operation	20
c.	Safety measures	10
d.	Observations and Recording	10
e.	Interpretation of result and Conclusion	20
f.	Answer to sample questions	10
g.	Submission of report in time	10
Total		**100**

6. MAJOR EQUIPMENT/ INSTRUMENTSREQUIRED

The major equipment with broad specification mentioned here will usher in uniformity in conduct of practical, as well as aid to procure equipment by authorities concerned**.**

Sr.No.	Major Equipment/ Instruments Required	Experiment Sr. No.
1	**Digital IC Tester**	All
2	Variable DC Power supply 0-30V with display for voltage and current	All
3	Digital Multimeter	1,2,4,14
4	CRO	10,11,12,13,14
5	Function Generator	13,14
6	Pulse Generator	10,11,12,13,14
7	Different types of cables and connectors	All

7. THEORY COMPONENTS

Unit Outcomes Os) (in cognitive domain)	**Topics and Sub-topics**
UNIT 1.Number System and Codes(Weightage-14, Hrs- 08)	
1a.Recognize andconvert the given number into the specified number system. 1b. Perform the binary arithmetic operation on the given binary numbers 1c. Find 1's compliments and 2's compliment of given no. 1d Add the given two decimal numbers using BCD code.	• 1.1Analog signal Vs Digital signal • 1.2Number system: Decimal, Binary,octal, hexadecimal conversion of onessystem into other • 1.3 Binary Arithmetic: - Addition, Subtraction(1's and 2's complement) Multiplication, Division, • 1.4 BCD Arithmatic: BCD addition • 1.5Codes:BCD,GreyCode,Excess-3,ASCIIcodes
UNIT 2Logic Gates and Logic Families(Weightage-12, Hrs- 06)	

Unit Outcomes Os) (in cognitive domain)	Topics and Sub-topics
2a Design the basic gate using NAND and NOR gate. 2b. Simplify the given expression using Boolean laws. 2c. Design logic circuits using the given Boolean Expression. 2d. Compare the silent characteristics of given digital logic families.	• 2.1 Logic Gates:Symbol ,logical expression,truth table, pin diagram of TTL logic gates ICs of basic logic gate (AND,OR,NOT), Universal gates(NAND and NOR),Special purpose gates(EX-OR,EX-NOR) • 2.2 Boolean algebra: Laws of Boolean algebra,Duality Theorem, De Morgan's theorems. • 2.3 Logic families:Characteristics of logic families(Noise Margin,power dissipation,figure of merit,Fan-in& fan -out , speed of operation,Comparison between different logic families.TTL NAND gate – Totem pole output,CMOS Inverter
UNIT 3Combinational Logic Circuits(Weightage- 18 , Hrs- 12)	
3a. Design logic circuits in standard SOP/POS forms for given logical expression. 3b. Minimize the given logic expression using K-map. 3c. Draw MUX/DEMUX tree for the given number of input and output lines. 3d. Design code converter using k map	• 3.1 Standard Boolean representation:Sum of product(SOP) & product of sum(POS),Min term and Maxterm conversion between SOP and POS forms. Realization using NAND /NOR gates • 3.2K-map reduction techniques: minimization of Boolean functions upto 4 variable using SOP & POS Forms • 3.3 Design of arithmetic circuits using K-maps: Half and Full Adder, Half and Full Subtractor • 3.4 Encoder&Decoder : Basic of Encoder and decoder , Decimal to BCD Encoder , IC 7447 as BCD to 7 segmentdecoder • 3.5 Multiplexers(MUX) and Demultiplexers (DEMUX): study of IC 74151 ,MUX tree, study of IC 74155 as DEMUX ,DEMUX Tree, DEMUX as decoder
UNIT 4 Sequential Logic circuit(Weightage- 16 , Hrs- 10)	
4a. Use relevant triggering technique for the given digital circuit. 4b.Use the given Flip flop to construct the specific type of counter.	• 4.1Basic memory cell: RS latch – using NAND & NOR. • 4.2 Triggering methods: Edge and level trigger • 4.3 S R Flip flop: SR- Flip flop ,Clocked SR flip flop with preset and clear, Drawbacks of SR Flip flop • 4.4 JK Flip flops: Clocked JK Flip flop with preset & clear, Race around condition in JK flip-flop,Master slave JK flip flop.

Unit Outcomes Os) (in cognitive domain)	**Topics and Sub-topics**
4c. Design synchronous and Asynchronous counter using excitation table . 4d.Design ring /twisted ring counter using the given flip-flop. 4e. Design 4 bit shift register using given flip flop.	D and T type flip flop. Excitation table of flip flops • 4.5 Shift Register: Logic diagram of 4 bit shift registers –Serial input serial output, Serial input parallel output, Parallel input serial output, Parallel input parallel output. • 4.6 Counters : Asynchronous counter: 4 bit Ripple counter , 4 bit up/down Counter, modulus of counter, Synchronous counter: Design of 4 bit synchronous up/down counter • 4.7 Applications of Shift Register: Ring counter, Twisted ring counter(Logic Diagram with waveforms)
UNIT 5Introduction to Microprocessor(**Weightage-08, Hrs- 04)**	
5a.Explain with sketches the architechure and pin diagram of the Intel 8085 Microprocessor 5b. Define BUS and explain different type of bus.	• 5.1 Microprocessor as Physical system, pin diagram & Pin configuration of Intel 8085 Microprocessor. • 5.2 Architecture and organization of INTEL 8085. • 5.3 Data bus, Control bus, Address bus, CPU, ALU, accumulator.
UNIT 6Data converter &Memories(Weightage-12, Hrs- 08)	
6a. Calculate the output voltage of R-2R ladder for the given specified digital input. 6b. Calculate the output voltage of the weighted resistor DAC for the given specified digital input. 6c. Explain with sketches the working principle of the given type of ADC and DAC 6d. State classification of Memory. 6e. Explain with sketches the working principle of memories. 6f. Compare different types of memories	• 6.1Digital to Analog converter: Types of DAC: Weighted resistor method and R-2R Method (along with Mathematical derivation) • 6.2Analog to Digital converter :Single slope ADC, Dual slope ADC,SAR ADC(Block diagram &working) • 6.3Classification of memory and Principle of operation :Types of memory RAM (Static, Dynamic), Volatile and Non-Volatile,ROM (PROM, EPROM, EEPROM),Flash memory, • 6.4Comparison: Comparison between RAM (Static, Dynamic), Volatile and Non-Volatile, ROM (PROM, EPROM, EEPROM), Flash memory

8. SUGGESTED SPECIFICATION TABLE FORQUESTION PAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	**Number System and Codes**	08	04	08	02	14
II	**Logic Gates and Logic Families**	06	02	04	06	12
III	**Combinational Logic Circuits**	12	04	08	06	18
IV	**Sequential Logic circuit**	10	04	08	04	16
V	**Introduction to Microprocessor**	04	04	04	00	08
VI	**Data converter &Memories**	08	06	04	02	12
Total		48	**20**	**38**	**22**	**80**

9. SUGGESTED STUDENT ACTIVITIES

Other than the classroom and laboratory learning, following are the suggested student-related ***co-curricular*** activities which can be undertaken to accelerate the attainment of the various outcomes in this course: Students should conduct following activities in group and prepare reports of about 5 pages for each activity, also collect/record physical evidences for their (student's) portfolio which will be useful for their placement interviews:

a. Prepare the survey report on the applications of different types of number system and code converters used in the design of digital system.
b. Test digital IC's using various testing equipment like digital IC tester, digital multi-meter etc.
c. Prepare charts of symbols, truth table, pin diagram of different logic gates.
d. Give seminar on any course relevant topic
e. Conduct library/internet survey regarding different data sheet and manuals.
f. Prepare power point presentation on digital circuits and their application.
g. Undertake a market survey of different digital IC's and different microprocessors IC's required for different applications
h. Search for video / animation / power point presentation on internet for complex topic related to the course and make a presentation.

10. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are sample strategies, which the teacher can use to accelerate the attainment of the various outcomes in this course:

a. Massive open online courses (***MOOCs***) may be used to teach various topics/sub topics.
b. About ***15-20% of the topics/sub-topics*** which is relatively simpler or descriptive in nature is to be given to the students for ***self-directed learning*** and assess the development of the COs through classroom presentations (see implementation guideline for details).
c. 'L'in item No 1 does not mean only the traditional lecture method but different types of teaching methods and media that are to be employed to develop the outcomes
d. Use proper equivalent analogy to explain different concepts.

e. Use Flash/Animations to explain various components, operation and
f. Teacher should ask the students to go through instruction and Technical manuals

11. SUGGESTED MICRO-PROJECTS

Only one micro-project is planned to be undertaken by a student that needs to be assigned to him/her. In special situations where groups have to be formed for micro-projects, the number of students in the group should ***not exceed three.***
The micro-project could be industry application based, internet-based, workshop-based, laboratory-based or field-based. Each micro-project should encompass two or more COs which are in fact, an integration of PrOs, UOs and ADOs.(Affective Domain Outcomes) .Each student will have to maintain activity chart consisting of individual contribution in the project work and give a seminar presentation of it before submission.. The student ought to submit micro-project by the end of the semester to develop the industry oriented COs.
A suggestive list of micro-projects is given here. Similar micro-projects could be added by the concerned faculty:

a. Built a circuit to test 7 segment display
b. Build a circuit to add 4 bit adder
c. Build a circuit for LED Flasher
d. Generate a triangular wave using Microprocessor
e. Design a memory map to interface 8 bit 2K ROM & 4K to 8085 Microprocessor
f. Any project related to topics in curriculum given by course teacher

12. SUGGESTED LEARNING RESOURCES

S.N.	Title	Author	Publisher, Edition ,Year of publication and ISBN Number
1	Modern Digital Electronics	R P Jain	McGraw Hill Education Pvt. Ltd, 4th Edition,2012ISBN 10: 0070669112 ISBN 13: 9780070669116
2	Digital circuits and Design	Salivahanan S.;Arivazhagan S.	ISBN-10: 9789325960411
3	Digital Electronics	Puri V.K.	ISBN :97800746331751
4	Digital Principles	MalvinA.P.;Leach D.P.;SahaG.	ISBN :9789339203405
5	Digital Design	Mano,Morris;Ciletti,Michael D	ISBN :9780131989245
6	Digital Electronics,Principles and Integrated circuit	Maini,Anil K	ISBN :9780470032145
7	Microprocessor Architecture,Programming,and application with the 8085	Ramesh S.Gaonkar	ISBN-10:8187972092,ISBN-13:9788187972099

13. SOFTWARE/LEARNING WEBSITES

1. www.cse.yorku.ca/~mack/1011/01.NumberSystems.ppt
2. www.people.sju.edu/~ggrevera/arch/slides/binary-arithmetic.ppt
3. www.mathsisfun.com/binary-number-system.html
4. www.codesandtutorials.com/hardware/electronics/digital_codes-types.php
5. www.ee.surrey.ac.uk/Projectys/Labview/gatesfunc/
6. www.ee.surrey.ac.uk/Projectys/Labview/boolalgebra/
7. www.eng.auburn.edu/~strouce/class/elec2200/elec2200-8.pdf
8. www.maxwell.ict.griffith.edu.au/yg/teaching/dns_module3_p3.pdf
9. www.eng.wayne.edu/~singhweb/seql.ppt
10. www.scs.ryerson.ca/~aabhari/cps213Chapter5.ppt
11. www.cs.sjsu.edu/faculty/lee/Ch2Problems2.ppt
12. www.rogtronics.net/files/datasheets/dac/sedraSmith.pdf
13. www.old.me.gatech.edu/mechatronics_course/ADC_F04.ppt
14. www.allaboutcircuits.com/vl_4/chpt_13/3.html
15. www.youtube.com/watch?v=5Wz5f3n5sjs
16. www.eee.metu.edu.tr/~cb/e447/Chapter%209%20-%20v2.0.pdf
17. www.cmc.gcg11.org/attachments/article/95/Memory2.ppt
18. www.cosc.brocku.ca/Offerings/3P92/seminars/Flash.ppt
19. www.webopedia.com/TERM/R/RAM.html
20. www.cs.sjsu,edu/~lee/cs147/Rahman.ppt

14. PO – COMPETENCY- CO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	-	2	-	-	-	2
CO2	3	-	2	-	-	-	2
CO3	2	-	3	-	-	-	2
CO4	2	-	3	-	-	-	2
CO5	3	-	2	-	-	-	2
CO6	3	-	2	-	1	-	2

	PSO1	PSO2	PSO3	PSO4
CO1	3	2	-	-
CO2	3	2	-	-
CO3	3	2	-	-
CO4	3	2	-	-
CO5	3	2	-	-
CO6	3	2	-	-

Sign: Name: Shri. A.D.Vikhankar Smt. M.V.Saraf (Course Experts)	Sign: Name: Shri. R.N.Shikari (Head of Department)
Sign: Name: Dr.S. S. Bharatkar/Shri.R. U. Shelke (Program Head) (Department of Electrical Engineering)	Sign: Name: Shri A. S. Zanpure (CDC Incharge)

Level 4 - A Curriculum

Government Polytechnic, Pune

'180 O.B.' – Scheme

Programme	Diploma in **CE/EE/ET/ME/MT/CO/IT/DDGM**
Programme code	**01/02/03/04/05/06/07/08/15/16/17/18/19/21/22/23/24/26**
Name of Course	**Environmental science**
Course Code	**AU4101**
Prerequisite course code and name	No
Class Declaration	No

1. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P)		Examination Scheme				
					Theory		Practical		Total Marks
L	T	P	C		ESE	PA	ESE	PA	
-	-	02	02	Marks	NA	NA	NA	50	50
				Exam Duration	--	--	--		

Legends : L- Lecture, P- Practical, T- Tutorial, C- Credits, ESE-End Semester Examination, PA- Progressive Assessment (Test I,II/Term Work), *- Practical Exam, $- Oral Exam, #- Online Examination. Each Lecture/Practical period is of one clock hour

2. RATIONALE

This is an interdisciplinary course, introduced with an aim to create awareness about environmental issues among the diploma students. The rate Industrialization and Urbanization is very fast, and the country/world is facing the issues like draught, flood, deforestation, increase in earth temperature, pollution and depletion of resources. In view of this the management of resources' and dilution of pollutants is of prime need to keep the environment safe and clean.

3. COMPETENCY

The aim of this course is to attend following industry identified competency through various teaching learning experiences:

- **To create environmental awareness for sustainable development.**

4. COURSE OUTCOMES (COs)

The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry-oriented COs associated with the above-mentioned competency**:**

1. Create awareness for conservation of natural resources and preserving the Environment.
2. Perform/Contribute in sustainable development.
3. Undertake preventive measures to control different pollutions.
4. Differentiate between Conventional and Non-conventional energy sources.
5. Identify the role of SPCB/CPCB and EPA in Environment protection

5. SUGGESTED PRACTICALS/ EXERCISES

Sr. No.	UNIT No	Practical Exercises (Outcomes in Psychomotor Domain)	Relevant CO	Approximate Hours Required.
1.	NA	Visit to "Kachara Depot (dumping yard) and write a report.	1, 3,5	04*
2.		Identify the Environmental issues and group discussion on the efforts made to increase public awareness and prepare a Report.	1,2,3	04*
3.		Assignment/Report on ecosystem and its components.	2	02
4.		Expert lecture on Role of NGOs and Government in Conserving Environment and write a report on it.	2,3,5	04
5.		Visit to a local area -Environmental assets such as river /forest / grassland / hill / mountain and writing report on it.	1,3	04
6.		Activity based on – "Best out of Waste" (use of waste paper, Plastic, glass bottles, clothe, scrap.)	3	02*
7.		Video Demonstration /Expert Lecture Report on Climate Change and Global warming.	1,2,3, 4,5	02
8.		Write a report on E-waste - 1. Describing E-waste and its type. 2. State its impact/hazards on environment. 3. State importance of E-waste disposal and disposal methods. 4. Comments on how E-waste is handled globally. (Role play can be enacted by each group representing different countries) 5. Description of how India handles e-waste. (Role play can be enacted by a group)	1,2,3	04
9.		Visit to nearby site, using nonconventional energy source	4	04

		(e.g., solar/wind)		
10.		Visit to nearby Poly house and write a report. (Product, financial assistance, limitations, difficulties in operating, any other related information)	2	04
11.		Individual Presentation on Environmental issues and his/her Contribution towards Environment.	12,3, 4,5	04*
12.		Write an assignment on Green House effect, carbon Footprint, carbon trading.	2,3,4	02
13.		Assignment on disposal of medical waste. (To study Incineration.)	3	02
14.	NA	Identify the issues related to the programmes in the institute and write the report. (Here disciplinary or interdisciplinary activity can be carriedout)	2,3	04*
15.		Write an assignment on role of Ministry of Environment and Forest Organizational Structure (MOEF) and Central Pollution Control Board (CPCB), State Pollution Control Board (SPCB), Environment Protection Act.	5	04*
16		Complete a micro project based on guidelines provided in Sr.no. 11	1 to 5	04*
		Total Hrs.		**32**

Practical marked with* are compulsory.

Sr.No.	Performance Indicators	Weightage in %
a.	Observation, collection, and analysis of data	40
b.	Preparation of report	30
c.	Interpretation of result/ observation and conclusion	10
d.	Answer to questions	10
e.	Submission of report in time	10
Total		**100**

6. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

NA

7. THEORY COMPONENTS

The curriculum is activity based. It is expected from teacher to explain to students the scientific theory behind each assignment. For e. g. - The assignment stating best out of waste does not mean to make only Decorative items from the waste. In this case it is expected to explain the concept of 4R i.e., reduce, reuse, recycle, and reproduce.

8. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

NA

9. SUGGESTED STUDENT ACTIVITIES

NA

10. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are sample strategies, which the teacher can use to accelerate the attainment of the various outcomes in this course:

a. Massive open online courses (***MOOCs***) may be used to teach various topics/sub topics.
b. About ***15-20% of the topics/sub-topics*** which is relatively simpler or descriptive in nature is to be given to the students for ***self-directed learning*** and assess the development of the COs through classroom presentations (see implementation guideline for details).

11. SUGGESTED MICRO-PROJECTS

Only one micro-project is planned to be undertaken by a student that needs to be assigned to him/her. In special situations where groups have to be formed for micro-projects, the number of students in the group should ***not exceed three.***

The micro-project could be industry application based, internet-based, workshop-based, laboratory-based or field-based. Each micro-project should encompass two or more COs which are an integration of PrOs, UOs and ADOs (Affective Domain Outcomes). Each student will have to maintain a dated work diary consisting of individual contributions to the project work and give a seminar presentation before submission. The student ought to submit micro-project by the end of the semester to develop the industry oriented COs.

A suggestive list of micro-projects is given here. Similar micro-projects could be added by the concerned faculty:

a. Prepare a report on visit to PUC Center.
b. Visit a nearby RO plant and prepare detail technical report.
c. Prepare report on Household water filtration unit
d. Prepare a list of polluted natural resources which arc responsible for pollution and collect information on how to damage them.
e. Collection of Data from Hospital: Collect everyday information on percentage of solid hazardous and toxic waste for two months
f. Visit of Municipal Effluent Treatment Plant: Visit effluent treatment plant and prepare report on waste management.
g. Visit of Water Treatment Plant: Visit water treatment plant and prepare report on various units of water treatment and its management.
h. Preparation of report: Prepare the chart of solid waste management showing effects on environment.
i. Suggest the remedial measures for the control of pollution of local water source by conduct relevant study
j. Undertake the Impact study of vehicular pollution on environment.
k. Visit to “Kachara Depot, (dumping yard) and analyze the waste.
l. Write a report on “Best out of Waste.

m. Write a report on Green House effect,
n. Study of air quality of Pune city.
o. Study of noise pollution in Pune city.
p. Study of solid waste management of Pune city.
q. Study of E-waste management of Pune city.
r. Study of Environmental Status Report of Pune city prepared by Pune Municipal Corporation.
s. And any other relevant topic related to course

12. SUGGESTED LEARNING RESOURCES

S.N.	Title	Author	Publisher, Edition and Year of publication, ISBN Number
1.	Basic Civil and Environmental Engineering	S.P. Nisture, D. A. Joshi, G.S.Chhawsaria, Pearson	978-1282531819
2.	Basics of Environmental Studies	Anindita Basak, D.L. Manjunath, Pearson	978-8131756072
3.	Global Warming the Hard Science	L.D.Danny Harvey Pearson	978-8131733318
4.	Environmental Studies	Benny Joseph,Tata McGraw Hill	978-9352605170
5.	Renewable Energy	Godfrey Boyle, Oxford Publications	0199261784, 9780199261789
6.	Environmental studies	R. Rajagopalan, Oxford University Press	9780199459759

13. SOFTWARE/LEARNING WEBSITES

1. www.nptel.com
2. http://www.mpcb.gov.in/
3. http://www.cpcb.nic.in/
4. http://www.envfor.nic.in/
5. http://www.neeri.res.in/

14. PO - COMPETENCY- CO MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	1	1	2	1	3	1	3
CO2	1	1	2	1	3	1	3
CO3	1	1	2	2	2	1	3
CO4	1	1	2	1	2	1	3
CO5	1	1	2	1	2	1	3

	PSO1	PSO2
CO1	--	--
CO2	--	--
CO3	--	--
CO4	--	--
CO5	--	--

List of Experts &Faculties Who Contributed for This Curriculum:

S.N.	Name	Designation	Institute / Industry
1.	DR. SMS Shashidhara.	Chairman PBOS	Head Civil Engg. Dept. GOVT. POLYTECHNIC, PUNE
2	Shri. Sanjay Deshpande.	Director,Sanjivani Development	Industry person
3.	Mrs.M.U.Kokate	Faculty from Institute	Head IT. Dept. GOVT. POLYTECHNIC, PUNE
4	Mrs.SeemaV.Kolhe	Faculty from Institute	Lecturer in Civil Engg. GOVT. POLYTECHNIC, PUNE
5	Shri .M.K.Panchawate	Faculty from Institute	Lecturer in Civil Engg. GOVT. POLYTECHNIC, PUNE
6	Mrs. P.M.Zilpe	Faculty from Institute	Lecturer in Electronics Engg. GOVT. POLYTECHNIC, PUNE
7	Mrs. S.S.Chhatwani .	Faculty from Institute	Lecturer in Electronics Engg. GOVT. POLYTECHNIC, PUNE
8	Mrs. M. H. Bilgi	Faculty from Institute	Lecturer in Electrical Engg. GOVT. POLYTECHNIC,Pune

Sign: Name: Mrs.S.V.KOLHE M.K.Panchawate (Course Experts)	Sign: Name: (Dr. S.M.S.Shashidhara) (Former Head of Department) Shri. V G Tambe (HOD, I Shift) Shri. V B Kondawar (HOD II shift)
Sign: Name: Dr.S. S. Bharatkar/Shri.R. U. Shelke (Program Head) (Department of Electrical Engineering)	Sign: Name: Shri A. S. Zanpure (CDC Incharge)

Government Polytechnic, Pune

'180 OB'– Scheme

Programme	Diploma in **CE/EE/ET/ME/MT/CO/IT/DDGM**
Programme code	**01/02/03/04/05/06/07/08/15/16/17/18/19/21/22/23/24/26**
Name of Course	**Renewable Energy Technologies**
Course Code	**AU4102**
Prerequisite course code and name	No
Class Declaration	No

1. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits(L+T+P)		Examination Scheme				
					Theory		Practical		Total Marks
L	**T**	**P**	**C**		**#ESE**	**PA**	**ESE**	**PA**	
02	00	00	02	**Marks**	40	10	00	00	50
				Exam Duration	2Hrs	1/2Hr	--	--	

Legends : L- Lecture, P- Practical, T- Tutorial, C- Credits, ESE-End Semester Examination, PA- Progressive Assessment (Test I,II/Term Work), *- Practical Exam, $- Oral Exam, #- Online Examination. Each Lecture/Practical period is of one clock hour

2. RATIONALE

Electrical energy is an important aspect in all sectors of economic growth of India. Considering the continuously increased demand of electrical energy, the conventional sources of energy are insufficient to meet these demands and hence the use of renewable sources of energy is the need of the hour. Hence these sources must be known to electrical technicians. This course consists of construction, working principle, operation and applications of Solar, Wind, Biomass, Geothermal and Tidal power plants.

3. COMPETENCY

The aim of this course is to attend following industry identified competency through various teaching learning experiences:

- **Practice of non-conventional energy as power source in electric field. Operate and maintain small Solar plants, Wind power stations, Geothermal plants etc.**

4. COURSE OUTCOMES (COs)

The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry oriented COs associated with the above mentioned competency**:**

1. Know the national scenario of energy production, utilization, consumption and reserves and need of non-conventional energy sources.
2. Describe construction, working principle, operation and applications of Solar power panel.
3. Describe construction, working principle, operation and applications for Wind and Biomass power plants.
4. Describe construction, working principle, operation and applications for Geothermal and Tidal energy power plants.

5. SUGGESTED PRACTICALS/ EXERCISES

NA

6. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

NA

7. THEORY COMPONENTS

Unit Outcomes (UOs) (in cognitive domain)	**Topics and Sub-topics**
UNIT 1: Review of Conventional Sources of Energy Hrs.- 02 Marks- 04	
1a. Classify the conventional energy sources and know their availability in India. 1b. Know the necessity of non-conventional energy sources. 1c. Describe the environmental impact of various energy sources and the need for sustainable development.	1.1 Types of conventional energy sources, Availability and important power plants in India. 1.2 India's production and reserves for Fossil fuels, Water power, Nuclear power. 1.3 Need for non-conventional energy sources. 1.4 Environmental impact of various energy sources, Green building, Sustainable development. Carbon credits and its significance.

UNIT 2:Solar Energy and its Applications Hrs.- 12 Marks- 14	
2a. Know the principle of conversion of solar energy to heat and electrical energy. 2b. Know the concept of solar radiation and define the terms used in solar radiation geometry. 2c. Explain the principle of electrical power generation by photovoltaic cell with merits and demerits of the system. 2d. Identify and describe the various applications based on solar energy.	2.1 Principle of conversion of solar energy into heat and electrical energy, Solar radiation, Solar radiations at earth's surface. 2.2 Solar radiation geometry: declination, hour Angle, altitude angle, incident angle, zenith angle, solar azimuth angle. 2.3 Solar collectors and their types, Application, Advantages and Limitations. 2.4 Solar electric power generation: Solar photovoltaic cell, Solar cell Principle and Working, Application, Advantages and Disadvantages. 2.5 Solar water heating, Solar distillation, Solar cooking and furnace 2.6 Solar pumping and Green house, Agriculture and industrial process heat. 2.7 Space heating, Space cooling.
UNIT 3:Wind Energy and Energy from Biomass Hrs.- 12 Marks- 14	
3a. Know the principle of conversion of wind energy to electrical energy. 3b. Describe the advantages and limitations and applications of wind energy. 3c. Explain with sketches the working of horizontal and vertical axis wind mills. 3d. Know the concept of obtaining energy from biomass through various methods. 3e. Identify and describe the various types of biomass power plants.	3.1 Basic principles of wind energy conversion, Power in wing, Available wind power formulation, Power coefficient, and Maximum power 3.2 Main considerations in selecting a site for wind mills, Advantages and Limitations of wind energy conversion 3.3 Classification of windmills, Construction and working of horizontal and vertical axis wind mills and their comparison 3.4 Main applications of wind energy for power generation and pumping 3.5 Common species recommended for biomass, methods for obtaining energy from biomass 3.6 Classification of biomass: Gasified, Fixed bed and Fluidized 3.7 Application of gasifier 3.8 Biodiesel production and application 3.9 Agricultural waste as biomass, Biomass digester, Comparison of biomass with conventional fuels
UNIT 4: Geothermal and Tidal Energy Hrs.- 06 Marks- 08	
4a. Know the principle of generation of energy from geothermal and tidal source. 4b. Identify and describe the variousmethods of generation of energy from geothermal and tidal source.	4.1 Availability, Forms of geothermal energy: Dry steam, Wet steam, Hot dry rock, Magnetic chamber system 4.2 Different geothermal power plants available. 4.3 Tidal power, Factors for selection of tidal power plant. 4.4 Classification: Single basin, Double basin type. 4.5 Tidal power plants in world, Ocean thermal plants

8. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Review of Conventional Sources of Energy	02	04	-	-	04
II	Solar Energy and its Applications	12	04	04	06	14
III	Wind Energy and Energy from Biomass	12	04	04	06	14
IV	Geothermal Energy and Tidal Energy	06	02	02	04	08
Total		**32**	**14**	**10**	**16**	**40**

9. SUGGESTED STUDENT ACTIVITIES

Other than the classroom and laboratory learning, following are the suggested student-related ***co-curricular*** activities which can be undertaken to accelerate the attainment of the various outcomes in this course: Students should conduct following activities in group and prepare reports of about 5 pages for each activity, also collect/record physical evidences for their (student's) portfolio which will be useful for their placement interviews:

a) To collect information about global and Indian energy market.
b) One field visit to be conducted to demonstrate application of Solar Energy.
c) One field visit to be conducted to Wind Mill
d) To visit a biomass/ biogas plant of municipal waste or elsewhere

10. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are sample strategies, which the teacher can use to accelerate the attainment of the various outcomes in this course:

a. Massive open online courses (***MOOCs***) may be used to teach various topics/sub topics.
b. About ***15-20% of the topics/sub-topics*** which is relatively simpler or descriptive in nature is to be given to the students for ***self-directed learning*** and assess the development of the COs through classroom presentations (see implementation guideline for details).
c. With respect to item No.8, teachers need to ensure to create opportunities and provisions for ***co-curricular activities***.
d. Correlate subtopics with power plant system and equipments.
e. Use proper equivalent analogy to explain different concepts.
f. Use Flash/Animations to explain various components, operation and working principle.

11. SUGGESTED MICRO-PROJECTS

NA

12. SUGGESTED LEARNING RESOURCES

Sr. No.	Title	Author	Publisher, Edition and Year of publication, ISBN Number
1	Non conventional energy resources	Dr. B.H.Khan	Tata McGraw Hill Education, New Delhi, ISBN- 9780070681033
2	Non conventional energy resources	G. D. Rai	Khanna publication, ISBN- 9788174090738
3	Solar Energy	Sukhatme S.P., Nayak J.K.	Tata McGraw, New Delhi, ISBN- 9781259081965
4	Solar Energy	Garg H. ,Prakash J.	McGraw Hill Education, New Delhi, ISBN- 9780074636312
5	India- The energy sector	P.H. Henderson	Oxford University Press, ISBN- 9780195606539
6	Industrial energy conservation	D. A. Ray	Pergaman Press, ISBN- 9780080232744

13. SOFTWARE/LEARNING WEBSITES

1. www.nptel.com
2. Website for AkshayUrja News Bulletinwww.mnes.nic.in

3 .https://www.bioenergyconsult.com/biomass-energy-systems/
4. https://mnre.gov.in/bio-energy

14. PO - COMPETENCY- CO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	2	1	1	1	1	1	1
CO2	2	2	2	2	2	1	3
CO3	2	2	2	2	2	1	3
CO4	2	2	2	2	2	1	3

	PSO1	PSO2
CO1	--	--
CO2	--	--
CO3	--	--
CO4	--	--

Sign: Name: 1.Shri.B.R.More 2. Mrs.M.H. Bilgi (Course Experts)	Sign: Name: Dr.S. S. Bharatkar/Shri.R. U. Shelke (Head of Department) (Electrical Engineering Dept.)
Sign: Name: Dr.S. S. Bharatkar/Shri.R. U. Shelke (Program Head) (Department of Electrical Engineering)	Sign: Name: Shri A. S. Zanpure (CDC Incharge)

Government Polytechnic, Pune

'180OB' – Scheme

Programme	Diploma in **CE/EE/ET/ME/MT/CO/IT/DDGM**
Programme code	**01/02/03/04/05/06/07/08/15/16/17/18/19/21/22/23/24/26**
Name of Course	**Engineering Economics**
Course Code	**AU4103**
Prerequisite course code and name	No
Class Declaration	No

1. TEACHING AND EXAMINATION SCHEME

<table>
<tr><th colspan="3" rowspan="2">Teaching Scheme (In Hours)</th><th rowspan="2">Total Credits (L+T+P)</th><th rowspan="3"></th><th colspan="5">Examination Scheme</th></tr>
<tr><th colspan="2">Theory</th><th colspan="2">Practical</th><th rowspan="2">Total Marks</th></tr>
<tr><th>L</th><th>T</th><th>P</th><th>C</th><th>#ESE</th><th>PA</th><th>*ESE</th><th>PA</th></tr>
<tr><td rowspan="2">02</td><td rowspan="2">00</td><td rowspan="2">00</td><td rowspan="2">02</td><td>Marks</td><td>40</td><td>10</td><td></td><td></td><td>50</td></tr>
<tr><td>Exam Duration</td><td>2 Hrs</td><td>30Mins</td><td>-</td><td>-</td><td></td></tr>
</table>

Legends : L- Lecture, P- Practical, T- Tutorial, C- Credits, ESE-End Semester Examination, PA- Progressive Assessment (Test I,II/Term Work), *- Practical Exam, $- Oral Exam, #- Online Examination. Each Lecture/Practical period is of one clock hour

2. RATIONALE

This course aims at equipping the students with fundamental knowledge of economics and cost analysis to make them capable of taking economically sound decisions.

3. COMPETENCY

The aim of this course is to address following industry identified competency through various teaching learning experiences:

- **Ability to analyze and decide acceptance or rejection of offers / project proposals based on economic criteria.**

4. COURSE OUTCOMES (COs)

The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry-oriented COs associated with the above-mentioned competency**:**

1. Interpret various principles, concepts and applications of Economics in the field of Engineering and technology.
2. Analyze Market Demand.
3. Apply the principles of economics and cost analysis to proposals in engineering and Technology.
4. Read and interpret financial statements and indicators.

5. SUGGESTED PRACTICALS/ EXERCISES

NA

6. MAJOR EQUIPMENT/ INSTRUMENTSREQUIRED

NA

7. THEORY COMPONENTS

Unit Outcomes (UOs) (in cognitive domain)	**Topics and Sub-topics**
UNIT 1. Introduction to Economics(06hrs, 08marks)	
1a.Define the term Economics. 1b.State the objectives and importance's of engineering Economics. 1c.Differiate between Micro and macro economics. 1d.Describe the functions of Market economy and Command economy. 1e.List the elements of mixed economy.	1.1 Definitions of economics 1.1.2 Objectives and Importance of engineering economics. 1.1.3 Concept of engineering economics. 1.2 General concepts on micro and macro economics 1.2.1 Market economy, 1.2.2 Command economy 1.2.3 Mixed economy.
UNIT 2 Demand Analysis (06hrs, 08marks)	
2a.List the utility related demand. 2b.State the importance of total and marginal utility. 2c.Explain Law of demand. 2d.Analyasis elasticity of demand. 2e.State factors governing the elasticity of demand. 2f.Enlist the techniques and methods for forecasting of demand.	2.1 Utility related demand 2.1.1Total and marginal utility 2.1.2 Law of diminishing marginal utility 2.1.3 Cardinal and ordinal utility. 2.2 Law of demand 2.2.1 Determinants of demand 2.2.2 Elasticity of demand 2.2.3 Factors governing the elasticity of demand. 2.3 Techniques and methods for forecasting of demand
UNIT 3Elements of Business/Managerial Economics(12hrs, 12marks)	
3a.Define the term cost and cost control. 3b.Enlist the types of costs. 3c.Interpret the lifecycle costs.	3.1 Cost and Cost Control –Techniques 3.1.1 Types of Costs 3.1.2 Lifecycle costs 3.1.3 Budgets

Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
3d.Define the term Budgets. 3e.Determine Break even analysis. 3f.Explain in brief application of Linear Programming. 3h.Importance of Time value of money. 3j.Ellabrorate the methods of cash flow. 3k.Evaluate the Causes of depreciation.	3.1.4 Break even Analysis 3.2 Capital Budgeting 3.2.1Application of Linear Programming. 3.3 Time value of money 3.4.1 Simple and compoundinterest. 3.4.2 Principle of economic equivalence. 3.5 Evaluation of engineering projects and Cost-benefit 3.6. Cash flow- Methods of comparison of alternatives – present worth and future worth method (Revenue dominated cash flow diagram) 3.7 Depreciation-Causes of depreciation 3.8.1 Depreciation straight line method and declining balance method
UNIT 4National Income, Finance and Banking (08hrs, 12 marks)	
4a.Expain Balance sheet, Book Keeping and Financial reporting. 4b.Mentionmeasurement parameters ofnational income. 4c.Differiate between Gross domestic and national production (GNP, GDP). 4d.State the functions of commercial banks and Reserve Bank of India.	4.1.Concept of profit and loss account 4.1.1 opening stock, closing stock, sales, purchases,wages, creditors, debtors, gross profit, net profit 4.2. Concept of Balance sheet, &book keeping 4.2.1. Fixed asset, Current assets, share capital, current liabilities,goodwill,debt, inventories, bill receivable, overheads and expenses. 4.3.Concepts and measurement of national income 4.4. Gross domestic and national production (GNP, GDP). 4.5 Banking- Meaning and functions of commercial banks and Reserve Bank of India.

8. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Introduction to Economics	06	02	02	04	08
II	Demand Analysis	06	02	02	04	08
III	Elements of Business/Managerial Economics	12	04	04	04	12
IV	National Income, Finance and Banking	08	02	02	08	12
Total		**32**	**10**	**10**	**20**	**40**

9. SUGGESTED STUDENT ACTIVITIES

Other than the classroom and laboratory learning, following are the suggested student-related ***co-curricular*** activities which can be undertaken to accelerate the attainment of the various outcomes in this course: Students should conduct following activities in group and prepare reports of about 5 pages for each activity, also collect/record physical evidences for their (student's) portfolio which will be useful for their placement interviews:

a. Study of datasheet of Cash flow of a firm.
b. Prepare charts of depreciation by taking different examples.
c. Case Study-Prepare a comparative statement of of two Engineering projects in respect of investment and profit.(Consider Capital Investment, over head expenses, wages, net profit)
d. Case study- Prepare a cost sheet for a small scale unit.
(In Cost sheet consider production, selling, overhead cost and profit analysis)

10. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are sample strategies, which the teacher can use to accelerate the attainment of the various outcomes in this course:

a. With respect to item No.9, teachers need to ensure to create opportunities and provisions for ***co-curricular activities***.
b. Guide student(s) in undertaking micro-projects.
c. Use proper equivalent analogy to explain different concepts.
d. Use Flash/Animations to explain various components, operation.
e. Teacher should ask the students to go through instruction and Technical manuals

11. SUGGESTED MICRO-PROJECTS

NA

12. SUGGESTED LEARNING RESOURCES

S.N.	Title	Author	Publisher, Edition and Year of publication, ISBN Number
1	"Contemporary Engineering Economics",	Author-Chan S.Park,	Publisher-Prentice Hall of India,2011 year. ISBN- 9780134105598
2	"Engineering Economics and analysis"	Author-Donald.G.Newman,	Publisher-Jerome.P.LavelleEngg. Press, Texas, 2010 year.ISBN- 0824709535
3	"Engineering Economy"	Author-Degarmo, E.P., Sullivan, W.G and Canada, J.R	Publisher- Macmillan, New York, 2011 yearISBN-9780029461396
4	"Engineering Economy"	Author-Zahid A khan: Engineering Economy .	Publisher-Dorling Kindersley, 2012 year ,ISBN-10- 8131763870 ISBN-13-978-8131763872

13. SOFTWARE/LEARNING WEBSITES-

1. https://online.nmims.edu/
2. https://www.quora.com
3. https://www.edx.org

14. PO - COMPETENCY- CO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	3	3	-	3	3	3
CO2	3	3	3	1	3	3	3
CO3	3	2	2	-	2	3	3
CO4	3	2	2	-	2	2	3

	PSO1	PSO2
CO1	-	-
CO2	-	-
CO3	-	-
CO4	-	-

Sign: Name: Smt.C.M. Ambikar Smt. N.V.Gondane (Course-Experts)	Sign: Name: Smt. P.V. Toshniwal (Kalantri) (Head of Department)
Sign: Name: Dr.S. S. Bharatkar/Shri.R. U. Shelke (Program Head) (Department of Electrical Engineering)	Sign: Name: Shri A. S. Zanpure (CDC Incharge)

Government Polytechnic, Pune

'180 OB'– Scheme

Programme	Diploma in **CE/EE/ET/ME/MT/CO/IT/DDGM**
Programme code	**01/02/03/04/05/06/07/08/15/16/17/18/19/21/22/23/24/26**
Name of Course	**Ethical Sources and Sustainability**
Course Code	**AU4104**
Prerequisite course code and name	No
Class Declaration	No

1. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P)		Examination Scheme				
					Theory		Practical		Total Marks
L	T	P	C		#ESE	PA	ESE	PA	
02	00	00	02	Marks	40	10	-	-	50
				Exam Duration	2Hrs	30mins	-	-	

Legends : L- Lecture, P- Practical, T- Tutorial, C- Credits, ESE-End Semester Examination, PA- Progressive Assessment (Test I,II/Term Work), *- Practical Exam, $- Oral Exam, #- Online Examination. Each Lecture/Practical period is of one clock hour

2. RATIONALE

This course is aimed at creating awareness amongst the students about global level commitment towards sustainable development. The course also creates awareness on ethical manner of production, including the supply chain, the environmental and social impacts of the production process and product as well as the safety and fair deal towards the work force involved at all levels.

3. COMPETENCY

The aim of this course is to attend following industry identified competency through various teaching learning experiences:

- **Adopt ethical practices and sustainable processes and products in industry.**

4. COURSE OUTCOMES (COs)

The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry oriented COs associated with the above mentioned competency**:**

1. Interprets the concept of ethical sourcing and fundamentals of Sustainability.
2. Practice Global Sustainable Development Goals (SDG).
3. Follow ethical and sustainable supply chain**.**
4. Differentiate traditional and sustainable manufacturing.

5. SUGGESTED PRACTICALS/ EXERCISES
NA

6. MAJOR EQUIPMENT/ INSTRUMENTSREQUIRE
NA

7. THEORY COMPONENTS

Unit Outcomes (UOs) (in cognitive domain)	**Topics and Sub-topics**
UNIT 1. ETHICAL SOURCING (06hrs, 08marks)	
1.1 Define Ethical Sourcing. 1.2 Explain Basic Eight Principles of Ethical Sourcing. 1.3 State the laws of industrial ethics. 1.4 Explain the policies of industrial ethics.	1.1 Definition-1.1.1 Ethical Sourcing 1.2 Basic Eight Principles 1.3 Policies 1.4 Benefits-Importance of Ethics 1.5 Challenges- Causes of Unethical Behavior 1.5Laws
UNIT 2 SUSTAINABILITY (08hrs,10marks)	
2.1 Define Sustainability and Ethical Sourcing and Sustainability. 2.2 Explain the principles of sustainability. 2.3 Explain the need and challenges of environmental sustainability. 2.4 Compare Social sustainability and economic sustainability. 2.5 Explain the agenda of 2030 sustainable development goals.	**2.1 Definition**-2.1.1 Sustainability 2.1.2 Ethical Sourcing and Sustainability **2.2 Twelve green engineering principles.** **2.3 Benefits and Challenges** **2.4 Types-** 2.4.1 Human Sustainability 2.4.2 Social Sustainability 2.4.3 Economic Sustainability 2.4.4 Environmental Sustainability **2.5 Introduction of Sustainable Development Goals (SDGs)=** (Leaving no one behind- Global agenda for 2030- 17 goals, 169 Targets 231 Indicators) **[17 Sustainable Development Goals (SDGs)]-** Goal1:NoPoverty Goal2:ZeroHunger Goal3:GoodHealthAnd Well-Being Goal4:QualityEducation Goal5:Gender equality Goal6:Clean water and sanitation Goal7:Affordable and clean energy Goal8:Decent work and economic growth Goal9:Industry,Innovation and infrastructure Goal10:Reduced inequality Goal11:Sustainable cities and communities Goal12:Responsible consumption and production Goal13:Climate Action

Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
	Goal14:Life Below Water Goal15:Life On Land Goal16: Peace and justice strong institutions Goal17: Partnerships to achieve the goal.
UNIT 3 ETHICAL AND SUSTAINABLE SUPPLY CHAIN (10hrs,12marks)	
3.1 State the use of three P's and E's of sustainability. 3.2 Explain the ways to reduce waste by simplifying supply chain processes with appropriate example. 3.3 Comment on existing environmental risks caused by tradition non sustainable manufacturing process. 3.4 Explain the ways decrease fossil fuel consumption by optimizing routes with appropriate example.	**3.1 Three P's-**3.1.1 Profit 3.1.2 Planet 3.1.3 People **3.2 Three E's-** 3.2.1 Environment 3.2.2 Equity 3.3.3 Economics **3.3 Study of Six Steps for supply-** 3.3.1 Reduce waste by simplifying supply chain processes 3.3.2 Ensure ethical sourcing and introduce transparency 3.3.3 Minimize overproduction through efficient supply and demand planning 3.3.4 Decrease fossil fuel consumption by optimizing routes. 3.3.5 Fully utilize containers and transportation to consolidate shipments. 3.3.6 Monitor for existing environmental risks.
UNIT 4 MATERIALS FOR SUSTAINABILITY (08 hrs,10marks)	
4.1 Explain the impact of material selection over environment. 4.2 Explain the factors to be considered for material selection to optimize performance. 4.3 Explain Life cycle assessment with appropriate example. 4.4 Give a note on "Production of green manufacturing materials" with appropriate example. 4.5 Explain the role of 5R's in sustainable development.	**4.1 Environmental impact of materials** **4.2 life-cycle assessment** **4.3 Material selection to optimize performance** **4.4 Design** **4.5Evaluation** **4.6 Production of green manufacturing materials.** **4.7 Role of 5R's for Sustainable Development-** 4.7.1 Refuse / Reject 4.7.2 Reduce 4.7.3 Reuse / Repurpose / Rethink 4.7.4 Repair 4.7.5 Recycle

8. SUGGESTED SPECIFICATION TABLE FORQUESTION PAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Ethical Sourcing	06	4	2	2	08
II	Sustainability	08	4	2	4	10
III	Ethical And Sustainable Supply Chain	10	4	4	4	12
IV	Materials For Sustainability	08	2	4	4	10
Total		**32**	**14**	**12**	**14**	**40**

9. SUGGESTED STUDENT ACTIVITIES

Other than the classroom and laboratory learning, following are the suggested student-related ***co-curricular*** activities which can be undertaken to accelerate the attainment of the various outcomes in this course: Students should conduct following activities in group and prepare reports of about 5 pages for each activity, also collect/record physical evidences for their (student's) portfolio which will be useful for their placement interviews:
a.Select any topic and prepare a Power Point Presentation in a group of three to four students covering economic, social and environmental sustainability aspects and give presentation to other students and teacher.
(Example- a)Green Construction Techniques, b)Sustainable Energy solutions for manufacturing, c) Recycling, d)Waste Management e)Rainwater conservation)

OR

a.Prepare a write up in a group of three to four students and present it to other students considering Global agenda for 2030-Leaving no one behind i.e. **Sustainable Development Goals (SDGs)** and its169 Targets 231 Indicators.

b. **Case Study-**Prepare a comparative statement of two Engineering projects in respect to traditional and sustainable manufacturing process considering benefits and challenges.

10. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are sample strategies, which the teacher can use to accelerate the attainment of the various outcomes in this course:

a. Massive open online courses (***MOOCs***) may be used to teach various topics/sub topics.
b. About ***15-20% of the topics/sub-topics*** which is relatively simpler or descriptive in nature is to be given to the students for ***self-directed learning*** and assess the development of the COs through classroom presentations (see implementation guideline for details).
c. With respect to item No.9, teachers need to ensure to create opportunities and provisions for ***co-curricular activities***.
d. Guide student(s) in undertaking micro-projects.
e. Correlate subtopics with automation.
f. Use proper equivalent analogy to explain different concepts.

g. Use Flash/Animations to explain various components, operation and its application
h. Teacher should ask the students to go through instruction and Technical manuals

11. SUGGESTED MICRO-PROJECTS

NA

12. SUGGESTED LEARNING RESOURCES

Sr.No.	Title	Author	Publisher, Edition and Year of publication. ISBN Number
1	Sustainable Construction Processes	Steve Goodhew	Wiley-Blackwell; 1 edition (13 April 2016) ISBN:140518759X
2.	Sustainable logistics Supply Chain Management	David.B.Grant	Kogan page 1st edition 3 March 2015,ISBN:9780749473860
3.	Global Value Chains, Flexibility and Sustainability	Julia Connell RenuAgarwal Sushil Sanjay Dhir	09 MAY 2018, ISBN:978-981-10-8929-9
4.	The Handbook of Ethical Purchasing:Principles and Practice	Rob Harrison	Publisher Routledge,13 oct 2021 ISBN:9781032059952

13. SOFTWARE/LEARNING WEBSITES

1. https://www.ncbi.nlm.nih.gov/books/NBK64933/
2. http://www2.econ.iastate.edu/classes/tsc220/hallam/TypesOfSustainability.pdf
3. https://www.woolworthsgroup.com.au/content/Document/Ethical%20Sourcing%20Policy.pdf
4. https://www.supplychainbrain.com/blogs/1-think-tank/post/29477-how-to-create-a-more-ethical-and-sustainable-supply-chain
5. https://h2mgroup.wordpress.com/2013/06/14/the-three-es-of-sustainability/
6. https://www.cce.ufl.edu/wpcontent/uploads/2012/08/Ethics%20of%20Sustainability%20Textbook.pdf
7. A global indicator framework for the Sustainable Development Goals and targets of the 2030 Agenda for Sustainable Development: https://unstats.un.org/sdgs/indicators/Global%20Indicator%20Framework%20after%202020%20review_Eng.pdf
8. Transforming our World: The 2030 Agenda for Sustainable Development United Nations,2015 https://sustainabledevelopment.un.org/content/documents/21252030%20Agenda%20for%20Sustainable%20Development%20web.pdf

14. PO - COMPETENCY- CO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	3	3	-	3	3	3
CO2	3	3	3	-	3	3	3
CO3	3	2	2	-	2	3	3
CO4	3	2	2	-	2	2	3

	PSO1	PSO2
CO1	-	-
CO2	-	-
CO3	-	-
CO4	-	-

Sign: Name: Ms. S. M. Waghchaure (Course Expert)	Sign: Name: Mrs. P.V. Toshniwal (Head of Department)
Sign: Name: Dr.S. S. Bharatkar/Shri.R. U. Shelke (Program Head) (Department of Electrical Engineering)	Sign: Name: Shri A. S. Zanpure (CDC Incharge)

Government Polytechnic, Pune

'180OB' – Scheme

Programme	Diploma in **CE/EE/ET/ME/MT/CO/IT/DDGM**
Programme code	**01/02/03/04/05/06/07/08/15/16/17/18/19/21/22/23/24/26**
Name of Course	**Digital Marketing**
Course Code	**AU4105**
Prerequisite course code and name	No
Class declaration	No

1. TEACHING AND EXAMINATION SCHEME

<table>
<tr><th colspan="3">Teaching Scheme (In Hours)</th><th>Total Credits (L+T+P)</th><th rowspan="2"></th><th colspan="5">Examination Scheme</th></tr>
<tr><th colspan="3"></th><th></th><th colspan="2">Theory</th><th colspan="2">Practical</th><th>Total Marks</th></tr>
<tr><th>L</th><th>T</th><th>P</th><th>C</th><th></th><th>ESE</th><th>PA</th><th>$ESE</th><th>PA</th><th rowspan="2">50</th></tr>
<tr><td rowspan="2">00</td><td rowspan="2">00</td><td rowspan="2">02</td><td rowspan="2">02</td><td>Marks</td><td>00</td><td>00</td><td>25</td><td>25</td></tr>
<tr><td>Exam Duration</td><td>--</td><td>--</td><td>--</td><td>--</td><td></td></tr>
</table>

Legends : L- Lecture, P- Practical, T- Tutorial, C- Credits, ESE-End Semester Examination, PA- Progressive Assessment (Test I,II/Term Work), *- Practical Exam, $- Oral Exam, #- Online Examination. Each Lecture/Practical period is of one clock hour

2. RATIONALE

Digital marketing is advertising or promotions of products and services using digital platforms. Digital Marketing is rapidly evolving technology. And social media is ever growing marketing platform for users. The course will help students to improve skills to market their product or service in the digital media. The course will enable students to explore and create something new who wants to be a good entrepreneur or good professional in design and development.

3. COMPETENCY

The aim of this course is to attend following industry identified competency through various teaching learning experiences:

- **Enhance business using various digital media channels**

4. COURSE OUTCOMES (COs)

The practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry-oriented COs associated with the above-mentioned competency**:**

1. Identify advertisement sections of web pages in a website.
2. Install Google analytics on a website.
3. Use Google analytics for reading analytics data.
4. Generate reports for sample web-site
5. Use e-mail marketing tool

5. SUGGESTED PRACTICALS/ EXERCISES

Sr. No	Unit No	**Practical Exercises** (Outcomes in Psychomotor Domain)	Relevant CO	Approximate Hours Required.
1	NA	Study and prepare a report of a sample web-site with strategic flow for e-commerce/publication etc. (with the use of: HTML, CSS, and JavaScript etc.)	1, 2	2
2		Set up and create account on Google Analytics and install it on a web-site. Study of Google Analytics GUI/IDE for: ● Inbound and outbound marketing ● Content marketing ● Website Content optimization	2	2
3		Study of Search Engine Optimization (SEO) using Digital marketing platform.	2	2
4		(A)Create the tracking id for web-site and track links (B) Analyze website traffic and leads using DM platform/tool	2	2
5		Read Analytics data. Read audience acquisition and behavior statistics	3	2
6		Generate different types of reports through Google Analytics	4	2
7		Study of any email marketing tool (Freeware)	5	2
8		Complete a micro project based on guidelines provided in Sr. No. 11	All Cos	2
		Total Hrs		**16**

S.No.	Performance Indicators	Weightage in %
a.	Study of web pages and web site	05
b.	Installing and setting up the tool for web site	10
c.	Observations and Recording	10
d.	Interpretation of reports, result and Conclusion	10
e.	Answer to sample questions	10
f.	Submission of term work journal in time	05
Total		**50**

6. MAJOR EQUIPMENT/ INSTRUMENTSREQUIRED

The major tools with broad specification mentioned here will usher in uniformity in conduct of practical, as well as aid to procure equipment by authorities concerned**.**

Sr.No.	Major tools Required	Experiment Sr. No.
1	Web browser	All
2	Any Web Server (e.g. Glassfish, Tomcat)	
3	Google Analytics	

7. THEORY COMPONENTS

NA

8. SUGGESTED SPECIFICATION TABLE FORQUESTION PAPER DESIGN

NA

9. SUGGESTED STUDENT ACTIVITIES

Other than the laboratory learning, following are the suggested student-related ***co-curricular*** activities which can be undertaken to accelerate the attainment of the various outcomes in this course: Students should conduct following activities in group and prepare reports of each activity.

a. Prepare journals based on practical performed in laboratory.
b. Study of different types of web-sites (ecommerce/ publication/ social media) and advertisements on these web-sites.

10. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are sample strategies, which the teacher can use to accelerate the attainment of the various outcomes in this course:

a. Massive open online courses (***MOOCs***) may be used to teach various topics/sub topics.
b. About ***15-20% of the topics/sub-topics*** which is relatively simpler or descriptive in nature is to be given to the students for ***self-directed learning*** and assess the development of the COs through presentations.
c. Self-learning through Online tutorials to analyze business data
d. Use of freeware marketing tools to check for the effectiveness for particular type of websites

11. SUGGESTED MICRO-PROJECTS

Only one micro-project is planned to be undertaken by a student that needs to be assigned to him/her. In special situations where groups have to be formed for micro-projects, the number of students in the group should ***not exceed three.***

The micro-project could be industry application based, internet-based, workshop-based, laboratory-based or field-based. Each micro-project should encompass two or

more COs which are an integration of PrOs, UOs and ADOs (Affective Domain Outcomes). Each student will have to maintain a dated work diary consisting of individual contributions to the project work and give a seminar presentation before submission. The student ought to submit micro-project by the end of the semester to develop the industry oriented COs.
A suggestive list of micro-projects is given here. The concerned faculty could add similar micro-projects:

a. Develop and deploy a sample web-site (using CSS, JavaScript, and similar techniques) for given sample commercial requirements. And identify advertising sections among these pages.
b. Create blog post for educational videos for demonstrating content marketing
c. Create an account on Google analytics and analyze traffic to the sample website
d. Create code for tracking ID for sample web site and generate reports through Google analytics

12. SUGGESTED LEARNING RESOURCES

Sr No	Title	Author	Publisher, Edition, Year of publication, ISBN Number
1	Fundamental of digital Marketing	Punneet Singh Bhatia	Pearson India, 2ndEdition(2019) ISBN_109789353434141
2	The Art of SEO	Eric Enge, Stephan Spencer, Jessie Stricchiola,	O'Reilly Media ,3 Edition (2015) ISBN_10 1491948965 ISBN_13 978- 1491948965

13. SOFTWARE/LEARNING WEBSITES

1. www.nptel.com
2. https://youtu.be/mXcQ7rVn3ro
3. https://youtu.be/gQe7gGGuzeQ
4. https://www.tutorialspoint.com/digital_marketing/

14. PO - COMPETENCY- CO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	-	1	3	2	-	1	-
CO2	-	2	1	2	-	-	1
CO3	1	2	3	3	-	1	1
CO4	-	1	2	3	-	1	1
CO5	-	3	3	3	1	1	1
Summary	1	2	2	3	1	1	1

	PSO1	PSO2
CO1	-	-
CO2	-	-
CO3	-	-
CO4	-	-
CO5	-	-

Sign: Name: 1) Mrs. M. G. Yawalkar 2) Mrs. A. S. Paike 3) Mrs. K. S.Gaikwad 4) Mrs. P. K. Zade (Course Experts)	Sign: Name: Mr. U.V. Kokate Mr. Dr. S. B. Nikam (Head of Department) (Department of Computer Engineering)
Sign: Name: Dr.S. S. Bharatkar/Shri.R. U. Shelke (Program Head) (Department of Electrical Engineering)	Sign: Name: Shri A. S. Zanpure (CDC Incharge)

Level 4 - B Curriculum

Government Polytechnic, Pune

'180OB' – Scheme

Programme	Diploma in **CE/EE/ET/ME/MT/CO/IT/DDGM**
Programme code	**01/02/03/04/05/06/07/08/15/16/17/18/19/21/22/23/24/26**
Name of Course	**Entrepreneurship and Startup**
Course Code	**MA 4101**
Prerequisite course code and name	No
Class Declaration	No

1. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P)		Examination Scheme				
					Theory		Practical		Total Marks
L	**T**	**P**	**C**		**#ESE**	**PA**	**ESE**	**PA**	
2	-	-	2	**Marks**	40	10	-	-	50
				Exam Duration	2 Hrs	1/2Hr	-	-	

Legends : L- Lecture, P- Practical, T- Tutorial, C- Credits, ESE-End Semester Examination, PA- Progressive Assessment (Test I,II/Term Work), *- Practical Exam, $- Oral Exam, #- Online Examination. Each Lecture/Practical period is of one clock hour

2. RATIONALE

Globalization, liberalization and privatization along with revolution in information technology have opened up new opportunities transforming lives of masses. In this context, there is immense opportunity of establishing manufacturing, service, trading, marketing and consultancy enterprises by diploma engineer. Our fast growing economy provides ample scope for diploma engineers to succeed as an entrepreneur. Entrepreneurship requires distinct skill sets which are attempted to be developed through this course. To begin with, this course aims to develop the competency and the related outcomes in order to start small enterprises. Government of India also motivates the young engineers to come up with new idea to promote Startups.

3. COMPETENCY

The aim of this course is to attend following industry identified competency through various teaching learning experiences:

- **Develop project proposals for launching small scale enterprises and starts up.**

4. COURSE OUTCOMES (COs)

The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry oriented COs associated with the above mentioned competency**:**

1 Identify entrepreneurial traits.
2 Collect information from stakeholder for starting starts up
3 Identify support systems available for Starts up
4 Execute plans for managing enterprise effectively.

5. SUGGESTED PRACTICALS/ EXERCISES

NA

6. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

NA

7. THEORY COMPONENTS

Unit Outcomes (UOs) (in cognitive domain)	**Topics and Sub-topics**
Unit-I Introduction to Entrepreneurship Development (08 Hrs, 10 Marks)	
1a. Describe procedure to evaluate entrepreneurial traits as a career option for given product 1b. Explain given terms related to Entrepreneurship 1c. Describe salient features of the resources required for starting the specified enterprise. 1d. Identify characteristics for a given type of enterprise.	1.1 Entrepreneurship as a career 1.2 Traits of successful entrepreneur: consistency, creativity, initiative, independent decision making, assertiveness, persuasion, persistence, information seeking, handling business communication, commitment to work contract, calculated risk taking. 1.3 Entrepreneurship: scope in local and global market. 1.4 Types of enterprises and their features: manufacturing, service and trading.
Unit-II Startup Selection Process (10 Hrs, 14 Marks)	
2a. Describe scheme(s) offered by the government for starting the specified enterprise. 2b. Suggest suitable place for setting up the specified enterprise on the basis of given data/circumstances with justification. 2c. Suggest steps for the selection process of an enterprise for the specified product or service with justification. 2d. Describe market study procedure of the specified enterprise.	2.1 Product/Service selection: Process, core competence, product/service life cycle, new product/ service development process, mortality curve, creativity and innovation in product/ service modification / development. 2.2 Process selection: Technology life cycle forms and cost of transformation, factors affecting process selection, location for an industry, material handling. 2.3 Market study procedures: questionnaire design, sampling, market survey, data analysis 2.4 Getting information from concerned stakeholders such as Maharashtra Centre for Entrepreneurship Development[MCED], National Institute for Micro, Small and Medium Enterprises [NI-MSME], Prime Minister Employment Generation Program [PMEGP], Directorate of Industries[DI],

Unit Outcomes (UOs) (in cognitive domain)	**Topics and Sub-topics**
	Khadi Village Industries Commission[KVIC]
Unit-III Support System for Startup (08 Hrs, 10 Marks)	
3a. Describe support system required for the specified enterprise. 3b. Describe help provided by the government agencies for the specified product/service. 3c. Describe help provided by the non-governmental agencies for the specified product/service. 3d. Compute breakeven point for the specified business enterprise, stating the assumptions made.	3.1 Categorization of MSME, ancillary industries 3.2 Support systems- government agencies: MCED, NI-MSME, PMEGP,DI, KVIC 3.3 Support agencies for entrepreneurship guidance, training, registration, technical consultation, technology transfer and quality control, marketing and finance. 3.4 Breakeven point, return on investment and return on sales.
Unit-IV Managing Enterprise (06 Hrs, 06 Marks)	
4a. Explain key elements for the given business plan with respect to their purpose/size. 4b. Justify USP of the given product/ service from marketing point of view. 4c. Formulate business policy for the given product/service. 4d. Choose relevant negotiation techniques for the given product/ service with justification. 4e. Identify risks that you may encounter for the given type of business/enterprise with justification. 4f. Describe role of the incubation centre for the given product/service.	4.1 Sources of Product for Business : Feasibility study 4.2 Ownership, Capital, Budgeting, Matching entrepreneur with the project , feasibility report preparation and evaluation criteria 4.3 Unique Selling Proposition [U.S.P.]: Identification, developing a marketing plan. 4.4 Preparing strategies of handling business: policy making, negotiation and bargaining techniques. 4.5 Risk Management: Planning for calculated risk taking, initiation with low cost projects, integrated futuristic planning, angel investors, venture capitalist. 4.6 Incubation centers: Role and procedure.

8. SUGGESTED SPECIFICATION TABLE FORQUESTION PAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Introduction to EDP	08	2	2	6	10
II	Entrepreneurial Opportunities and selection Process	10	2	4	8	14
III	Support System	08	2	4	4	10
IV	Managing Enterprise	06	2	2	2	06
Total		32	**8**	**12**	**20**	**40**

9. SUGGESTED STUDENT ACTIVITIES

Other than the classroom and laboratory learning, following are the suggested student-related ***co-curricular*** activities which can be undertaken to accelerate the attainment of the various outcomes in this course: Students should conduct following activities in group and prepare reports of about 5 pages for each activity, also collect/record physical evidences for their (student's) portfolio which will be useful for their placement interviews:

a. Download product development and innovative films from internet.
b. Invite entrepreneurs, industry officials, bankers for interaction.
c. Identify your hobbies and interests and convert them into business idea.
d. Convert you project work into business.
e. Choose a product and design a unique selling preposition, brand name, logo, advertisement (print, radio, and television), jingle, packing, packaging, and label for it.

10. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are sample strategies, which the teacher can use to accelerate the attainment of the various outcomes in this course:

a. Massive open online courses (***MOOCs***) may be used to teach various topics/sub topics.
b. About ***15-20% of the topics/sub-topics*** which is relatively simpler or descriptive in nature is to be given to the students for ***self-directed learning*** and assess the development of the COs through classroom presentations (see implementation guideline for details).
c. With respect to item No.8, teachers need to ensure to create opportunities and provisions for ***co-curricular activities***.
d. Guide student(s) in undertaking micro-projects.
e. Correlate subtopics with power plant system and equipment.
f. Use proper equivalent analogy to explain different concepts.
g. Use Flash/Animations to explain various components, operation and
h. Teacher should ask the students to go through instruction and Technical manuals.

11. SUGGESTED MICRO-PROJECTS-

NA

12. SUGGESTED LEARNING RESOURCES

S.N.	Title	Author	Publisher, Edition and Year of publication ISBN Number
1	Reading Material of Entrepreneurship Awareness Camp	Gujral, Raman	Entrepreneurship Development Institute of India (EDI), GOI, 2016 Ahmedabad, ISBN: 9946302512012
2	Product Design and Manufacturing	Chitale, A K	PHI Learning, New Delhi, 2014; ISBN: 9788120348738
3	Entrepreneurship Development Small Business Entrepreneurship	Charantimath, Poornima	Pearson Education India,New Delhi; ISBN: 9788131762264
4	Entrepreneurship Development: Special edition for MSBTE	CPSC, Manila	Tata Mc-Graw Hill, New Delhi, ISBN: 9789432961123
5	Entrepreneurship and Small Business Management	Khanka, S.S.	S.Chand and Sons, New Delhi, ISBN: 978-93-5161-094-6

13. SOFTWARE/LEARNING WEBSITES

1. MCED Books links: http://www.mced.nic.in/UdyojakSpecial.aspx?linktype=Udyojak
2. MCED Product and Plan Details: http://www.mced.nic.in/allproduct.aspx
3. The National Institute for Entrepreneurship and Small Business Development Publications: http://niesbud.nic.in/Publication.html
4. Courses : The National Institute for Entrepreneurship and Small Business Development: http://niesbud.nic.in/docs/1standardized.pdf
5. Entrepreneur.com: https://www.entrepreneur.com/lists
6. Govt. Sponsored Schemes: https://www.nabard.org/content1.aspx?id=23andcatid=23andmid=530
7. NABARD - Information Centre: https://www.nabard.org/Tenders.aspx?cid=501andid=24
8. NABARD – What we Do: http://www.nabard.org/content1.aspx?id=8andcatid=8andmid=488
9. Market Review: http://www.businesstoday.in/markets
10. Start Up India: http://www.startupindia.gov.in/pdffile.php?title=Startup%20India%20Action%20Planandtype=Actionandq=Action%20Plan.pdfandcontent_type=Actionandsubmenupoint=action
11. About - Entrepreneurship Development Institute of India (EDII): http://www.ediindia.org/institute.html
12. NSTEDB – Training: http://www.nstedb.com/training/training.htm
13. Tata Exposures: http://www.tatasocial-in.com/project-exposure

14. Ministry Of Micro, Small And Medium Enterprises: http://www.dcmsme.gov.in/schemes/TEQUPDetail.htm
15. List of Business Ideas for Small Scale Industry: https://smallb.sidbi.in/%20/thinking-starting-business/big-list-business-ideas-small-business
16. Thinking of Entrepreneurship: https://smallb.sidbi.in/entrepreneurship-stage/thinking-entrepreneurship
17. List of services for Small Scale Industry: http://www.archive.india.gov.in/business/Industry_services/illustrative.php
18. NSIC Schemes and Services: http://www.nsic.co.in/SCHSERV.ASP

14. PO - COMPETENCY- CO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	1	-	-	-	2	2	2
CO2	1	-	-	-	2	2	2
CO3	-	-	-	-		1	3
CO4	-	-	-	1	-	1	2

	PSO1	PSO2
CO1	-	-
CO2	-	1
CO3	-	1
CO4	-	1

Sign: Name:- Mr. S. S. Harip (Course Expert)	Sign: Name: Dr. N. G. Kulkarni. (Head of Department)
Sign: Name: Dr.S. S. Bharatkar/Shri.R. U. Shelke (Program Head) (Department of Electrical Engineering)	Sign: Name: Shri A. S. Zanpure (CDC Incharge)

Government Polytechnic, Pune.

'180OB' – Scheme

Programme	Diploma in **CE/EE/ET/ME/MT/CO/IT/DDGM**
Programme code	**01/02/03/04/05/06/07/08/15/16/17/18/19/21/22/23/24/26**
Name of Course	**Industrial Organization and Management**
Course Code	**MA 4102**
Prerequisite course code and name	No
Class Declaration	No

1. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P)		Examination Scheme				
					Theory		Practical		Total Marks
L	**T**	**P**	**C**		**#ESE**	**PA**	**ESE**	**PA**	50
02	00	00	02	**Marks**	40	10			
				Exam Duration	2 Hrs	1/2 Hr	--	--	

Legends : L- Lecture, P- Practical, T- Tutorial, C- Credits, ESE-End Semester Examination, PA- Progressive Assessment (Test I,II/Term Work), *- Practical Exam, $- Oral Exam, #- Online Examination. Each Lecture/Practical period is of one clock hour

2. RATIONALE

The industrial organization is a structured organization which has different levels of management. There are different sections / divisions of industry in which, a diploma engineer is expected to work. There are various roles of diploma engineers at different levels of technical and administration departments in an industry. They must be aware of financing agencies, Market survey, marketing techniques, human relations management and different acts by which the industries are governed.

3. COMPETENCY

The aim of this course is to attend following industry identified competency through various teaching learning experiences:

- **Ability to work with various levels of management in industry, develop awareness about different departments of industry, acts by which, industries are governed, industrial ethics and leadership qualities.**

4. COURSE OUTCOMES (COs)

The theory experiences and behavioral skills associated with this course are to be taught and implemented, so the student will able to exhibit the following CO'S.
1: Understand different levels of Industry Organization and entrepreneurship.
2: Implement skills for organizing Market Survey and Managements technique.
3: Implement various Financial & Material Management techniques.
4: Use the relevant acts applicable for factories.

5. SUGGESTED PRACTICALS/ EXERCISES

NA

6. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

NA

7. THEORY COMPONENTS

Unit Outcomes (UOs) (in cognitive domain)	**Topics and Sub-topics**
Unit-I : **Overview of Business and Organizational Management** (Weightage-08 , Hrs-6)	
1.a.Students can describe types of business. 1.b Students can classify types of industries. 1.c Students can describe Organizational Structure of Industry. 1.d Students can describe forms of ownerships.	1.1 Classification of Industries: Engineering, IT, ITeS Banking, Retail. Small Scale, Large Scale, Pvt. Ltd, India Ltd, Multi-National, MSME. 1.2 Role of engineer in Manufacturing, Service-sector, Trade , Consultancy. 1.3 Introduction to Types of business: Manufacturing, service, Trade, Consultancy. 1.4 definition of Organization. Types : Line, Functional, Line and staff, Project. 1.5 Authority and delegation of power at different levels of organization. 1.6 Forms of Ownerships : Proprietorship, Partnership, Joint Stock, Cooperative Society, Government Sector.
Unit-II **Fundamentals of Management (**Weightage-08, Hrs-6)	
2.a Describe concept of Management. 2.b. Describe different levels of Management. 2.c Describe different functions of Management.	2.1 Definition of Management. 2.2 Role of management. 2.3 Levels of Management: Higher, Middle and Lower Level management. 2.4 Scientific management by FW Taylor. 2.5 Function of Management: Planning, Organizing, Directing, Coordinating, Controlling. 2.6 Role of Management with respect to feedback & Corrective actions.
Unit-III	

Unit Outcomes (UOs) (in cognitive domain)	**Topics and Sub-topics**
Financial Management, Accounting and Material Management. (Weightage-12, Hrs-10)	
3.a . Describe different types of capital generation. 3.b Describe different types of budgets. 3.c Describe advantage of balance sheet to calculate Profit / Loss. 3.d Describe concept of Inventory management.	3.1 Overview of : Capital generation and Management, Fixed & Working Capital. 3.2 Sources of raising Capital. 3.3 Budget & Accounts : Types of Budget viz. Production budget, fixed and variable budget (concept level) 3.4 (MRP)-function of MRP, input to MRP, benefit of MRP. 3.5 Basic concepts Enterprise resource planning (ERP)- concepts, advantages and disadvantages of ERP . 3.6 Accounts : Profit & Loss accounts, rules for debits & credits, books of accounts. 3.7 Balance Sheet : definition, sample format, various fields. 3.8 Material Management : Inventory (Concept, classification, functions.), Necessity of ABC analysis. 3.9 Standard steps in purchasing. Direct Purchase , tender method, E- Tendering. .
Unit-IV **Marketing, Industrial Safety and various Acts.** (Weightage-12, Hrs10)	
4.a Describe the concept of Market Survey and types of survey. 4.b List different techniques of increasing sales of product. 4.c List and Describe various types of accidents in industry. 4.d List and Describe various acts with respect to industry.	4.1 Market Survey: Need, Advantages and Types of market survey. 4.2 Different techniques of increasing sales of product. 4.3 Packaging of goods. 4.4 Industrial Safety: Types of accidents in industry, Causes of accidents, Preventive measures to avoid accidents. 4.5 Industrial legislation : Indian Factory Act, Minimum Wages Act, Workmen Compensation Act. (Main provisions in the acts). 4.6 Penal actions on violation of Acts. (provisions)

8. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

Unit No.	**Unit Title**	**Teaching Hours**	**Distribution of Theory Marks**			
			R Level	**U Level**	**A Level**	**Total Marks**
I	Overview of Business and Organizational Management.	06	02	06	00	08
II	Fundamentals of Management.	06	02	06	00	08
III	Financial Management, Accounting and Material Management.	10	04	06	02	12
IV	Marketing, Industrial Safety and various Acts.	10	02	06	04	12
Total		**32**	**10**	**24**	**06**	**40**

9. SUGGESTED STUDENT ACTIVITIES:

1) Prepare/download information about different industrial acts.
2) Visit to manufacturing Industry and Prepare Report on...
i) Structure of Organization/Department
ii) Safety Measures taken in Organization
iii) Procedure adopted for quality control
iv) Any Specific observation you have noticed
3) Prepare the Technical details of 5 (Electronics Product like mobile phone, TV ,Laptop, Home Theatre, Projector etc. of different company including cost and Suggest which is cost effective to buy.
4) Prepare Project report which includes financial Viability of any product of your choice.
5) Prepare a questionnaire for market survey of electronic product of your choice.
6) Write detailed Processes to start the Partnership firm.

10. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

a. To arrange a Visit to an Industry and observe industrial safety norms followed in the industry. Students should submit a report based on their observations regarding the safety norms to be followed in the industry.
b. Arrange an Expert Lecture by a Lawyer to update the students regarding Amendments in Different acts (Factory act, Minimum Wages Act, Workmen Compensation Act) and Penal actions on violation of the acts.

11. SUGGESTED MICRO-PROJECTS:

NA

12. SUGGESTED LEARNING RESOURCES

S.N.	Title	Author	Publisher, Edition and Year of Publication, ISBN Number
1	Industrial Engineering and Management.	O.P. Khanna,	Dhanpat Rai and Sons ISBN-10:818992835X
2	Project Planning and Entrepreneurship.	T.R.Banga, Indu Banga,	CBS Publishers
3	Behavioral Process in Organizations.	Uday Parikh, T.V. Rao and D.M. Pestonjee,	Tata McGrawhill. ISBN-13: 9788120400313

13. SOFTWARE/LEARNING WEBSITES

1. **www.nptel.com**
2. **www.slideshare.net**

14. PO - COMPETENCY- CO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	-	-	-	-	2	3	2
CO2	-	-	-	-	2	3	2
CO3	-	-	-	-	1	3	2
CO4	-	-	-	-	2	3	2

	PSO1	PSO2
CO1	-	-
CO2	-	-
CO3	-	-
CO4	-	-

Sign: Name: Shri. G. W. Sonone (Course Expert)	Sign: Name: Shri. R. N. Shikari (Program Head) (Electronics &Telecommunication Dept.)
Sign: Name: Dr.S. S. Bharatkar/Shri.R. U. Shelke (Program Head) (Department of Electrical Engineering)	Sign: Name: Shri A. S. Zanpure (CDC Incharge)

Government Polytechnic, Pune

'180OB' – Scheme

Programme	Diploma in **CE/EE/ET/ME/MT/CO/IT/DDGM**
Programme Code	**01/02/03/04/05/06/07/08/15/16/17/18/19/21/22/23/24/26**
Name of Course	**Materials Management**
Course Code	**MA4103**
Pre-requisite course code and name	No
Class Declaration	No

1. TEACHING AND EXAMINATION SCHEME

<table>
<tr><th colspan="3" rowspan="2">Teaching Scheme (In Hours)</th><th rowspan="2">Total Credits (L+T+P)</th><th rowspan="2"></th><th colspan="5">Examination Scheme</th></tr>
<tr><th colspan="2">Theory</th><th colspan="2">Practical</th><th>Total Marks</th></tr>
<tr><th>L</th><th>T</th><th>P</th><th>C</th><th></th><th>#ESE</th><th>PA</th><th>ESE</th><th>PA</th><td rowspan="2">50</td></tr>
<tr><td rowspan="2">02</td><td rowspan="2">00</td><td rowspan="2">00</td><td rowspan="2">02</td><th>Marks</th><td>40</td><td>10</td><td>00</td><td>00</td></tr>
<tr><th>Exam Duration</th><td>2Hrs</td><td>1/2 Hr</td><td>-</td><td>-</td><td></td></tr>
</table>

Legends : L- Lecture, P- Practical, T- Tutorial, C- Credits, ESE-End Semester Examination, PA- Progressive Assessment (Test I,II/Term Work), *- Practical Exam, $- Oral Exam, #- Online Examination. Each Lecture/Practical period is of one clock hour

2. RATIONALE

This course deals with management of materials. Smooth running of any industry depends upon the interdepartmental relations and planning for execution of work jointly. Efficiency of the production department also depends upon the availability of raw material of required quality and quantity. Therefore there should be proper coordination between the production department, production planning, stores department and purchase department. Incorrect materials planning can also lead to higher inventories & high cost.

3. COMPETENCY

The aim of this course is to attend following industry identified competency through various teaching learning experiences:

- **To acquaint with the latest techniques in materials management and inventory management.**

4. COURSE OUTCOMES (COs)

The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented so that the student demonstrates the following industry oriented COs associated with the above mentioned competency**:**

1. State the importance of materials and inventory management.
2. Describe different aspects of buying procedure and price forecasting.
3. To acquaint with latest techniques in materials management.

5. SUGGESTED PRACTICALS/ EXERCISES

NA

6. MAJOR EQUIPMENTS / INSTRUMENTS REQUIRED

NA

7. THEORY COMPONENTS

Unit Outcomes (UOs) [In cognitive domain]	**Topics and Sub-topics**
Unit – I Importance of Materials Management (08 hrs, 10 marks)	
1.a. State needs of material management. 1.b. List the fields of material management. 1.c. State the objectives and functions of material management. 1.d.Describe methods for organization of materials 1.e. Explain importance of specifications in material management.	1.1 Growing importance of Materials Management. 1.2 Materials Management: - Scope - Objectives - Functions 1.3 Organizing for Materials Management. 1.4 Introduction to Materials planning. 1.5 Importance of specifications in Materials Management.
Unit – II Inventory Management (08 hrs, 10 marks)	
2.a. Describe concept of inventory, ABC analysis 2.b. State advantages of ABC analysis mechanics	2.1 Selective control – ABC Analysis Purpose and objectives Advantages and limitations of ABC Analysis. 2.2 Order point, Lead time, safety stock, Reorder point, Standard order, Economic order. 2.3 Economic Order Quantity Concept, graphical representation, determination of EOQ.
Unit – III Buying & Inventory Control (08 hrs, 10 marks)	
3.a. Describe purchase functions & procedures. 3.b. State significance and approaches of price forecast 3.c. Describe coding techniques for inventory.	3.1 Sourcing, Buy or lease and Purchase systems. 3.2 Value analysis framework, Implementation methodology. 3.3 Ethics in purchasing. 3.4 Price Forecasting- Importance & Approaches. 3.5 Inventory turns ratios.

3.d. State importance of standardization.	3.6 Standardization- need & importance. 3.7 Codification- concept, benefits.
Unit - IV Latest Techniques in Materials Management (08 hrs, 10 marks)	
4.a. Explain Just in Time (JIT) inventory concept. 4.b. State importance and applications of SAP.	4.1 Inventory concept - Just in Time (JIT). 4.2 Introduction to SAP - importance and applications of SAP. 4.3 Introduction to Supply chain management. 4.4 Objectives, Importance Forecasting and Applications of supply chain management.

8. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Importance of Materials Management	8	6	2	2	10
II	Inventory Management	8	2	4	4	10
III	Buying & Inventory control	8	2	2	6	10
IV	Latest Techniques in Materials Management	8	2	4	4	10
	Total	**32**	**12**	**12**	**16**	**40**

9. SUGGESTED STUDENT ACTIVITIES

Other than the classroom and laboratory learning, following are the suggested student-related ***co-curricular*** activities which can be undertaken to accelerate the attainment of the various outcomes in this course: Students should conduct following activities in group and prepare reports of about 5 pages for each activity, also collect/record physical evidences for their (student’s) portfolio which will be useful for their placement interviews:

a. Do survey and make a report on actual difficulties faced in materials management in different segments of industries.
b. Study and make a presentation on different Inventory management practices followed in industries.
c. Collect information and make a report on benefits achieved by maintaining good / optimum levels of inventory on the shop floor.
d. Study and make a report on different factors affecting the purchase cost in industrial materials management.
e. Do survey and make presentation on different classes of materials observed w.r.t materials management practices.

10. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are sample strategies, which the teacher can use to accelerate the attainment of the various outcomes in this course:

a. Massive open online courses (***MOOCs***) may be used to teach various topics/subtopics.
b. About ***15-20% of the topics/sub-topics*** which are relatively simpler or descriptive in nature is to be given to the students for ***self-directed learning*** and assess the development of the COs through classroom presentations (see implementation guideline for details).
c. With respect to item No.9, teachers need to ensure to create opportunities and provisions for co-curricular activities.
d. Guide student(s) in undertaking micro-projects.
e. Correlate subtopics with concerned equipments / technology.
f. Use the proper equivalent analogy to explain different concepts.
g. Use Flash/Animations to explain various components, operations, processes.
h. Teacher should ask the students to go through instruction and technical manuals.

11. SUGGESTED MICRO PROJECTS

NA

12. SUGGESTED LEARNING RESOURCES

S.N.	Title	Author	Publisher, Edition and Year of Publication, ISBN Number
1	Materials Management	Ammer Deans S	R.D. Irwin Hellions Publisher. ISBN10: 0210226765 ISBN13: 9780210226766
2	Materials Management An Integrated Approach	P. Gopalakrishnan and M. Sundaresan	Prentice – Hall of India Pvt. Ltd. New Delhi ISBN978-81-203-0027-9
3	An Integrated Concept of Materials Management	M.M. Shah	Tata McGraw Hill Publisher Co. Ltd. New Delhi. ISBN: 007451749X 9780074517499
4	Supply chain management strategy, planning and operation	Sunil Chopra	Kellogg School of Management Peter MeindlKepos Capital- Pearson Education, Inc., publishing as Prentice Hall. ISBN-13:978-0-13-274395-2 (alk. paper)

13. SOFTWARE/LEARNING WEBSITES

1. https://youtu.be/raqi4gjMLm8
2. https://youtu.be/abBvHqf26H8
3. https://nptel.ac.in/courses/110/105/110105095/
4. https://www.digimat.in/nptel/courses/video/110105095/L02.html
5. https://www.digimat.in/nptel/courses/video/110105095/L06.html

14. PO - COMPETENCY- CO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	1	1	2	1	2	3	2
CO2	1	2	1	1	3	3	1
CO3	2	1	3	2	2	3	3

	PSO1	PSO2
CO1	-	-
CO2	-	-
CO3	-	-

Sign: Name: Shri. R. S. Tuljapurkar (Course Expert)	Sign: Name: Smt. N. S. Kadam (Head of Department) Department of Metallurgical Engg.
Sign: Name: Dr.S. S. Bharatkar/Shri.R. U. Shelke (Program Head) (Department of Electrical Engineering)	Sign: Name: Shri A. S. Zanpure (CDC Incharge)

Government Polytechnic, Pune

'180OB' – Scheme

Programme	Diploma in **CE/EE/ET/ME/MT/CO/IT/DDGM**
Programme code	**01/02/03/04/05/06/07/08/15/16/17/18/19/21/22/23/24/26**
Name of Course	**Disaster Management**
Course Code	**MA 4104**
Prerequisite course code and name	No
Class Declaration	No

1. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P)		Examination Scheme				
					Theory		Practical		Total Marks
L	T	P	C		#ESE	PA	ESE	PA	
02	00	00	02	Marks	40	10	Nil	NIL	50
				Exam Duration	2Hrs	30 min	NA	NA	

Legends: L- lecture, T-Tutorial/teacher guided theory practice, P-practical, C-Credits, ESE-End semester examination, PA- Progressive Assessments(Test I, II/Term Work), * - Practical Exam, $ - Oral Exam. # - Online Exam., Each lecture/practical period is of one clock hour.

2. RATIONALE

Sensitization of every citizen of the country regarding disaster management is of utmost importance. A diploma holder in any discipline has a greater role in disaster management owing to the technical skill sets possessed by him/her. The course is an attempt to sensitize the students pursuing diploma programme in Engineering / Technology about various aspects of Disaster management.

3. COMPETENCY

The aim of this course is to address following Society / Industry identified competency through various teaching learning experiences:

- **Exhibit capability to contribute in Disaster management related activities through the technical skill sets possessed.**

4. COURSE OUTCOMES (COs)

On completion of the course through theory and relevant soft skills, the student shall demonstrate the following tangible outcomes;

1. Define and emphasize the significance of various terms associated with disaster and disaster management.
2. Classify and distinguish various types of disasters.
3. Interpret and elaborate features of the disaster management setup in India
4. Elaborate on the disaster mitigation, disaster preparedness and relief operations.

5. SUGGESTED PRACTICALS/ EXERCISES

The teaching and examination scheme for the course does not mandate any practical for the course.

6. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

NA

7. THEORY COMPONENTS

Unit Outcomes (UOs) (in cognitive domain)	**Topics and Sub-topics**
**UNIT 1. Disaster and Disaster Management Concepts (**Hrs-6 , Marks- 6)	
1a. Define disaster and disaster management. 1b. Define terms associated with disaster and disaster management. 1c. Correlates the effect of Vulnerability and Coping capacity on disaster management.	**1.1 Disaster and Disaster management:** Definitions of Disaster and disaster management. **1.2 Definition of terms associated with disaster and disaster management:** Definition of terms Vulnerability to disaster, Hazard, Risk, Risk management, Coping capacity **1.3Correlation of Vulnerability and Coping capacity in Disaster management:** Effect of vulnerability to disaster on the effect of disaster and disaster management. Influence of coping capacity on disaster assessment and mitigation.
UNIT 2. Types of disasters (Hrs- 6 ,Marks: 8)	
2a. Classify disasters based on source. 2b.Classify Natural and Manmade disasters in to further categories. 2c.Further classification of disasters based on sequence of occurrence, Pace and scale.	2.1 Classification of disaster based on source as Natural and Manmade. 2.2 Classification of Natural disasters as atmospheric, Terrestrial, Aquatic and Biological. 2.3 Classification of manmade disasters as Industrial, Chemical, Technological, Nuclear, Gas leaks, Oil spills, Dam failures and canal breaches, Wars, Terrorist attacks, Biological, Transportation accidents. 2.4 Primary and secondary, Slow on set and rapid onset, simple and complex disasters.

Unit Outcomes (UOs) (in cognitive domain)	**Topics and Sub-topics**
UNIT 3 Disaster management in India (Hrs- 12, Marks: 16)	
3a. Elaborates the provisions of Disaster management Act 2005. 3b. Signifies the role of National Institute of Disaster Management (NIDM) and elaborates on its activities. 3c. Describes the evolution of disaster management set up at national / state / district levels.	3.1 Disaster scenario in India, its vulnerabilities, review of some of the notable disasters in Indian history. 3.2 National disaster management Act 2005, its provisions, authorities at different levels and their roles/ responsibilities. 3.3. National Institute of Disaster Management (NIDM) – the need for its establishment, activities, contributions to disaster management in India. 3.4. National disaster management policy 2009, National Disaster management plan 2016 and 2019, Maharashtra state disaster management plan 2016. Provisions, features and role in strengthening national disaster management.
UNIT 4. Disaster mitigation and relief (Hrs- 8, Marks: 10)	
4a.Describes various stages involved in disaster mitigation. 4b.Elaborates disaster risk reduction strategies. 4.c. Signifies the need for disaster preparedness in disaster management. 4.d.Elaborates Disaster relief and rehabilitation activities.	4.1 Disaster mitigation strategies as per national disaster management plan provisions. 4.2 Disaster risk reduction strategies and study of factors contributing to disaster vulnerability. 4.3 Study of disaster preparedness strategies and early warning systems to anticipate occurrences of disaster to improve preparedness. 4.4 Disaster relief activities as per the provisions of statutes and the action plans and procedures for disaster relief. Stake holders in disaster relief management. 4.5 Capacity building rehabilitation measures and long term reconstruction.

8. SUGGESTED SPECIFICATION TABLE FORQUESTION PAPER DESIGN

Unit No.	**Unit Title**	**Teaching Hours**	**Distribution of Theory Marks**			
			R Level	**U Level**	**A Level**	**Total Marks**
I	Disaster and Disaster Management Concepts	06	02	04	00	06
II	Types of disasters	06	04	04	00	08
III	Disaster management in India	12	04	12	00	16
IV	Disaster mitigation and relief	08	04	06	00	10
Total		32	**14**	**26**	**00**	**40**

9. SUGGESTED STUDENT ACTIVITIES

Other than the classroom, following student-related ***co-curricular*** activities are suggested which reinforce the cognitive learning and aid in attainment the course outcomes;

a. Individual student shall prepare a report on one natural and one manmade disaster that has occurred in India (Preferably in Maharashtra) in the last 10 years. The report shall highlight classification of the disaster, magnitude, vulnerability of the disaster location/ site, mitigation measures, relief activities undertaken and long-term measures and their effect.
b. Individual student shall prepare a report on a successful disaster preparedness exercise executed in India in the near past. The report shall highlight the risk reduction strategies adopted, early warning systems used and reduction of vulnerability to hazard measures adopted.
c. Each individual student undergoing this course shall complete “Course 1 – Basics of disaster management under the self-study programme of National Institute of Disaster Management (NIDM) and secure certification for the same.

10. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

a. All the units of curriculum are supported by selective MOOCS prepared by Educational Multimedia Research Centre (EMRC) Osmania University on Disaster management. The Urls of the earmarked video clips for the course are listed as reference material in the curriculum. The students can access them.
b. The course teacher shall prepare study material to the students based on the MOOCs, reference materials listed.

11. SUGGESTED MICRO-PROJECTS

The scope of the course does not mandate any micro projects. However, suggested student activities suffice as micro projects.

12. SUGGESTED LEARNING RESOURCES

Sr.No.	Title	Author	Publisher, Edition and Year of publication, ISBN Number
1	The Disaster Management Act, 2005	Government of India	N A (pdf of the bare act is enclosed with curriculum)
2	National Disaster Management Plan (NDMP) 2016	Government of India	N A (pdf of the bare act is enclosed with curriculum)
3	Maharashtra State Disaster Management Plan 2016	Government of Maharashtra	N A (pdf of the bare act is enclosed with curriculum)
4	National Disaster Management Plan 2019	Government of India	N A (pdf of the bare act is enclosed with curriculum)
5	Draft National Disaster Management Plan Part II Disaster mitigation and response function plans	Government of India	N A (pdf of the bare act is enclosed with curriculum)

13 SOFTWARES / ONLINE LEARNING RESOURCES

The students and faculty can visit following earmarked urls for MOOCs of EMRC Osmania University without indulging in any acts violating copyright.

1. https://youtu.be/DExlZTfKZAM?list=PLC4PaTsQiLcbejXqJR7S59Ohk2OK1rgEG(Disaster and Disaster management concepts)
2. https://youtu.be/7ZhS_HrivqA?list=PLC4PaTsQiLcbejXqJR7S59Ohk2OK1rgEG (Types of Disaster)
3. https://youtu.be/BI38KKij9Nc?list=PLC4PaTsQiLcbejXqJR7S59Ohk2OK1rgEG (Natural Disasters)
4. https://youtu.be/cijSod44Q2g?list=PLC4PaTsQiLcbejXqJR7S59Ohk2OK1rgEG (Manmade Disaster)
5. https://youtu.be/zwIQVKqytD4?list=PLC4PaTsQiLcbejXqJR7S59Ohk2OK1rgEG (Slow onset and Rapid onset Disasters)
6. https://youtu.be/zBqvJkzbk-w?list=PLC4PaTsQiLcbejXqJR7S59Ohk2OK1rgEG (Simple and Complex Disaster)
7. https://youtu.be/e3MwwrRMfZ8?list=PLC4PaTsQiLcbejXqJR7S59Ohk2OK1rgEG (Evolution of Disaster in India)
8. https://youtu.be/iFPMSRCswG0?list=PLC4PaTsQiLcbejXqJR7S59Ohk2OK1rgEG (Disaster and disaster management in India)
9. https://youtu.be/u9ch6eqjG-Y?list=PLC4PaTsQiLcbejXqJR7S59Ohk2OK1rgEG (Disaster management act 2005)
10. https://youtu.be/e5KV2exJTeE?list=PLC4PaTsQiLcbejXqJR7S59Ohk2OK1rgEG (National Institute of Disaster Management)
11. https://youtu.be/6zFOS1VVGLw?list=PLC4PaTsQiLcbejXqJR7S59Ohk2OK1rgEG (National Policy on disaster management)
12. https://youtu.be/PHUf3WFtGfc?list=PLC4PaTsQiLcbejXqJR7S59Ohk2OK1rgEG (National disaster management plan 2016)
13. https://youtu.be/mgb7bs4Yv1g?list=PLC4PaTsQiLcbejXqJR7S59Ohk2OK1rgEG (Stake holders in disaster management)
14. https://youtu.be/GtFO-FaUwbM?list=PLC4PaTsQiLcbejXqJR7S59Ohk2OK1rgEG (Central Government as stake holder in disaster management)
15. https://youtu.be/J4oMdAOuUFQ?list=PLC4PaTsQiLcbejXqJR7S59Ohk2OK1rgEG (State Government as stake holder in disaster management)
16. https://youtu.be/7TFTXqOtARo?list=PLC4PaTsQiLcbejXqJR7S59Ohk2OK1rgEG (District administration as stake holder in disaster management)
17. https://youtu.be/rUziSTV2l9o?list=PLC4PaTsQiLcbejXqJR7S59Ohk2OK1rgEG (Armed forces as stake holder in disaster relief management)
18. https://youtu.be/lv80bN26KeE?list=PLC4PaTsQiLcbejXqJR7S59Ohk2OK1rgEG (Paramilitary forces as stake holder in disaster relief management)
19. https://youtu.be/lDhM8Co1pEs?list=PLC4PaTsQiLcbejXqJR7S59Ohk2OK1rgEG (Fire services as stake holder in disaster relief management)
20. https://youtu.be/ueqXlFC5bg0?list=PLC4PaTsQiLcbejXqJR7S59Ohk2OK1rgEG (Disaster risk reduction strategies)
21. https://youtu.be/VQ6tMdBZARM?list=PLC4PaTsQiLcbejXqJR7S59Ohk2OK1rgEG (Disaster preparedness plan)
22. https://youtu.be/TFLwWMcQll4?list=PLC4PaTsQiLcbejXqJR7S59Ohk2OK1rgEG (Early warning system in disaster preparedness)
23. https://youtu.be/972scfiEPtw?list=PLC4PaTsQiLcbejXqJR7S59Ohk2OK1rgEG (Factors contributing to disaster vulnerability)
24. https://youtu.be/9e-iiKwQ3I4?list=PLC4PaTsQiLcbejXqJR7S59Ohk2OK1rgEG (Disaster risk reduction master plan for the future)

25. https://youtu.be/y0qui7QWTQU?list=PLC4PaTsQiLcbejXqJR7S59Ohk2OK1rgEG
    (Components of disaster relief)
26. https://youtu.be/9EWZvwE2548?list=PLC4PaTsQiLcbejXqJR7S59Ohk2OK1rgEG
    (Capacity building rehabilitation measures and long term reconstruction)

14 PO - COMPETENCY- CO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	-	-	-	-	-	-	1
CO2	-	-	-	-	1	-	1
CO3	-	1	2	1	2	1	2
CO4	1	1	2	1	2	2	2

	PSO1	PSO2
CO1	--	--
CO2	--	--
CO3	--	--
CO4	--	--

Sign: Name: Dr. S M S Shashidhara Shri. V B Kondawar (Course Experts)	Sign: Name: (Dr. S. M. S. Shashidhara) (Former Head of Department) Shri. V G Tambe (HOD I Shift) Shri. V B Kondawar (HOD II shift)
Sign: Name: Dr.S. S. Bharatkar/Shri.R. U. Shelke (Program Head) (Department of Electrical Engineering)	Sign: Name: Shri A. S. Zanpure (CDC Incharge)

Government Polytechnic, Pune

'180 OB' – Scheme

Programme	Diploma in **CE/EE/ET/ME/MT/CO/IT/DDGM**
Programme code	**01/02/03/04/05/06/07/08/15/16/17/18/19/21/22/23/24/26**
Name of Course	**Introduction to E-Commerce**
Course Code	**MA4105**
Prerequisite course code and name	No
Class Declaration	No

1. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P)		Examination Scheme				
					Theory		Practical		Total Marks
L	T	P	C		#ESE	PA	ESE	PA	
02	-	-	02	Marks	40	10	-	-	50
				Exam Duration	2Hrs	1/2 Hr	-	-	

Legends: L- lecture, T-Tutorial/teacher guided theory practice, P-practical, C-Credits, ESE-End semester examination, PA- Progressive Assessments(Test I, II/Term Work), * - Practical Exam, $ - Oral Exam. # - Online Exam., Each lecture/practical period is of one clock hour.

2. RATIONALE

This course is aimed at providing the students with modules on the use of the Internet and e-commerce. It also includes all aspects of deploying e-business and e-commerce within an organization. It also provides theories and concepts and questions the validity of these models in the light of the differences between the Internet and other media.

3. COMPETENCY

The aim of this course is to attend following industry identified competency through various teaching learning experiences:

- **Understand real time problem solving and relevant soft skills.**

4. COURSE OUTCOMES (COs)

The theory, real time problem solving and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry-oriented COs associated with the above-mentioned competency:

1. Define E-commerce and various business models.
2. Describe fundamental sales process.
3. Recognise the variants of the process of B2C and B2B.
4. Identify ethical aspects of ICT.

5. SUGGESTED PRACTICALS/ EXERCISES

NA

6. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

NA

7. THEORY COMPONENTS

Unit Outcomes (UOs) **(**in cognitive domain**)**	**Topics and Sub-topics**
Unit- I Introduction to E-Commerce (Weightage-06, Hrs- 04)	
1a. Define E-commerce. 1b. Differentiate between various business models. 1c. Explain technical challenges. 1d. Explain economic challenges.	1.1 Basics and definitions – E-Commerce. 1.2 Business models related to E-Commerce. 1.3 Technical and economic challenges.
Unit-II Frameworks and Architectures (Weightage-10, Hrs- 08)	
2a. Explain fundamental sales process. 2b. List out Technological elements.	2.1 Actors and Stakeholders. 2.2 Fundamental sales process. 2.3 Technological elements.
Unit-III B2C Business (Weightage-10, Hrs- 08)	
3a. Explain the variants of the process of B2C. 3b. Differentiate between various challenges. 3c. Understand CRM.	3.1 The process model and its variants. 3.2 The pricing challenges. 3.3 The fulfilment challenges. 3.4 The payment challenges. 3.5 B2C-business and CRM. 3.6 B2C software systems.
Unit-IV B2B Business (Weightage-08, Hrs- 06)	
4a. Explain the variants of the process of B2B. 4b. Identify B2B software systems.	4.1 The process model and its variants. 4.2 B2B software systems.
Unit-V Impact of E-Commerce (Weightage-06, Hrs- 06)	
5a. Identify ethical aspects of ICT. 5b. List out different impacts of E-Commerce.	5.1 Ethics, morale and technology. 5.2 Ethical aspects of ICT. 5.3 Overall impacts of E-Commerce. 5.4 Specific impacts of E-Commerce.

8. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Introduction To E-Commerce	04	02	02	02	06
II	Frameworks and Architectures	08	02	04	04	10
III	B2C Business	08	02	04	04	10
IV	B2B Business	06	02	02	02	08
V	Impact of E-Commerce	06	02	04	02	06
Total		**32**	**10**	**16**	**14**	**40**

9. SUGGESTED STUDENT ACTIVITIES

Other than the classroom and laboratory learning, following are the suggested student-related ***co-curricular*** activities which can be undertaken to accelerate the attainment of the various outcomes in this course: Students should conduct following activities in group and prepare reports of about 5 pages for each activity, also collect/record physical evidences for their (student's) portfolio which will be useful for their placement interviews: -Student can study and prepare report on any application in which e-commerce they used.

10. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are strategies, which can be used to accelerate the attainment of the various outcomes in this course:

Sr. No.	Topic	Instructional Strategy
1	Introduction To E-Commerce	Class room teaching
2	Frameworks and Architectures	Class room teaching
3	B2C Business	Class room teaching
4	B2B Business	Class room teaching
5	Impact of E-Commerce	Class room teaching

11. SUGGESTED MICRO-PROJECTS

NA

12. SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publisher, Edition and Year of publication ISBN Number
1	Introduction to E-Commerce: Combining Business and Information Technology	Prof. Dr. Martin Kutz	1st Edition Jan 2020 ISBN 9788740315202

13. SOFTWARE/LEARNING WEBSITES

Not applicable

14. PO - COMPETENCY- CO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	-	-	-	-	1	3	2
CO2	1	1	-	1	1	3	2
CO3	1	-	-	1	1	3	3
CO4	1	1	-	1	1	3	3

	PSO1	PSO2
CO1	-	-
CO2	-	-
CO3	-	-
CO4	-	-

Sign: Name: 1. Smt. H. S. Pawar 2. Smt. N. R. Wagh 3. Smt. P. N. Yewale 4. Smt. S. S. Ingavale 5. Smt. S. J. Siraskar 6. Smt. S. R. Hande (Course Experts)	Sign: Name: Mr. U.V. Kokate Dr. S. B. Nikam. (Head of Department) (Department of Computer Engineering)
Sign: Name: Dr.S. S. Bharatkar/Shri.R. U. Shelke (Program Head) (Department of Electrical Engineering)	Sign: Name: Shri A. S. Zanpure (CDC Incharge)

Government Polytechnic, Pune

'180OB' – Scheme

Programme	Diploma in **CE/EE/ET/ME/MT/CO/IT/DDGM**
Programme code	**01/02/03/04/05/06/07/08/15/16/17/18/19/21/22/23/24/26**
Name of Course	**Information Management**
Course Code	**MA4106**
Prerequisite course code and name	No
Class Declaration	No

1. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P)		Examination Scheme				
					Theory		Practical		Total Marks
L	T	P	C		#ESE	PA	ESE	PA	
2	-	-	2	Marks	40	10	-	-	50
				Exam Duration	2 Hrs	1/2 Hr	-	-	

Legends : L- Lecture, P- Practical, T- Tutorial, C- Credits, ESE-End Semester Examination, PA- Progressive Assessment (Test I,II/Term Work), *- Practical Exam, $- Oral Exam, #- Online Examination. Each Lecture/Practical period is of one clock hour

2. RATIONALE

Organizations of all sizes generate and work on information .Collection and management of Information becomes an important aspect in each and every field. This course is aimed at providing the students with the basics of Information Management.

3. COMPETENCY

The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- **Use information management system in industries.**

4. COURSE OUTCOMES (COs)

The theory, real time problem solving and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry-oriented COs associated with the above-mentioned competency:

1. Recognize information system in any organization.

2. Enlist types of Information Systems.
3. Identify the competitive environment of business.
4. Identifying challenges in Information management.
5. State Social and Ethical issues with Information Management.

5. PRACTICALS/ EXERCISES

(Not Applicable)

6. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

(Not Applicable)

7. THEORY COMPONENTS

Unit Outcomes (UOs) (in cognitive domain)	**Topics and Sub-topics**
Unit-I Organizationsand Information Systems (Weightage-08, Hrs-06)	
1a. List different types of modern organizations. 1b. Explain IT interaction mod-el. 1c. Identify challenges for the manager.	1.1 Modern Organization- IT enabled, Net-worked, Dispersed, Knowledge Information Systems in Organizations. 1.2Managing Information Systems in Organization. 1.3 Challenges for the manager. 1.4 The Role of Internet 1.5 Managing the Internet era
Unit-II Concepts of ManagementInformation Systems (Weightage-08, Hrs-06)	
2a. Enlist types of Information Technology. 2b. Enlist types of Information Systems. 2c. Differentiate between various decisions. 2d. Explain communication in organizations.	2.1 Data and Information, Information as a re-source. 2.2 Information in organizational functions. 2.3 Types of Information Technology, Types of Information Systems. 2.4 Decision making with MIS. 2.5 Communication in organization.
Unit-III Information Systems and ManagementStrategy (Weightage-10, Hrs-08)	
3a. Identify the competitive environment of business. 3b. Find out the properties of Information Goods. 3c. Explain value chain.	3.1 The competitive environment of business. 3.2 Using IT for competing. 3.3 Information Goods. 3.4 Information Systems and Competitive strategy.
Unit-IV Managing InformationSystems (Weightage-08, Hrs-06)	
4a. Understand the challengesof managing the IT function. 4b. Identify vendor. 4c. Explain the role of CIO.	4.1 Challenges of managing the IT function. 4.2 Vendor Management. 4.3 The Role of CIO.
Unit-V Ethical and Social Issues (Weightage-06, Hrs-06)	

5a. Explain Ethical issues. 5b. Explain Social issues.	5.1 Ethical issues- Privacy, Workplace Monitor- ing, Power over Users. 5.2 Social issues- Workplace behaviour and Health, De-skilling and Alienation, Tele- commuting, E-Waste.

8. SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Organizations and InformationSystems	6	4	2	2	08
II	Concepts of Management Information Systems	6	4	2	2	08
III	Information Systems and Management Strategy	8	4	4	2	10
IV	Managing Information Systems	6	2	4	2	08
V	Ethical and Social Issues	6	2	2	2	06
Total		**32**	**16**	**14**	**10**	**40**

9. STUDENT ACTIVITIES

Other than the classroom learning, following are the suggested student-related *co-curricular* activities which can be undertaken to accelerate the attainment of the various outcomes in this course: Students should conduct following activities in group and prepare reports of about 5 pages for the activity mentioned, also collect/record physical evidences for their (student’s) portfolio which will be useful for their placement interviews :-

Student can study and prepare report on information management as done in any small setup like cyber café, canteen, medical or grocery shops etc.

10. SPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are strategies, which can be used to accelerate the attainment of the various outcomes inthis course:

Sr. No.	Topic	Instructional Strategy
1	Organizations and Information Systems	Class room teaching
2	Concepts of Management Information Systems	Class room teaching
3	Information Systems and Management Strategy	Class room teaching
4	Managing Information Systems	Class room teaching
5	Ethical and Social Issues	Class room teaching
6	Organizations and Information Systems	Class room teaching

11. SUGGESTED LIST OF MICROPROJECTS:-
Not Applicable

12. LEARNING RESOURCES

Sr.No.	Title of Book	Author, Publisher, Edition and Year of publication
1	Indian Economy	Rahul Rai

13. SOFTWARE/LEARNING WEBSITES

1. https://en.wikipedia.org/wiki/Information_system

14. PO - COMPETENCY- CO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	-	-	-	-	2	2	3
CO2	-	-	-	-	1	2	3
CO3	-	-	-	-	2	2	3
CO4	-	-	-	-	1	3	3
CO5	-	-	-	-	3	2	3

	PSO1	PSO2
CO1	--	--
CO2	--	--
CO3	--	--
CO4	--	--
CO5	--	--

Sign : 1. Smt. P. N. Yewale 2. Smt. G.B. Garud 3. Smt. A.S. Paike 4. Smt. P.K. Zade 5. Smt. S.R. Hande (Course Experts)	Sign : Mrs. M. U. Kokate (Head of the Department) (Department of Information Technology)
Sign: Name: Dr.S. S. Bharatkar/Shri.R. U. Shelke (Program Head) (Department of Electrical Engineering)	Sign: Name: Shri A. S. Zanpure (CDC Incharge)

Level 4 - C Curriculum

Government Polytechnic, Pune

'180 OB' – Scheme

Programme	Diploma in ET/CE/**EE**//ME/MT/CM/IT/DDGM
Programme code	01/**02**/03/04/05/06/07/08/15/**16**/17/18/19/21/**22**/23/24/26
Name of Course	**INDUSTRY INPLANT TRAINING**
Course Code	**EE4101**
Prerequisite course code and name	**Level 1 & Level 2 courses Term grant**
Class Declaration	No

1. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P)		Examination Scheme				
					Theory		Practical		Total Marks
L	T	P	C		ESE	PA	$ ESE	PA	
00	00	06	06	Marks	-	-	50	50	100
				Internship Duration	6 weeks duration				

Legends: L- lecture, T-Tutorial/teacher guided theory practice, P-practical, C-Credits, ESE-End semester examination, PA- Progressive Assessments(Test I, II/Term Work), * - Practical Exam, $ - Oral Exam. # - Online Exam., Each lecture/practical period is of one clock hour.

2. RATIONALE :

Employability competencies can be enhanced by exposing students to the actual real time working environment in industry . The industrial skills like, soft skills, life skills and hands-on will be inculcated among the students. Inplant training is the only way students learn application of acquired knowledge to fulfill market demand and develop skills and competencies required to become employable.

3. COMPETENCY :

Following competencies are expected to be developed through INDUSTRY INPLANT TRAINNG :

a) **Soft Skills : Communication, Presentation, Technical Report Writing.**
b) **Life Skills : Time management, Safety, Innovation, Entrepreneurship, Team building etc..**
c) **Hands-on Practices: Implementation of production process and development of software and Quality Assurance aspects.**

4. COURSE OUTCOMES:

Industry Inplant training is intended to acquire the competencies as mentioned above to supplement those attained through several courses up to fourth semester of the program:

1. Communicate effectively (verbal as well as written) to execute the work.
2. Prepare the report of the executed work at the industry.
3. Exercise time management and safety in the work environment.
4. Work in teams for successful completion of projects assuring quality.

5. GENERAL GUIDELINES FOR INDUSTRIAL TRAINING

a) **Period of Industrial Training:** Between 4th and 5th semester (Summer Vacation).
b) **Duration of the training:** Six weeks
c) The Industries/Organizations can be Government/Public limited/or Private family enterprises.

- **Training Area:** Students should be placed in large and medium scale Industry / Organization. However, despite the best efforts by the institute, if large and medium scale Industry / Organization are not available to all students then, students can also be placed in small scale Industry / Organization.

For **Civil engineering** it can be public works department, irrigation department, public health engineering, municipal corporations, town and country planning, highway and roads authorities, railways, large and medium scale civil contractors, rural engineering departments, environment corporations, large and medium scale private construction companies, mining companies etc.

For **Mechanical Engineering** it can be manufacturing, fabrication, foundry or processing industry which may include compressors, boilers, engines, heat exchangers, air conditioning and refrigeration plants, conveyors ,automation etc are either manufactured or used. Power plants, Railways, process plants, ordinance factories, textile factories, automobile manufacturers or major automobile workshops

For **Electrical Engineering** it can be electricity transmission and distribution companies, power generating stations, sub stations, railways, industries manufacturing electrical products which may include industry where large motors/transformers etc. are used, process plants, electrical contractors.

For **Electronic Engineering** it can be telecommunication companies, post and telegraph department, manufacturer of telecommunication product, manufacturers of control equipments, manufacturer of CNC machines, any manufacturing industry where electronic controls are used either in production process or in its products, computer hardware manufacturers, signal divisions of railways, etc.

For **Computer and IT Engineering** it can be any software developers, cyber security companies, web page developers, networking companies, data base management companies, telecommunication companies or IT division of any other industries/finance/retail companies or organizations where software are used and maintained for various applications.

For **Metallurgical Engineering** it can be manufacturing industry such as fabrication , foundry , processing industry, forging, galvanizing, Iron making and steel making industries.

For **Dress Designing and Garment Manufacturing** it can be Textile industries, Weaving and Knitting industries, Garments industries, Design and Styling fashion garments , Retail malls.

6. ROLE OF PARENT DEPARTMENT & THE INSTITUTE:

A. Formation of Placement cell for IIP at institute level:

It will be consisting of Training& Placement Officer (TPO), CDC Incharge , and one Faculty from each program .

Following Activities will be carried by Institute IIP Cell:

A.1 Collecting information about Industry / Orginisation available for training along With the capacity.

A.2 Communication with Industry / Orginisation available for training along with capacity and its confirmation.

A.3 Issue letter to the Industry / Orginisation for the training along with details of students and mentors.

B. Formation of IIP Cell At program level:

It will be consisting of a faculty from Institute IIP cell , One faculty per division.

for examiners coordination ,orientation +mentors ,letters initialization,

Following Activities will be carried by Program level IIP Cell:

B.1 Student and mentor allocation as per the slots available for in-plant Training.

B.2 Obtaining consent letter from parents / guardian.(Undertaking on Rs100 stamp, Insurance)

B.3 Orientation and selection of Students before start of Industry inplant training through counseling.

B.4 Mentors to carry out progressive assessment of the students during the in-plant training.

B.5 End of training assessment by mentor along with Industry / Organization expert as external

- **Scheduling for Implant Training placements –**

Sr. no	activity	Period	Responsibility
1	Industries to be identified	6^{th}-8^{th} week of 4^{th} Semester.	Departmental inplant training coordinator
2	Communication and coordination with industry	8^{th}-10^{th} week of 4^{th} Semester	Departmental inplant training coordinator
3	Allocation of faculty / Mentor	8^{th}-10^{th} week of 4^{th} Semester	Departmental inplant training coordinator
4	Acquire undertaking from students and parents .	10^{th} – 12^{th} week of 4^{th} Semester	Allocated faculty / Mentor
5	Finalise and prepare letter of placements	12^{th} – 16^{th} week of 4^{th} Semester	Allocated faculty / Mentor
6	Organise orientation and guidance and counseling Session for respective students	12^{th} – 16^{th} week of 4^{th} Semester	Allocated faculty / Mentor
7	Progressive assessment of the students during the in-plant training	Each week of training	Allocated faculty / Mentor
8	End of training assessment by mentor along with Industry / Organization expert	Before 5^{th} semester ESE	Allocated faculty / Mentor

- Faculty will be visiting the industry **at least once** during training phase after third week for assessment in coordination with industry personnel and for taking feedback. Weekly assessment can be done through online mode .

7. FORMAT FOR TRAINING REPORT

Following is the suggestive format for the training report, actual format may differ slightly depending upon the nature of Industry / Organisation. The training report may contain the following

- Title page
- Certificate
- Abstract
- Acknowledgement
- Content Page

Chapter 1. Organizational structure of Industry / Organisation and General Lay Out
Chapter 2. Introduction of Industry / Organisation (Type of products and services, history, turn over and number of employees etc.)
Chapter 3. Types of major equipment/instruments/machines/hardware and software used in industry with their specification, approximate cost and specific use and their routine maintenance.
Chapter 4. Manufacturing Processes/Models along with planning , handling and control methods.
Chapter 5. Testing of Hardware/Software/raw materials, components and finished products along with quality assurance procedures.
Chapter 6. Safety procedures followed and safety gear used (includes Preventive maintenance schedule and breakdown maintenance procedures).
Chapter 7. Particulars of Practical Experiences in Industry / Organisation if any in Production/ Assembly/ Testing/Maintenance.
Chapter 8. Detailed report of the Task . (if any done during the training)
Chapter 9. Special/challenging experiences encountered during training if any (may include students liking & disliking of work places)
Chapter 10. Conclusion
Chapter 11. References /Bibliography

8. SUGGESTED LEARNING & EVALUATION STRATEGIES/GUIDELINES

- Students should visit the website of the industry where they are undergoing training to collect information about products, processes, capacity, number of employees, turnover etc.
- They should also refer the handbooks of the major machinery, softwares and operation, testing, quality control and testing manuals used in the industry.
- Students may also visit websites related to other industries wherein similar products are being manufactured as their learning resource.
- Both the industry supervisor and the faculty supervisor are responsible to assess the students' performance and soft-skills.
- To assess the students, the scoring rubric, scoring schemes and rating scales are developed. The components to be assessed are :
  - Industrial training Report,
  - Logbook(Diary),
  - Industrial training Oral Presentation,
  - Student Performance Evaluation by Organization Supervisor, and
  - Student Performance Evaluation by Faculty Supervisor
- Industrial Training report writing require students to produce a substantial report to explain about the organization's background, the overall training that have been performed and the specific projects that they have conducted.

- The students must apply the skills of communicating using written language, outlining, organizing, and planning a report, as well as using reference materials and sources and follow the above format.
- The student plays important role in deciding what should be included in the log book and learn to understand and evaluate her own progress.

  Student performance evaluation focuses on a student's work performance and the personality. The scoring rubric forms are used that relates assessment item to the learning outcome. The work performance is the ability to complete the given tasks within the specified time frame independently using their knowledge and skills with good quality of work. The soft skills include the socialization, communication, initiative and motivation, discipline, cooperation and teamwork

9. TENTATIVE WEEK-WISE SCHEDULE OF INDUSTRIAL TRAINING

Industrial training is a common course to all programs; therefore the industry / Organisation selection will depend upon the nature of programme and its related industry. The training activity may vary according to nature and size of Industry / Organisation. The following table details suggestive schedule for industrial training for all programs.

Table 1: Guidelines for generalized week schedule and PA Marks distribution

S. No.	**Week No.**	**Details of activities to be completed during Industrial training**	**Marks distribution/ week for PA**
1	Week No. 1	Induction to industry and its departments or study of assigned job.	04
2	Week No. 2	Study of layout and specifications of major machines, equipment and raw materials / components / software and models used.	04
3	Week No. 3	Execute/study Task. **(Execution may start from first week as per job assigned and nature of industry)**	04
4	Week No. 4	Study of QA/QC/Testing procedures.	04
5	Week No. 5	safety and maintenance procedure in an industry/organization .	04
		Total	**20**
6b	Week No. 6	Report Writing (PA marks to be given by faculty based on report writing)	**10**
PA marks to be given by industry supervisor based on student involvement and quality of job performed or job assigned.			**20**
Total PA marks for training			**50**

Table 2: Suggested Rubric for PA Assessment of Internships/Implant Training

Note: Allot the marks in the appropriate cell given based on Presentations Done

Week No	Task to be assessed	Outcome Achievement – Poor	Outcome Achievement- Moderate	Outcome Achievement – High		Total week wise Marks
		Poor (Marks 1)	Average (Marks 2)	Good (Marks 3)	Excellent (Marks 4)	
Week 1 : Industry Induction	Induction to industry and its departments or study of assigned job.	Minimal knowledge of departments, processes, products & work culture of the company	Moderate knowledge of departments, processes, products & work culture of the company	Good knowledge of all departments, processes, products & work culture of the company	Extensive knowledge of all departments, processes, products & work culture of the company	
					]	
Week 2 : Study of Existing Systems	Study of layout and specifications of major machines, equipment and raw materials / components / software and models used.	Minimal Explanation of existing systems & Objectives of the proposed work are not identified	Moderate Explanation of existing systems & Objectives of the proposed work are not well defined	Good Explanation of existing systems & Some objectives of the proposed work are well defined	Detailed Explanation of existing systems & All objectives of the proposed work are well defined	

Week No. 3: Execution of task	Execute/study Task. **(Execution may start from first week as per job assigned and nature of industry)**					
Week 4 : Testing Procedures	Study of QA/QC/Testing procedures.	Applications are not appropriate	Applications are Appropriate but not well delivered	Applications are appropriate and well delivered Student cannot apply his/her knowledge on top of assessing what he/she knows	Applications are appropriate and well delivered Student can apply his/her knowledge on top of assessing what he/she knows.	
Week 5 : Study Safety & Maintenance Procedure	Study safety and maintenance procedure in an industry/organization .	Not very appropriate	Appropriate but not well delivered	Appropriate and well delivered Student cannot apply his/her knowledge on top of assessing what he/she knows	Appropriate and well delivered Student can apply his/her knowledge on top of assessing what he/she knows.	
Week No	**Task to be assessed**	**Outcome Achievement – Poor**	**Outcome Achievement-**	**Outcome Achievement – High**	**Week No**	**Task to be assessed**

			Moderate			
		Poor (Marks 5)	**Average (Marks 6)**	**Good (Marks 8)**	**Excellent (Marks 10)**	
Week 6 : Report Writing	**Description of concepts and technical details Conclusions and Discussion**	Results are not presented properly Project work is not summarized and concluded Future extensions in the project are not specified	Results are presented in good manner Project work is not well summarized and concluded Future extensions in the project are not properly specified	Results are presented in good manner Project work is well summarized and concluded Future extensions in the project are not properly specified	Results are presented in very appropriate manner Project work is well summarized and concluded Future extensions in the project are well specified.	
Total Marks Out of 60						
Marks mapped to 50						

Table 2.1 -PA of Industrial training

Academic year : 20 -20

Name of the industry:

Sr. No.	Enrolment Number	Name of student	Marks from above Rubrics(Mapped to 4 marks for each week)						PA Marks by Industry Supervisor	PA based on Report by mentor faculty (Week 6)	Total
			Week 1	Week 2	Week 3	Week 4	Week 5	Total out of 20 (A)	Out of 20 (B)	Out of 10 (C)	Out of 50 (A)+(B)+(C)

Marks for PA are to be awarded out of 4 for each week considering the level of completeness of activity observed, from the daily diary maintained and feedback from industry supervisor.

Signature of mentor

Name of mentor:

Table 3 Assessment Scheme ESE

	Contents(30 marks)					Presentation(20 marks)					Total Out of (50)
Enroll ment No.	**Title of Industrial project**	**Topic Selection (5)**	**Presen tation skill (10)**	**Overall understan ding capability (5)**	**Knowle dge (Q & A) (10)**	**Speech Clarity (5)**	**Body Langua ge (3)**	**Neat Dressi ng (2)**	**Slides (05)**	**Report Writin g(5)**	**Total Out of (50)**

Suggested structure for industry Inplant training	
Sign: Dr. V. K. Jadhav, Lecturer,Electrical Engineering. Smt. P. M. Zilpe Lecturer,E&TC Engineering.	Sign: Smt. M. U. Kokate, Head of Department of Information Technology,
Sign: Name: Dr.S. S. Bharatkar/Shri.R. U. Shelke (Program Head) (Department of Electrical Engineering)	Sign: Name: Shri A. S. Zanpure (CDC Incharge)

Government Polytechnic, Pune

'180 OB' – Scheme

Programme	Diploma in ET/CE/**EE**//ME/MT/CM/IT/DDGM
Programme code	01/**02**/03/04/05/06/07/08/15/16/17/18/19/21/**22**/23/24/26
Name of Course	**Project**
Course Code	**EE4102**
Prerequisite course code and name	**90 credits & L1 passed**
Class Declaration	**Yes**

1. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P)		Examination Scheme				
					Theory		Practical		Total Marks
L	T	P	C		ESE	PA	$ ESE	PA	
00	00	04	04	**Marks**	**--**	**--**	**50**	**50**	100

Legends: L- lecture, T-Tutorial/teacher guided theory practice, P-practical, C-Credits, ESE-End semester examination, PA- Progressive Assessments(Test I, II/Term Work), * - Practical Exam, $ - Oral Exam. # - Online Exam., Each lecture/practical period is of one clock hour.

2. RATIONALE

This course tends to mould students towards integrating the knowledge acquired throughout and applying it to the real life projects, in order to gain the confidence of acquiring Engineering skills and thus fulfill the objective of Diploma programme. Projects mainly serve the purpose of developing learning-to-learn skills.

3. COMPETENCY

The course should be taught and implemented with the aim to develop the required course outcomes (COs) so that students will acquire following competency needed by the industry:

- **The discipline of planning, organizing, and managing resources to bring about the successful completion of a specific project.**

4. COURSE OUTCOMES (COs)

After undergoing this course, the student will demonstrate the following Course Outcomes :

1. Analyze and define the real life problem from Project development point of view.
2. Apply appropriate design methodology to the Projects.
3. Make use of designing tools.
4. Conduct feasibility study and cost estimation
5. Create test and debug working model.
6. Compile and Write a Project Report
7. Communicate effectively and confidently as a member /and leader of team.

5. GUIDELINES FOR UNDERTAKING A PROJECT :

I. During the guidance and supervision of the project work, faculty should ensure that students acquire following ***learning outcomes*** (depending upon the nature of the project work some of these learning outcomes may not be applicable):

a) Identify the problems in the area related to their programme based on the competencies acquired since inception into the programme.
b) Identify the information suggesting the cause of the problem and possible solutions.
c) Assess the feasibility of different solutions and the financialimplications:
d) Collect relevant data from different sources (books/internet/market/suppliers/experts etc. through surveys/interviews).
e) Prepare required drawings and detailed plan for execution of the work.
f) Prepare seminar presentations to present findings/features of the project.

II. In case of Industry sponsored/guided project, implementation stages may vary as per industry requirements but same format of project report, diary, demonstration and RUBRICs will be required to be fulfilled.

Sr. No.	General Guidelines
1.	Project can be Hardware or Software or Combination of Both. It must involve logic building and application of various technologies learnt during Diploma Completion
2.	Project has to be done in a group of 3-4 students under the guidance of allotted faculty
3.	Faculty may Form a team of students as per industry roles- Requirement Gathering, Developers, testers, Business Analysts, Project managers. Assign this team a project. Each group is to be assigned a guide faculty. Project titles are to be decided in co-ordination with Faculty.
4.	Students are required to prepare working model of the Project and simultaneously prepare a report. In general project can be - i. Prototype (design, make, test and evaluate). ii. Application development using hardware/software.
5.	Students Must Submit One Hard copy and one Soft copy each of Project Report and soft-copy of the project code or the working model.

6.	Generically these titles are to be covered in Project Report: a. Problem Definition b. Platform and/Hardware Specifications c. Feasibility Study: Cost Estimation, Time Estimation d. Various Design UML charts/diagrams as applicable like Use Case Diagram, Activity Charts, Class Hierarchy, DFD, CFD, ER-Diagrams, Dependency charts or any other e. Important project Code f. Testing details g. Limitations h. Future Scope/Extend ability i. Books/References/Web Sites (Other titles may be added and used as applicable, based on the nature of project)
7.	Student should maintain a project diary and note down all the progress steps and details in the diary. Faculty should check the diary each week and accordingly interact with students based on the progress shown and keep proper noting's. Impart proper guidance. This will assist in proper evaluation of students. Format of cover page of diary is as Annexure IV. Project diary may contain not more than 5-10 pages.

<u>Course Implementation Stages:</u>

1. **Orientation Session:** Portfolio In-charge faculty has to coordinate conduction of Project orientation session during last week of fifth semester.
2. **Problem Search and problem statement finalization:** Students have to undergo survey activity under the guidance of faculty. This activity maybe started during earlier semester in parallel with Seminar activity and **completed during first week of semester start.**
3. **Requirement Gathering:** One week to be utilized for gathering detailed project requirements including human resource, technical requirements/resources (software and hardware platforms), feasibility study and cost requirements. Presented to the faculty.
4. **Planning: Next week** must be utilized towards prepare a detailed project proposal and plan which must be executed or implemented within the time allocated. **Planning includes resources required, work allocation, time estimations and cost estimations.** Decide the development model to be implemented.
5. Outcome to be published under **project proposal.** May only be submitted in softcopy.
6. **Project Development, Testing& Report preparations:** Project development to proceed under faculty guidance as per planned.
7. **Project Demonstration:** Phase wise demonstration to faculty is done. The project would have to go through minimum two demonstrations :
    a. Preliminary demonstration (Given to faculty guide)
    b. Final Demonstration: During ESE final demonstration of working model is to be presented.

Note :

i. Student must be maintaining a project diary simultaneously as well as preparing a project report, periodically monitored and assessed by the teacher as per provided RUBRICS.

ii. Some stages maybe done recursively.

6. ASSESSMENT OF PROJECT WORK

A. Progressive Assessment (PA)Guidelines and criteria

The assessment of the students in the fifth semester Progressive Assessment (PA) for 50 marks is to be done based on following criteria.

Sr.No.	Criteria	Marks
1	Topic Selection & Problem definition	10
2	Requirement Gathering	10
3	Stage wise progress as per discussion	10
4	Involvement in project development	10
5	Report Writing	10

B. End Semester Exam Assessment(ESE) criteria/Term Work assessment criteria

The assessment of the students in the fifth semester End-Semester-Examination (ESE) for 50 marks is to be done based on following criteria. This assessment Shall be done by the Faculty.

Sr. No.	Criteria	Marks
1	Knowledge	20
2	Development	20
3	Innovation	5
4	Presentation	5

- **Mapping Course Outcomes With Program Outcomes:**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO	Basic and Discipline Specific knowledge	Problem Analysis	Design/Development of Solutions	Engineering Tools, Experimentations and Testing	Engineering Practices for Society ,Sustainability and Environment	Project Management	Life Long Learning
Analyze and define the real life problem from Project development point of view.	3	1	2	2	2	3	3
Apply appropriate design methodology to the Projects.	3	2	3	3	2	3	3
Make use of designing tools.	3	3	3	2	2	3	3
Conduct feasibility study and cost estimation.	3	2	3	2	2	3	3
Create , test and debug working model.	3	3	3	2	2	3	3
Compile and Write a Software Project Report.	2	-	3	2	2	3	3
Communicate effectively and confidently as a member and leader of team.	2	1	3	2	-	3	3
Summary	**3**	**2**	**3**	**2**	**2**	**3**	**3**

Mapping Course Outcomes with Program Specific Outcomes:

Annexure-II
Major Project Report

After completion of the project work, every student will submit a project report which should contain the following:

1. Cover Page (as per annexure 1)
2. Title page (as per annexure 2)
3. Certificate by the Guide (as per annexure3)
4. Acknowledgment (The candidate may thank all those who helped in the execution of the project.)
5. Abstract (It should be in one page and include the purpose of the study; the methodology used.)
6. Table of Contents (as per general guidelines):Detailed description of the project (This should be split in various chapters/sections with each chapter/section describing a project activity in totality). This portion of report should contain all relevant diagrams, tables, flow charts, which are properly labelled.
7. Conclusion
8. References (The listing of references should be typed 2 spaces below the heading "REFERENCES" in alphabetical order in single spacing left – justified. It should be numbered consecutively (in square [ ] brackets, throughout the text and should be

CO /PSO	Hardware and Networking	Database Technologies	Software Development
Analyze and define the real life problem from Project development point of view.	2	2	2
Apply appropriate design methodology to the Projects.	2	2	3
Make use of designing tools.	2	2	3
Conduct feasibility study and cost estimation.	1	2	3
Create , test and debug working model.	2	2	3
Compile and Write a Software Project Report.	1	2	2
Communicate effectively and confidently as a member and leader of team.	1	2	2
Summary	**2**	**2**	**2**

collected together in the reference list at the end of the report. The references should be numbered in the order they are used in the text. The name of the author/authors should be immediately followed by the year and other details). Typical examples of the references are given below:

Report Specifications:

1. Project Report's Cover Type: Hard-bound
2. Color of Project Report Cover: Black only with golden alphabets (as per annexure 1)
3. Number of Copies: 5 (Individual copies(each per student) + Departmental Copy(one))
4. Paper Size (orientation): A4 (portrait)
5. Margins: 1" top / bottom / right and 1.5" left
6. Font Type: Times New Roman
7. Font Size: 16 bold for chapter names, 14 bold for headings and 12 for normal text
8. Line Spacing: 1.5 throughout
9. Page Numbering: Bottom center of page in the format – Page 1 of N

NOTE: Project report must contain only a relevant and short mention – technology or platform or OS or tools used. It must be more focused on project work carried out and its implementation details without including any source code.

Details of Softcopy to be submitted:

CD of the project work is required to be pasted on the back cover of the project report in clear packet, which should include the following folders and contents:

1. **Presentation** (should include a PPT about project in not more than 15 slides)
2. **Documentation** (should include a word file of the project report)
3. **Source Code** (full source code of the project with libraries used)
4. **Program** (final copy of the project executable)
5. **Support** (any third party tools used or runtime environment setups that are required to run the project)
6. **Help** (user manual on how to run the project)

NOTE: CD must be checked for any harmful viruses before submission. SourceCode and Program folders can be combined into single folder **Project** if it's a web project etc.

Annexure-III

Government Polytechnic,Pune

(An Autonomous Institute of Government of Maharashtra)

CERTIFICATE

This is to certify that

1)Name Of Student	**Enrollment Number**
2)Name Of Student	**Enrollment Number**
3)Name Of Student	**Enrollment Number**
4)Name Of Student	**Enrollment Number**

Has completed the necessary project work and prepared the bonafide on

"Project Title"

In a satisfactory manner as a partial fulfillment of requirement of the

THIRD YEAR DIPLOMA IN

ELECTRICAL ENGINEERING

FOR THE ACADEMIC YEAR

20 -20

(H.O.D) **(Principal)**

(Internal Guide) **(External Examiner)**

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6.	**SCREENSHOTS**	
7.	**ADVANTAGES & DISADVANTAGES**	
8.	**CONCLUSIONS**	
9.	**REFERENCES**	

***Students can add/remove/edit chapter names as per the discussion with their guide**

PROJECT DIARY

Name of the Student: ______________________________ Name of Guide (Faculty) : ________________________________

Enrollment Number: ____________________ Semester: ________________Project batch Number: ____________________

Date	Discussion Topics/Activity Details	Work Allotted Till Next Session/Corrections Suggested/Faculty Remarks	Dated Signature of Faculty

Dated Signature of Faculty

Dated Signature of HOD

Annexure-V

Rubrics

Progressive Assessment					Project Presentation			
Topic Selection & Problem definition (10)	Requirement Gathering (10)	Stage wise progress as per discussion (10)	Involvement in project development (10)	Report Writing (10)	Knowledge (20)	Development (20)	Innovation (5)	Presentation (5)

Sign: Name: Smt. A.B.Bhusagare (Course Expert)	Sign: Name: Smt. M.U Kokate (Head of Information Technology)
Sign: Name: Dr.S. S. Bharatkar/Shri.R. U. Shelke (Program Head) (Department of Electrical Engineering)	Sign: Name: Shri A. S. Zanpure (CDC Incharge)

Government Polytechnic, Pune

'180OB' – Scheme

Programme	Diploma in ET/CE/**EE**//ME/MT/CM/IT/DDGM
Programme code	01/**02**/03/04/05/06/07/08/15/**16**/17/18/19/21/**22**/23/24/26
Name of Course	**Seminar**
Course Code	**EE4103**
Prerequisite course code and name	**90 credits & L1 passed**
Class Declaration	**Yes**

1. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P)		Examination Scheme				
					Theory		Practical		Total Marks
L	T	P	C		ESE	PA	$ ESE	PA	
00	02	00	02	**Marks**	--	--	25	25	50

Legends: L- lecture, T-Tutorial/teacher guided theory practice, P-practical, C-Credits, ESE-End semester examination, PA- Progressive Assessments(Test I, II/Term Work), * - Practical Exam, $ - Oral Exam. # - Online Exam., Each lecture/practical period is of one clock hour.

2. RATIONALE

This course tends to mould students towards integrating the knowledge acquired throughout and applying it to understand and interpret evolving technologies in order to strengthen the confidence over acquired Engineering skills and thus fulfill the objective of Diploma Programme. Seminar mainly serve the purpose of developing learning-to-learn skills with an aim to develop the following attributes in the students:

3. COMPETENCY

The course should be taught and implemented with the aim to develop the required course outcomes (COs) so that students will acquire following competency needed by the industry:

- **Interpret innovative/new technologies independently .**

4. COURSE OUTCOMES (COs)

After undergoing this course,the student will demonstrate the following Course Outcomes

1. Analyze and study new technologies/tools.
2. Apply technical knowledge.
3. Compile and Write a Seminar Report
4. Work independently,
5. prepare and deliver presentations.

5. GUIDELINES FOR UNDERTAKING A SEMINAR :

1. Department must organise a Seminar Orientation session for all the registered students .
2. The process of conducting a Seminar includes allocating a topic to individual student who should perform the required search, decide on the topic objectives, design and prepare an appropriate method of presentation, and present the topic to their fellow students and teachers with all of the necessary explanation and discussion. Faculty assigned to student should be providing necessary guidance.
3. Students would individually prepare the Seminar report with the following sub-titles:
    a. Acknowledgement
    b. Abstract
    c. Index
    d. List of Figures
    e. Introduction
    f. Information/Chapters related to Seminar topic
    g. Advantages and Disadvantages
    h. Conclusion
    i. References
4. Seminar topic shall be approved by the respective guide.
5. The student will begin to maintain a dated Seminar Diary for the whole semester. This diary should be assessed by respective guide timely. Format of diary is as given in **table I**

Suggested Seminar Activities to be performed:-

a. Collection of **atleast three Seminar topics** on recent technologies and presentation of their abstract to faculty guide.
b. Finalization of Seminar topic.
c. Submission of final abstract on selected topic.
d. Weekly interaction of students in group withseminar guide.
e. Weekly assessment of seminar and work is labeled as Progressive Assessment.
f. Group of Students should prepare and submit Report writing and presentation slidesof Seminar in consultation with Seminar guide.

g. Presentation of Seminar in well defined manner within specified time.
h. Submission of Seminar report with the permission of faculty and Head of the Department..
i.

6. ASSESSMENT OF SEMINAR WORK

- Like other courses, assessment of Seminar work also has two components, first is progressive assessment, while another is end of the term assessment that is Term Work.
- The faculty will undertake the progressive assessment to develop the COs in the students. They can give oral informal feedback about their performance and their interpersonal behaviour while guiding them on their seminar work every week.
- There will also be regular progressive assessment by the teacher.

A. Progessive Assessment (PA)Guidelines and criteria :
The assessment of the students in the fifth semester Progressive Assessment (PA) for 25 marks is to be done based on following criteria.

Sr.No.	Criteria	Marks
1	**Topic Selection**	**5**
2	**Regularity in Seminar work as mentioned in Diary**	**5**
3	**Overall understanding capability**	**5**
4	**Progress in work and effortsdisplayed (Interactions with Q & A)**	**10**

B.End Semester Assessment(ESE) criteria/Term Work assessment criteria :
The assessment of the students in the fifth semester end-semester-examination (ESE) for 25 marks is to be done as per RUBRICS of Annexure V. This assessment shall be done by the faculty.

- **Mapping Course Outcomes With Program Outcomes:**

CO → ↓	PO1 Basic and Discipline Specific knowledge	PO2 Problem Analysis	PO3 Design/Development of Solutions	PO4 Engineering Tools, Experimentations and Testing	PO5 Engineering Practices for Society ,Sustainability and Environment	PO6 Project Management	PO7 Life Long Learning
Analyze and study new technologies.	3	1	2	2	2	3	3
Apply technical knowledge.	3	2	3	3	2	3	3
Study working model	3	2	3	2	2	3	3
Compile and Write a Seminar Report	3	3	3	2	2	3	3
Work independently and deliver presentations.	2	1	3	2	-	3	3
Summary	**3**	**2**	**3**	**2**	**2**	**3**	**3**

- **Mapping Course Outcomes With Program Specific Outcomes:**

CO /PSO → ↓	Hardware and Networking	Database Technologies	Software Development
Analyze and study new technologies.	2	2	2
Apply technical knowledge.	2	2	3
Study working model	2	2	3
Compile and Write a Seminar Report	1	2	3
Work independently and deliver presentations.	2	2	3
Work independently and deliver presentations.	1	2	2
Summary	**2**	**2**	**2**

Annexure-I

Seminar Report Guideline

1. **All students should submit their seminar report to their respective guide on or before ____________.**
2. **Seminar report must include**
    1. **Cover Page**
    2. **Certificate**
    3. **Acknowledgement**
    4. **Index**
    5. **Abstract**
    6. **Chapters (as per discussion with guide)**
    7. **References/Bibliography**
3. The page size of the seminar report should be in A4 size.
4. The seminar report should be **Spiral bonded.**
5. Two copies of the report (hard copy only). One for self and one to be submitted to department.
6. **Page Numbering (Centered having format Page No__ of __)**
7. **Paper Size:** A- 4 size paper
    1. **Margins :**
        - **Top:** 1” (1 inch=2.54cm)
        - **Bottom:** 1.15” (2.86cm)
        - **Left:** 1.5”
        - **Right:** 0.6”
    2. **Line Spacing:** 1.5 line
    3. **Title of Chapter**
        - **Font:** Times New Roman (Bold face)
        - **Size:** 14 point
        - **Alignment:** Centre
8. **Text**
    - **Font:** Times New Roman
    - **Size:** 12 point
    - **Alignment:** Justified (Full Text)
9. **Figures and Tables:**
    a. **Font:** Times New Roman (**Bold**)
    b. **Size:** 12 point
    c. **Alignment:** Centered
    d. **Figure Caption must be below the figure and centered**
    e. **Table caption must be above the table and centered**

<u>Annexure-II</u>

Government Polytechnic, Pune-16

(An Autonomous Institute of Government of Maharashtra)

A
Seminar Report
On

"SEMINAR TITLE"

SUBMITTED BY:

<Name of the student>

Under the Guidance of

<Guide Name>

DEPARTMENT OF ELECTRICAL ENGINEERING
(Academic Year: 2019-20)

Government Polytechnic, Pune-16

(An Autonomous Institute of Government of Maharashtra)

Department Electrical Engineering

CERTIFICATE

This is to certify that Ms/Mr.______________with Enrollment No.__________, of Third Year Diploma in **Electrical Engineering** has successfully completed the seminar titled "_____________" as part of his/her diploma curriculum in academic year 2019-20.

SeminarGuide **H.O.D** **Principal**

ACKNOWLEDGEMENT

Acknowledgement should be prepared by the students in their wordings expressing their gratitude towards department.

Government Polytechnic Pune

Department of Electrical Engineering

General Guideline

for

Seminar-EE4103

Annexure-III

Department of Electrical Engineering

GENERAL SEMINAR GUIDELINES (Odd 2019)

Purpose of carrying out Seminars is to develop self learning capability of students wherein they will be able to apply the knowledge gathered to a new technology, understand it and deliver the presentations accordingly. All students must follow the guidelines given below :

- Seminar Presentation should be on Technical Topic only. The topic (technology) chosen may be related to perspective project.
- Seminar topic contents cannot be the contents of their Diploma course.
- Evaluation of Seminar should be based on Topic Selection, Technical Contents, Content Understanding, Content Delivery and Response to the Questions.
- Seminar topics across all students must not be repeated.
- Seminar Topics of last year should not be repeated.
- Each student has to collect 3-4 topics, present their abstract to guide, discuss with guides and finalise topics through number of discussions. Abstract must also contain key terms in topics.
- Each abstract should not exceed 200 words.
- Abstract must be written with grammatically correct statements. Shortcuts must not be used for any words and should not contain spelling mistakes with neat and clean handwriting.
- Each student must prepare and attach the seminar diary to their Seminar Reports containing:
    - Table I .
    - Abstract of 3-4 topics with keywords.
- Every student must report to respectiveguide as per timetable, perform necessary work and submit as per plan, get necessary attestations on activities done in seminar diary on due dates and time as per Time Table.

Annexure-IV

SEMINAR DIARY

Name of the Student: ______________________________ Name of Guide (Faculty) : ______________________________
Enrollment Number: _____________________ Semester: ________________ Batch Number: _____________________

Date	Discussion Topics/Activity Details	Work Allotted Till Next Session/ Corrections Suggested/Faculty Remarks	Dated Signature of Faculty

Dated Signature of Faculty **Dated Signature of HOD**

Annexure-V

Rubrics

SeminarTerm work(50)										
				Presentation(20)						
Topic Selection(5)	Regularity in Seminar Work(5)	Overall understanding capability(5)	Knowledge (Q & A) (10)	Speech Clarity (5)	Body Language(3)	Neat Dressing(2)	Slides (10)	Report Writing(5)	Total Out of (50)	Marks mapped to (25)

Sign: Name: 1) Smt. U. S. Tulangekar 2) Smt. A. B. Bhusagare (Course Experts)	Sign: Name: Dr. S. S. Bharatkar/ Shri. R. U. Shelke (Program Head) (Electrical Engineering)
Sign: Name: Dr. S. S. Bharatkar/ Shri. R. U. Shelke (Program Head) (Electrical Engineering)	Sign: Name: Mr. A. S. Zanpure (CDC In-charge)

Government Polytechnic, Pune

'180OB' – Scheme

Programme	Diploma in ET/CE/**EE**//ME/MT/CM/IT/DDGM
Programme code	01/**02**/03/04/05/06/07/08/15/**16**/17/18/19/21/**22**/23/24/26
Name of Course	**Power Electronics and Applications**
Course Code	**EE4104**
Prerequisite course code and name	**ET 2108 - Electronics Components and Circuits**
Class Declaration	**Yes**

1. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P)		Examination Scheme				
					Theory		Practical		Total Marks
L	T	P	C		ESE	PA	$ ESE	PA	
03	00	02	05	Marks	80	20	25	25	150
				Exam Duration	03	01	-		

Legends: L- lecture, T-Tutorial/teacher guided theory practice, P-practical, C-Credits, ESE-End semester examination, PA- Progressive Assessments(Test I, II/Term Work), * - Practical Exam, $ - Oral Exam. # - Online Exam., Each lecture/practical period is of one clock hour.

2. RATIONALE

With rapid development in modern technology, power electronics devices and circuits are playing a major role in nearly all industries. By virtue of their operating characteristics; for which study of these devices is very essential for the electrical technician to control the electrical system in very efficiently. Hence they must be well conversant with the power electronics devices and their applications. This course aims to impart the knowledge and skills related to handling in terms of the applications and maintenance of these devices.

3. COMPETENCY

The aim of this course is to attend following industry identified competency through various teaching learning experiences:

- **Maintain the proper functioning of power electronic devices.**
- **Maintain power electronics circuits used in industries and domestics applications.**

4. COURSE OUTCOMES (COs)

The practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry oriented COs associated with the above mentioned competency**:**

1 - Interpret the use of power electronics devices as per its characteristics.
2- Explain Thyristor turn-on and turn-off control circuits.
3-Analyze the working of Converters (i.e. controlled rectifiers, cycloconverter and inverters)
4- Describe the operation of choppers.
5- Illustrate the applications of power Electronics.

5. SUGGESTED PRACTICALS/ EXERCISES

Pr. No .	**Unit No.**	**Practical Exercises (Outcomes in Psychomotor Domain)**	**Relevant CO**	**Approx. Hours Require d.**
1	1	Conduct an experiment to plot the V –I characteristics forward biased SCR for different gate currents.	1	2
2	1	Conduct an experiment to plot the V –I characteristics TRIAC in preferred turn on modes	1	2
3	2	Construct a firing circuit using UJT and pulse transformer and R & RC triggering circuits to trigger the SCR	2	4
4	3	Construct single phase half controlled bridge converter for resistive load. Trace the waveforms across SCR and load. Plot fringing angle vs. output voltage	3	2
5	3	Construct single phase full controlled bridge converter for resistive load, inductive load, R-L with freewheeling diode. Trace the waveforms across SCR and load. Plot fringing angle vs. output voltage	3	2
6	4	Construct cycloconverter circuit and	3	2

		observe the input and output waveforms and noted the output frequency at different firing angle		
7	5	Construct parallel inverter circuit and plot & analyze the output waveforms.	3	2
8	6	Construct step up chopper circuit. Trace the waveforms across SCRs, input and output. Observe the input and output voltages at different firing angles.	4	2
9	7	Construct and test a Triac - fan motor speed control circuit.	5	2
10	7	Construct and test a SCR battery charger circuit.	5	2
11	7	Construct ac & dc static switch using SCR and observe the wave forms.	5	2
12	7	To perform speed control of DC motor using controlled rectifier or chopper using SCRs	5	2
13	7	To perform speed control of single phase motor using VFD.	5	2
14	7	To perform speed control of three phase induction motor using PWM inverter using SCRs	5	2
15	2 to 7	By using open source SEQUAL software simulate the different power electronics circuits.	3, 4, 5	2
16	7	Microproject planning, Execution & Report Writing as suggested in microproject list	5	2
		Total Hrs		**34**

Sr.No.	Performance Indicators	Weightage in %
1	Arrangement of available equipment / test rig or model	05
2	Setting and operation	20
3	Safety measures	10
4	Observations and Recording	20
5	Interpretation of result and Conclusion	20
6	Answer to sample questions	10
7	Submission of report in time	15
Total		**100**

6. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

The major equipment with broad specification mentioned here will user in uniformity in conduct of practical, as well as aid to procure equipment by authorities concerned**.**

Sr. No.	Major Equipment/ Instruments Required	Pr. No.
1	DC Regulated power supply (0-300V, 0-10A)	1 to 14
2	DC Regulated Dual power supply (0-30V,0-2A)	1 to 14
3	Cathode Ray Oscilloscope- Dual trace, 25 MHz with isolation transformer , attenuator probe for CRO	1 to 14
4	Digital Multimeter- 31 /2 digit, 0-800 volts ,0-10A, micro-ammeters 0-100 µA	1 to 14
5	Experimental thyristoried kits related to VI characteristic, Turn-on methods of SCRs, half and full wave single phase converter for different types of load with freewheeling diode.	1 to 3
6	Experimental thyristoried kits related to step up choppers, parallel inverter, cycloconverter	6 to 8
7	Resistive load (lamp 40W – 100 W)	1 to 14
8	Experimental Triac kits to perform, speed control of fan and temperature control of water	9
9	Open source SEQUAL software	15

7. THEORY COMPONENTS

The following topics/subtopic should be taught and assessed in order to develop UOs for achieving the COs to attain the identified competency.

Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
UNIT 1. Power Electronics Devices	**(Marks 12, Hrs 07)**
1a. Explain with sketches the Construction and working of the given power electronics devices(s). 1b. Describe with sketches the construction and working of the given triggering device(s). 1c. Interpret the V-I characteristics of the given power electronics device(s) and triggering device(s). 1d. Select suitable power electronic device for given situation with justification	1.1 Introduction of Power Electronics, Power electronics concepts. Thyristors. 1.2 SCR: construction, working and V-I characteristics. 1.3 Two transistor analogy of SCR(PO1) 1.4 Thyristors family power devices: GTO, LASCR, TRIAC, symbol, construction, operating principle and V-I characteristics. 1.5 Thyristors family triggering devices: UJT, PUT, DIAC, SCS, SBS symbol, construction, operating principle and V-I characteristics. 1.6 IGBT: construction, working principle, V-I characteristics and applications. 1.7 MOSFET: construction, working principle, V-I characteristics and application. 1.8 Know the symbol, characteristics, property and applications of modern power electronics devices such as IGCT (Integrated gate commuatated thyristor) , MCT (MOS controlled thyristor, SITh (Static induction thyristor)
Unit 2 Turn-on and turn-off methods of thyristors.	**(Marks 08, Hrs 06)**
2a. Classify the type of turn-on and turn-off methods of SCR. 2b. Explain the sketches of circuits and working of the given type of turn-on and turn-off methods. 2c.Explain the role of pulse transformer in given triggering circuits.	2.1 SCR Turn-ON methods: -High forward voltage , thermal triggering, Illumination triggering, dv/dt triggering and Gate triggering. 2.2 Gate trigger circuits :- Resistance and Resistance – Capacitance trigger circuits 2.3 SCR triggering using UJT and PUT, Relaxation Oscillator and synchronized UJT triggering circuit. 2.4 Pulse transformer and opto-coupler based triggering. 2.5 SCR Turn-Off methods :- Class A –Series resonant commutation circuit, Class B- Shunt resonant commutation circuit, Class C- Complimentary symmetry commutation circuit, Class D- Auxiliary commutation, Class E- External pulse commutation, Class F- Line or Natural commutation.
UNIT 3 Controlled Rectifiers	**(Marks 12, Hrs 08)**

Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
3a. Explain with circuit diagram and operation of the phase control. 3b. Describe with circuit diagram the operation of the half wave/ full wave controlled rectifier with different loads. 3c. Interpret/draw the input-output waveforms of the controlled rectifier(s) 3d. Explain with circuit diagram operation of three phase controlled rectifier and draw the input and output waveform 3e. Write any four comparison between single phase and three phase controlled rectifiers.	3.1 Phase control, firing angle, conduction angle 3.2 Single phase half wave controlled rectifier with resistive load, RL load, RL load with freewheeling diode and general load. 3.3 Single phase full wave controlled rectifier using a center tapped transformer with resistive load, RL load, RL load with freewheeling diode and general load. 3.4 Single phase fully controlled bridge converter with resistive load, RL load, RL load with freewheeling diode and general load. 3.5 Single phase full wave half controlled bridge converter (1 Ph semi converter) 3.6 Three phase half wave and full wave controlled rectifier for R and RL loads. 3.7 Comparison of single phase and three phase converters
UNIT 4 Dual Converters and Cycloconverters	**(Marks 08, Hrs 05)**
4a. Explain with sketches the function and working of the given type of dual converter. 4b. Explain with sketches the working principle of the given type of cyclo-converter. 4c. Describe the sketches the procedure to troubleshoot the given dual converter and cyclo-converter.	4.1 Dual converters: Principle and types 4.2 Single phase dual converter, Non-circulating current mode of operation, Circulating current mode of operation. 4.3 Cyclo-converters: Principle and types 4.4 Single phase to single phase, three phase to single phase, three phase to three phase: operation with circuit and waveforms.
UNIT 5 Inverter Circuits	**(Marks 12, Hrs 7)**
5a. Classify based on the nature of source, configuration of the inverter, nature of output waveform, type of commutation circuit, and power semiconductor devices used. 5b. Interpret the input-output waveforms of the given type of inverter. 5c. Describe with sketches the	5.1 Introduction of inverters and classification of Inverters 5.2 SCR inverters: Single phase series inverter, single phase parallel inverter with R and R-L load, single phase half and full bridge inverter description with circuits and waveforms. 5.3 Three-phase bridge inverter description with circuits and waveforms of 120^o & 180^o mode with star and delta connected load.

Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
procedure to troubleshoot the given inverters.	
Unit 6 Chopper Circuits	**(Marks 12, Hrs 7)**
6a. Describe the basic principle of chopper operation with control strategies. 6b. Explain with circuit diagram of step- down and step up choppers with its output mathematical expression and waveforms. 6c. Classify choppers on the bases of different types of quadrant operation. 6d. Draw circuit diagram & waveform and explain the different types of choppers.	6.1Principle of chopper operation 6.2 Control strategies of chopper. 6.3 Step up chopper. 6.3 Single quadrant, two quadrant, four quadrant chopper circuit diagram, and operation with waveforms. 6.4 Thyristor chopper circuits, voltage-commutated chopper, current-commutated chopper, and load-commutated chopper
Unit 7 Application of power electronics	**(Marks 16, Hrs 8)**
7a. Describe need of electric drives and classify it. 7b. Draw and explain the circuits diagram of the given DC and AC electric drives. 7c. Explain with sketches the working of the given type of static circuit breaker. 7d Explain with sketches the working principle of given type of application of power electronics circuits.	7.1 Industrial application 7.1.1 Introduction of Electric Drive. Need of drives 7.1.2 DC drives. Components of a DC drive. DC drives types and it’s working principle. Analog and Digital drives. 7.1.3 AC drives. Classification of AC drives. Construction and principle operation of variable frequency drive (VFD) . 7.2 Domestic applications, Statics circuit breaker (DC and AC) , SCR battery charger controller, static VAR compensation, SMPS, UPS. 7.3 Power system application 7.3.1 HVDC transmission system. 7.3.2 Interconnection of renewable energy sources and energy storage systems to the utility

8. SUGGESTED SPECIFICATION TABLE FORQUESTION PAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Marks			
			R Level	U Level	A Level	Total Marks

Unit No.	Unit Title	Teaching Hours	Distribution of Marks			
			R Level	U Level	A Level	Total Marks
I	Power Electronics Devices	**07**	**4**	**4**	**4**	**12**
II	Turn-on and turn-off methods of thyristors.	**06**	**4**	**2**	**2**	**08**
III	Controlled Rectifiers	**08**	**2**	**4**	**6**	**12**
IV	Dual Converters and Cyclo-converters	**05**	**2**	**4**	**2**	**08**
V	Inverter Circuits	**07**	**4**	**2**	**6**	**12**
VI	Chopper Circuits	**07**	**2**	**4**	**6**	**12**
VII	Application of power electronics	**08**	**4**	**6**	**6**	**16**
Total		48	22	26	32	**80**

9. SUGGESTED STUDENT ACTIVITIES

Other than the classroom and laboratory learning, following are the suggested student-related ***co-curricular*** activities which can be undertaken to accelerate the attainment of the various outcomes in this course: Students should conduct following activities in group and prepare reports of about 5 pages for each activity, also collect/record physical evidences for their (student's) portfolio which will be useful for their placement interviews:

a. Prepare journals based on practical performed in laboratory.
b. Do simulation of power electronics circuits.

10. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are sample strategies, which the teacher can use to accelerate the attainment of the various outcomes in this course:

a. Massive open online courses (***MOOCs***) may be used to teach various topics/sub topics.
b. About ***15-20% of the topics/sub-topics*** which is relatively simpler or descriptive in nature is to be given to the students for ***self-directed learning*** and assess the development of the COs through practically implementation.
c. With respect to item No.8, teachers need to ensure to create opportunities and provisions for ***co-curricular activities***.
d. Guide student(s) in undertaking micro-projects.
e. Teacher should ask the students to go through instruction and Technical manuals

11. SUGGESTED MICRO-PROJECTS

Only one micro-project is planned to be undertaken by a student that needs to be assigned to him/her in the beginning of the semester. In the first four semesters, the micro-project are group-based. However, in the fifth and sixth semesters, it should be preferably be ***individually*** undertaken to build up the skill and confidence in every student to become problem solver so that s/he contributes to the projects of the industry. In special situations where groups have to be formed for micro-projects, the number of students in the group should ***not exceed three.***

The micro-project could be industry application based, internet-based, workshop-based, laboratory-based or field-based. Each micro-project should encompass two or more COs which are in fact, an integration of PrOs, UOs and ADOs. Each student will have to maintain dated work diary consisting of individual contribution in the project work and give a seminar presentation of it before submission. The total duration of the micro-project should not be less than ***16 (sixteen) student engagement hours*** during the course. The student ought to submit micro-project by the end of the semester to develop the industry oriented COs.

A suggestive list of micro-projects is given here. Similar micro-projects could be added by the concerned faculty:

Suggested micro-projects activity (any one to be submitted with 3 pages report):

1Study data sheet of various power semiconductor devices

2 Identify various power electronic components and method of testing

3 Construct a digital firing circuit for converters

4 Disassembling and assembling, identify the circuits in UPS

5 Determine the rating of UPS according to customer requirement

6 Construct and test a Triac - fan motor speed control circuit.

7 Construct and test a SCR battery charger circuit.

8 Construct ac & dc static switch using SCR and observe the wave forms.

9 Construct temperature controller using triac.

10 Construct speed control of DC motor by using SCR

12. SUGGESTED LEARNING RESOURCES

S.N.	Title	Author, Publisher, Edition and Year of publication	ISBN Number
1	Power Electronics	Dr. P. S. Bimbhra , Khanna Publishers, fifth Edition, 2017	978-81-7409-279-3
2	Power Electronics	M.D. Singh, K. B. Khanchandani , Tata McGraw Hill Education Private Limited, second Edition, 2017	978-0-07-058389-4 0-07-058389-7
3	Power semiconductor controlled drives	G.K. Dubey, Printice Hall, 1989	0-13-686890-8
4	Power and industrial Electronics	Harish C Rai	10: 8188114146 13: 9788188114146
5	Power Electronics: Circuits, Devices & Applications	M. H. Rashid, Prentice hall of India, 3rd Edition,2004	978-81-317-0246-8
6	Power Electronics, Applications & Design	Ned Mohan , John Wiley & Sons, 3rd Edition ,2002	978-0-471-22693-2
7	Modern Power Electronics & A. C. Drives	Pearson Education Inc, 2002	10 : 0130167436 978-0130167439;

13. SOFTWARE/LEARNING WEBSITE

1. https://www.electricaltechnology.org/2015/10/electrical-drives-ac-drives-vfd-dc-drives.html
2. https://www.electricaltechnology.org/2015/10/electrical-drives-ac-drives-vfd-dc-drives.html
3. www.nptel.ac.in/courses/108101038
4. www.ee.iitb.ac.in/-apel
5. www.tutorialpoint.com/power_electronics/
6. SEQUEL: software for power electronics
7. www.youtube.com

14. PO - COMPETENCY- CO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	2	3	-	3	1	2	3
CO2	2	2	2	3	-	-	-
CO3	3	3	2	3	1	2	2
CO4	3	3	2	3	1	2	2
CO5	1	3	2	3	1	2	3

CO1	2	1	-	1
CO2	1	-	-	-
CO3	2	-	-	-
CO4	2	-	-	-
CO5	2	2	-	1

Sign: Name: Dr. V. K. Jadhav	Sign: Name: Dr. S. S. Bharatkar/Shri.R. U. Shelke (Head of Department)
Sign: Name: Dr. S. S. Bharatkar/Shri.R. U. Shelke (Program Head) (Department of Electrical Engineering)	Sign: Name: Shri. A.S. Zanpure (CDC Incharge)

Government Polytechnic, Pune

'180 OB'– Scheme

Programme	Diploma in ET/CE/**EE**//ME/MT/CM/IT/DDGM
Programme code	01/**02**/03/04/05/06/07/08/15/**16**/17/18/19/21/**22**/23/24/26
Name of Course	**AC Machines**
Course Code	**EE4105**
Prerequisite course code and name	**EE3105 (DC Machines & Transformers)**
Class Declaration	**Yes**

1. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P)		Examination Scheme				
					Theory		Practical		Total Marks
L	T	P	C		ESE	PA	*ESE	PA	
3	1	2	6	Marks	80	20	25	25	150
				Exam Duration	3 Hr	1 Hr	-	--	

Legends: L- lecture, T-Tutorial/teacher guided theory practice, P-practical, C-Credits, ESE-End semester examination, PA- Progressive Assessments(Test I, II/Term Work), * - Practical Exam, $ - Oral Exam. # - Online Exam., Each lecture/practical period is of one clock hour.

2. RATIONALE

The most popular drives used in industries as well as in other professional applications are either three phase induction motors or a single-phase induction motors. Hence for a technician working in the field, study of these motors is essential pertaining to their types, construction, working principle, operation, characteristics, applications, starting devices used etc. Hence the course of A C Machines is of vital importance. As electrical energy is not available in natural form for transporting over a long distance, it is necessary to convert a naturally available energy into electrical energy. This is done at generating stations using machines that are known as Alternators. Being a machine of prime importance, it is necessary for an electrical engineer to study the ‘Alternator’. This course deals with construction, working principle, operation, characteristics, Application, Synchronizing Process & Parallel Operation of Alternators. The knowledge gained by the student is useful in the study of subjects such switchgear & protection, utilization of electrical power, testing and maintenance of electrical equipment and in their project work. The knowledge and skills gained will be helpful while performing duties of electrical supervisor, maintenance engineer, quality control engineer etc.

3. COMPETENCY

The aim of this course is to attain following industry identified competency through various teaching learning experiences:

"**Operate and Control various parameters of 3-phase Induction motor, 1-phase Induction motor& 3-phase alternator.**"

4. COURSE OUTCOMES (COs)

The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry oriented / profession demanding COs associated with the above mentioned competency**:**

1: Describe the construction of 3-phase alternator and three phase & single phase Induction motor.
2: Analyze the performance of 3-phase alternator and three phase & single phase Induction motor for finding derived parameters such as efficiency, power factor etc.
3: Operate the different types of starters and describe the various methods of speed control of three phase Induction motor.
4: Analyze the performance of three phase alternator by finding voltage regulation with different methods.
5: Synchronize an alternator with another alternator or supply bus bars & connections of alternators in parallel.
6: Select single phase Induction motor as per application & operate the motor accordingly.

5. SUGGESTED PRACTICALS/ EXERCISES

The practicals in this section are sub-components of the Cos, to be developed and assessed in the student for the attainment of the competency**:**

Pr. No.	Unit No	Practical Exercises (Learning Outcomes in Psychomotor Domain)	Relevant CO	Approx. Hrs. required
1	01	To identify the various parts of three phase I.M. Also write the function of each part a) Squirrel cage b) Slip ring.	1	02
2	01	To determine the slip of 3-phase I.M. by a) Tachometer b) Galvanometer Method c) Stroboscopic Method	2	02
3	02	To Perform load test on 3-phase I.M. by pulley-belt arrangement(brake test)	2	02
4	04	To Perform load test on 3-phase I.M. by coupled to DC shunt generator	2	02
5	03	Study of following starters: a) DOL starter b)Auto transformer starter c) Star –delta starter	3	04
6	03	Speed control of three phase I. M. by: a) Rheostatic control b) Pole changing	3	04
7	02	To perform O.C. & S.C. test on 3-phase IM to draw circle diagram	3	04
8	04	To determine voltage regulation of 3-phase alternator by direct loading at: a) Unity p.f. b) Leading p.f.	4	04

9	04	To determine voltage regulation of 3-phase alternator by performing O.C. test & S.C. test using: a) Synchronous impedance method b) mmf method	4	04
10	05	To synchronise an alternator with bus bar with lamp method	5	02
11	06	To perform no load test on 1-phase I.M.	6	02
Total				32

	Performance Indicators	**Weightage in %**
a	Arrangement of available equipment or model for testing	15
b	Setting and operation	20
c	Safety measures	20
d	Observations and Recording	15
e	Interpretation of result and Conclusion	15
f	Submission of report in time	15
Total		**100**

6. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

The major equipment with broad specification mentioned here will usher in uniformity in conduct of practical, as well as aid to procure equipment by authorities concerned**.**

Sr. No	**Equipment Name with Broad Specifications**	**PrO. No.**
1	Induction Motor 3-phase – dismantled unit	Pr.1
2	Induction Motor 3-phase – squirrel cage type& Slip ring type	Pr.2, Pr.3, Pr.4, Pr.6, Pr.7
3	Induction Motor 3-phase – Pole changing apparatus	Pr.6
4	Tachometer	Pr.2 to Pr.11
5	Wattmeters	Pr.3, Pr.4, Pr.7
6	A C Ammeters	Pr.2 to Pr.7
7	A C Voltmeters	Pr.2 to Pr.7
8	D C Ammeters	Pr.4 ,Pr. 8, Pr.9, Pr.10
9	10D C voltmeters	Pr.4, Pr.8, Pr.9, Pr.10
10	Galvanometer	Pr.2
11	Load bank -resistive, capacitive	Pr.4, Pr.8
12	Frequency meter	Pr.10
13	Synchroscope	Pr.10
14	Stroboscope	Pr.2
15	Induction Motor single-phase	Pr.11
16	Induction Motor three phase coupled to D C Generator	Pr.4
17	Alternator three phase (coupled with prime mover)	Pr.8, Pr.9, Pr.10
18	Synchronizing lamp apparatus	Pr.10
19	Three phase auto-transformer	Pr.3, Pr.7
20	Different Starters for Induction Motor – DOL, star/delta, rotor resistance etc.	Pr.4

7. THEORY COMPONENTS-

Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
SECTION – I	
UNIT-1 Three Phase Induction Motor	**HRS – 10 Marks –16**
1a. Explain constructional features of three phase I.M. and differentiate between squirrel cage and slip-ring induction motors. 1b. Explain how rotating magnetic field is produced and working principle three phase induction motor. 1c. Understand the Slip and its significance in the operation of three phase induction motor. 1d. Develop an expression for rotor induced emf and current. Know the rotor parameters at standstill and running condition. 1e. Derive torque equation of three phase induction motor & condition for maximum torque. 1f. Explain the torque- slip characteristics of induction motor 1g. Effect of change in supply voltage & rotor resistance on the characteristics. 1h. Describe various methods of slip measurement of three phase induction motor. 1j. Numerical	1.1 Induction motor: - Construction of I.M., types, Comparison between squirrel cage and wound rotor induction motors. 1.2 Production of rotating magnetic field in 3 phase windings when balanced 3 phase supply given to them. 1.3 Working principle of three phase I.M. 1.4 Define Slip, Frequency of Rotor Induced Emf, Rotor Current. 1.5 Equation of Rotor Induced Emf, Current, Rotor Resistance & Reactance, i.e., Impedance at Standstill & and under Running Condition. 1.6 Torque equation of three phase induction motor. 1.7 Starting and Running Torque of Induction motors. 1.8 Condition for Maximum Starting and Running torque. 1.9 Ratio of Full load torque to starting torque, full load torque to maximum torque, maximum torque to starting torque 1.10 Torque- slip characteristics of three phase induction motor. 1.11 Effect of change in supply voltage on torque-slip Characteristics. 1.12 Effect of change in rotor circuit resistance on torque-slip characteristics. 1.13 Measurement of slip by a) Actual speed measurement b) Stroboscopic method c) Galvanometer method. 1.14 Numerical on above topics.
UNIT-2 Performance of Three Phase Induction Motor	**HRS –8 Marks - 14**
2a. State the losses in I.M. and determine the efficiency. 2b. Explain the power flow diagram of three-phase induction motor. 2c. Explain the equivalent circuit of three phase induction motor. 2d. Draw circle diagram by	2.1 Various losses in induction motor and efficiency. 2.2 Power flow diagram of induction motor calculation of efficiency from power flow diagram. 2.3 induction motor as short-circuited transformer. 2.4 Phasor diagram of induction motor 2.5 Equivalent circuit of three phases induction motor (No numerical) 2.6 Graphical method to find performance of Three phase I.M. by performing open circuit test &

Unit Outcomes (UOs) (in cognitive domain)	**Topics and Sub-topics**
performing O.C&S.C test on 3-phase I.M.	short circuit test. Construct the circle diagram and plot following points: a) Full load b) Maximum output c) Maximum torque d) Maximum input 2.7 Numerical on circle diagram
UNIT-3 Induction motor control & Applications	**HRS – 6 Marks - 10**
3a. Explain various methods of speed control of 3 phase induction motor. 3b. Justify the need of starter for induction motor and describe various methods of starting. 3c. List the applications of various types of induction motors. 3d. Explain constructional features, characteristics of double squirrel cage induction motor & list out its applications.	3.1 Speed control of three phase induction motor By : a) Pole changing method b) frequency control method, c) stator voltage control, d) PWM technique, e) Rotor resistance control method 3.2 Necessity of starter. 3.3 Types of starters. a) DOL Starter. b) Star/delta starter, c) Auto transformer starter d) Rotor resistance starter e) Soft starters. 3.4 Applications of three phase Induction Motors. 3.5 Comparison of I.M. with DC shunt motor. 3.6 Construction, Characteristics and Applications of double squirrel cage Induction Motor.
SECTION – II	
UNIT-4 Three Phase Alternator	**HRS -10 Marks-16**
4a. Describe the function of different parts of an alternator with sketches. 4b. Explain the working principle of an alternator. 4c. Derive emf equation of an alternator 4d. Explain the factors affecting on terminal voltage of an alternator. 4e. Determine the voltage Regulation of an alternator by different methods	4.1 Construction of three phase Alternator, a) Armature windings b) Rotor- salient pole type & non salient pole type. 4.2 Advantages of stationary armature, construction. 4.3 Excitation of rotor field system. 4.4 Working principle of an alternator. 4.5 E.m.f. equation of Alternator 4.6 Effect of short pitch coil on induced emf and pitch factor. 4.7 Effect of distributed winding on induced emf and distribution factor. 4.8 Use of damper winding. 4.9 Factors affecting the terminal voltage of alternator a) Armature resistive drop b) Leakage reactance drop. c) Armature reaction at various power factors. d) Concept of Synchronous impedance. e) Phasor diagram of alternator on different loads. 4.10 Regulation of three phase Alternator by

Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
	a) Direct loading b) Synchronous impedance method c) mmf method.
UNIT-5 Three Phase Alternator- Parallel Operation HRS – 8 Marks-12	
5a. Understand the synchronization of an alternator. 5b. Parallel operation & load sharing of alternators and Numerical 5c. Understand the effect of change in excitation & change in input power (steam supply)	5.11 Synchronizing by 1) All dark method 2) One dark and two bright lamps 3) Synchroscope. 5.12 Synchronizing current, power and torque. 5.13 Parallel operation of alternators and advantages. 5.14 Load sharing in parallel alternators. 5.15 Numerical on load sharing of single phase & threephase alternators. 5.16 Effect of change in excitation, effect of Change in input power (steam supply)
UNIT- 6 Single Phase Induction Motor Hrs– 06 Marks-12	
6a. Explain the double field revolving theory & working principle of single phase I.M. 6b. Describe the constructional features of different types of single phase I.M. 6c. Torque- slip characteristics of single phase induction motors & their applications.	6.1 Double field revolving theory and working principle of single-Phase Induction motor. 6.2 Starting of single phase I.M. 6.3 Types of single-phase I. M.: - Split phasing principle and starting of a) Resistance start I. M. b) Capacitor start-run I.M. c) Double value capacitor run induction motor. d) Shaded pole motor. 6.3 Torque- slip characteristics of above single-phase induction motors. 6.4 Applications of above motors.

8. SUGGESTED SPECIFICATION TABLE FORQUESTION PAPER DESIGN-

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Mark
1	Three phase Induction Motor.	10	06	06	04	16
2	Performance of 3 Phase I.M.	08	02	04	08	14
3	Induction motor control & Applications	06	-	04	06	10
4	Three Phase Alternator	10	02	04	08	16
5	Three Phase Alternator-	08	02	04	08	12
6	Single Phase Induction Motors	06	04	06	02	12
Total		**48**	**16**	**28**	**36**	**80**

9. SUGGESTED STUDENT ACTIVITIES

Other than the classroom and laboratory learning, following are the suggested student-related ***co-curricular*** activities which can be undertaken to accelerate the attainment of the various outcomes in this course: Students should conduct following activities in group and prepare reports of about 5 pages for each activity, also collect/record physical evidences for their (student's) portfolio which will be useful for their placement interviews:
Visit to :

a) Rewinding shop of three phase induction motor
.**b)** Rewinding shop of single phase induction motor
c) Alternator manufacturing industry.
Prepare journal based on practical performed in Electrical laboratory. Journal consists of drawing, observations, required equipment's, date of performance with teacher signature.

10. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are sample strategies, which the teacher can use to accelerate the attainment of the various outcomes in this course:

These are sample strategies, which the teacher can use to accelerate the attainment of the various outcomes in this course:

a) Massive open online courses (MOOCs) may be used to teach various topics/sub topics.
b) About 15-20% of the topics/sub-topics which is relatively simpler or descriptive in nature is to be given to the students for self-directed learning and assess the development of the COs through classroom presentations (see implementation guideline for details).
c) With respect to item No.8, teachers need to ensure to create opportunities and provisions for co-curricular activities.
d) Guide student(s) in undertaking micro-projects.
e) Teacher should ask the students to go through instruction and Technical manuals

11. SUGGESTED MICRO-PROJECTS

Only one micro-project is planned to be undertaken by a student that needs to be assigned to him/her. In the first four semesters, the micro-projects are group-based. However, in the fifth and sixth semesters, it should be preferably be individually undertaken to build up the skill and confidence in every student to become problem solver so that s/he contributes to the projects of the industry. In special situations where groups have to be formed for micro-projects, the number of students in the group should not exceed three.
The micro-project could be industry application based, internet-based, workshop-based, laboratory-based or field-based. Each micro-project should encompass two or more COs which are in fact, an integration of PrOs , UOs and ADOs. Each student will have to maintain dated work diary consisting of individual contribution in the project work and give a seminar presentation of it before submission. The total duration of the micro-project should not be less than 16 (sixteen) student engagement

hours during the course. The student ought to submit micro-project by the end of the semester to develop the industry-oriented COs.
A suggestive list of micro-projects is given here. Similar micro-projects could be added by the concerned faculty(Any one by one batch):

a) Prepare document related to rewinding of 3-phase I.M.
b) Study of soft starters recently used in industries- case study.
c) Comparative study of all types of domestic appliances where 1-phase I.M. are used such as: i)ceiling fan, ii)Washing machine, iii)Mixer, iv)Domestic pump, v) Table fan, vi) Air conditioner

12. SUGGESTED LEARNING RESOURCES

Sr. No.	Title of Book	Author	Publication
1	Electrical Technology Vol.II	B.L.Theraja	S. Chand Publication, Delhi ISBN 978812192
2	Control of Electrical Machines	Dr. S. K. Bhattacharya	New Age International. ISBN 9788122409970
3	Performance and Design of Alternating Current Machines	M. G. Say	CBS Publications ISBN 9788123910277
4	Principles of Electrical Machines	V. K. Mehta	S. Chandand Co., New Delhi ISBN: 9788121921916
5	Electrical Machinery	P.S. Bimbhra	Khanna Publications ISBN : 9788174091734

13. SOFTWARE/LEARNING WEBSITES

http://electrical-updates.blogspot.com/2019/02/pdf-electrical-machinery-by-ps-bimbhra.html
https://www.academia.edu/8844577/Principles_of_Electrical_Machines_by_V.K.Mehta
https://www.academia.edu/8844577/Principles_of_Electrical_Machines by_V.K.Mehta
https://www.youtube.com/watch?v=b5tc0FrYk60
https://www.youtube.com/watch?v=AhxMrUo806Y
https://www.youtube.com/watch?v=h89TTwlNnpY

14. PO - COMPETENCY- CO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	1	1	2	1	1	3
CO2	3	3	2	2	2	1	3
CO3	2	2	2	2	2	1	3
CO4	3	2	2	2	2	1	2
CO5	2	2	2	2	1	1	3
CO6	2	2	1	2	1	1	3

	PSO1	PSO2	PSO3	PSO4
CO1	2	2	2	2
CO2	3	3	2	2
CO3	2	3	2	2
CO4	3	3	2	2
CO5	2	2	2	2
CO6	2	2	2	2

Sign: Name: 1. Mrs. M. A. Chigteri 2. Shri. S. B. Kale 3. Shri. S. S. Ashtaputre (Course Experts)	Sign: Name:Dr. S. S. Bharatkar/Shri. R. U. Shelke (Head of Department)
Sign: Name: Dr. S. S. Bharatkar/Shri. R. U. Shelke (Program Head) (Department of Electrical Engineering)	Sign: Name: Shri. A. S. Zanpure (CDC Incharge)

Government Polytechnic, Pune

'180 OB'– Scheme

Programme	Diploma in ET/CE/**EE**//ME/MT/CM/IT/DDGM
Programme code	01/**02**/03/04/05/06/07/08/15/**16**/17/18/19/21/**22**/23/24/26
Name of Course	**Installation Testing & Maintenance of Electrical Equipment**
Course Code	**EE4106**
Prerequisite course code and name	**EE4105 (AC Machines)**
Class Declaration	**Yes**

1. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P)		Examination Scheme				
					Theory		Practical		Total Marks
L	T	P	C		ESE	PA	* ESE	PA	
04	00	02	06	Marks	80	20	25	25	150
				Exam Duration	3 Hr	1 Hr	-	--	

Legends: L- lecture, T-Tutorial/teacher guided theory practice, P-practical, C-Credits, ESE-End semester examination, PA- Progressive Assessments(Test I, II/Term Work), * - Practical Exam, $ - Oral Exam. # - Online Exam., Each lecture/practical period is of one clock hour.

2. RATIONALE

In industry the technicians are required to install, commission, maintain and test different types of electrical equipment. It is also important to have safety knowledge to save human life, equipment and machinery from fire, accidents and electrical faults. This course includes the skills of fault finding and trouble shooting of electrical equipment / machinery.

The testing and maintenance of Insulating materials is very important in electrical engineering

3. COMPETENCY

The aim of this course is to attain following industry identified competency through various teaching learning experiences:

- **Install and commission the electrical equipment / machines.**
- **Test and maintain the electrical equipment / machines.**
- **Develop fault finding & trouble shooting skills.**
- **Follow electrical safety rule to avoid electrical accidents.**

4. COURSE OUTCOMES (COs)

The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry oriented COs associated with the above mentioned competency**:**

1- Verify the performance of the electrical equipment / machines by testing.
2- Maintain the electrical equipment / machines for efficient operation.
3- Confirm the quality of insulation by performing different processes.
4- Detect and remove the faults of the electrical equipment / machines.
5- Install and ensure the commissioning of the electrical equipment / machines
6- Avoid electrical accidents by implementing electrical safety IE rules.

5. SUGGESTED PRACTICALS/ EXERCISES

Pr. No.	**Unit No**	**Practical Exercises** (Learning Outcomes in Psychomotor Domain)	**Relevant CO**	**Approx. Hrs. required**
1	1	To perform the polarity & phasing out test on 3 phase transformer.	**1**	4
2	1	To perform test to determine the magnetizing current & core loss of single phase transformer	**1**	2
3	1	To perform test to determine the impedance & copper losses of single phase transformer	**1**	2
4	1	To determine regulation and efficiency of single-phase transformers by back-to-back connection.	**1**	4
5	1	To measure winding resistance and insulation resistance of transformer & a. c. rotating machines	**1 , 3**	4
6	3	To perform crackle test and sludge test on transformer oil.	**3**	4
7	1	To perform reduced voltage running up test on 3- phase induction motor.	**1**	2
8	1	To perform open circuit test on single- phase induction motor.	**1**	2
9	4	To prepare trouble shooting charts for single phase and three phase Induction motor.	**4**	2
10	4,5	To use different maintenance tools such as bearing puller, growler, dial test indicators, feeler gauge, spirit level etc.	**2 , 5**	4
11	7	To demonstrate the operation of fire extinguisher or film show for the fire fighting.	**6**	2
12		Microproject planning & Execution as written in suggested microproject list		2
13		Microproject report writing		2
14		Suggested student activity report		2
		Total Hrs		**38**

S.No.	Performance Indicators	Weightage in %
a.	Arrangement of available equipment or model for testing	20
b.	Setting and operation	15
c.	Safety measures	20
d.	Observations and Recording	15
e.	Interpretation of result and Conclusion	15
f.	Submission of report in time	15
Total		**100**

Sr. No	Equipment Name with Broad Specifications	Pr. No.
1	a) 1-phase transformer : 230V/110V, 50Hz , 1kVA b) 3-phase transformer (6 terminals out of H.V &L.V.) : 440V/230V, 50Hz,3kVA	**1,2, 3,4, 5,**
c)	Beaker (or any glass container)with Transformer oil, soldering iron.	**3 & 6**
d)	3-phase squirrel cage Induction Motor : 3 H.P. , 230V,8.7Amp, 3-phaseAuto Transformer.	**7**
e)	All tools such as :a) Bearing puller, b)Filler gauges, c) Dial test indicator, d) Spirit level, e)Megger, f) earth tester, g) Growler.	**8**
f)	Fire extinguisher demonstration,	**10**

6. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

The major equipment with broad specification mentioned here will usher in uniformity in conduct of practicals, as well as aid to procure equipment by authorities concerned**.**

7. THEORY COMPONENTS -

Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
SECTION - I	
UNIT 1. Testing of Electrical Machines	**HRS -20 MARKS-20**
1a. State the objectives of testing. 1b. Explain the significance of Indian Standards and role of BIS in testing of electrical equipment's 1c. Know the types and methods of testing 1d.Know the Concepts of tolerances in testing of equipment as per IS 1e. To list and perform tests on	1.1 Objectives of testing 1.2 Significance of Indian Standards 1.3 Roles of Bureau of Indian Standards (BIS) in testing of electrical equipment. 1.4 Types of tests: Routine test ,Type test , Supplementary test & Special tests. 1.5 Methods of testing a) Direct b)Indirect c) Regenerative 1.6 Define : Tolerance, Tolerances for rotating machines and transformers for: a) Voltage b) Current c) Frequency d) Noise as per Indian Standards. 1.7 Testing of transformer as per IS 2026 (Part-I)-2011

Unit Outcomes (UOs) (in cognitive domain)	**Topics and Sub-topics**
transformer as per Indian Standards	**A. Routine tests:** a) Measurement of winding resistance b) Voltage ratio test c) Polarity test d) Phasing out test (only for 3-phase transformer) e) Measurement of no load loss& current f) Measurement of impedance voltage, s.c impedance & load losses g) Measurement of Insulation resistance h) Dielectric test/High voltage test **B. Type tests** : All above (a to h and also) i) Temperature rise test j) Impulse voltage withstand test **C. Special tests**: a) Dielectric test b) Measurement of zero sequence (3 phase transformer) c)Measurement of harmonics of no load current d)Measurement of acoustic noise level **D. Supplementary tests**: a) back to back test b) Load test or efficiency test
1f. List the tests to be carried out before installation of electrical equipment.	1.8 Tests before commissioning of transformer. 1.9 Testing of three-phase Induction motor as per IS 4029 : – 2010 and IS 325 – 1996 **A. Routine tests**: a) Measurement of DC resistance b) Measurement of Insulation resistance c) Dielectric test / H.V. test d) Reduced voltage running up test e)Open circuit voltage ratio test (only for slip ring I.M.) f) No load test or O.C. test g)Blocked rotor test or S.C. test h) Measurement of slip **B. Type tests**: All above (a to h and also) i) Temperature rise test j) Momentary overload test **C. Special tests**: Load test on 3-phase I.M. by i) Using calibrated generator ii) Brake test (using spring pulley arrangement)
1g. To perform tests on single-phase Induction motor as per Indian Standards	1.10 Testing of single-phase induction motor as per IS 7572-2009. **A. Routine tests**: a) Measurement of DC resistance b) Measurement of Insulation resistance c) High voltage test d) Quiet running test e) No load test

Unit Outcomes (UOs) (in cognitive domain)	**Topics and Sub-topics**
	f) Blocked rotor test **B. Type tests :** a) Load test b) Temperature rise test c) Momentary overload test d) Moisture proofness test e) Pullout torque test f) Leakage current test 1.11 Mechanical & Electrical tests before installation of electrical equipment. 1.12 Numerical on : Testing of **1).** Transformer : a) O.C. test and S.C. test b) Back to back test c) Winding resistance **2.)** 3-phase I. M. : a) Measurement of winding resistance b) Brake test c) Load test with calibrated generator.
UNIT 2. Maintenance of Electrical Machines	**HRS -06 MARKS-10**
2a. Explain the need of maintenance, importance of routine and preventive maintenance. 2b. Know safety while doing maintenance. 2c. maintenance schedules for electrical equipment as per IS	2.1 Maintenance, Need of maintenance. 2.2 Types of maintenance:-Routine, Preventive & Breakdown maintenance. 2.3 Causes of failure of electrical machines. 2.4 Preventive maintenance:- Meaning, Importance and advantages of preventive maintenance. 2.5 Procedure for developing preventive maintenance schedules for electrical machines. 2.6 Factors affecting preventive maintenance schedules. 2.7 Breakdown maintenance and its record keeping. 2.8 Safety rules applicable for preventive maintenance and breakdown maintenance 2.9 Maintenance schedules of the following as per I.S. 1. Distribution transformer and Power transformer as per IS 10028 (Part-III)-1981 2. Single phase & Three phase Induction motors as per IS 900-1992 . 3. 3-phase Synchronous generator or 3-phase alternator
UNIT 3. Testing and Maintenance of Insulation	**HRS -06 MARKS-10**
3a. Know the importance & qualities of insulating materials in electrical equipment.	3.1 Insulation & importance of insulation in electrical equipment& machines. 3.2 Qualities of insulating materials used in electrical

Unit Outcomes (UOs) (in cognitive domain)	**Topics and Sub-topics**
3b. Classify insulating materials 3c. Know the factors affecting life of insulating materials.	equipment& machines. 3.3 Classification of insulating materials as per I.S.8504 (part III) 1994. 3.4 Factors affecting life of insulating materials 3.5 Measurement of insulation resistance by different methods : i) Polarization, ii) Dielectric absorption, iii) Megger
3d. Measure I. R. by different methods & interpret the condition of insulation. 3e. Explain the methods of reconditioning of insulation 3f. What are the agents contaminating of insulating oil. 3g. Know the testing of insulating oil as per IS	3.6 Interpretation of condition of insulation 3.7 Meaning of infinity and zero reading 3.8 Reconditioning of insulation 1.Cleaning of the insulation. 2.Drying of electrical insulation. 3. Re-varnishing & it's different methods. 4. Construction & working of vacuum impregnation plant 3.9 Properties of good insulating oil (transformer oil) 3.10 Agents which contaminates the insulating oil. 3.11 Testing of as per IS 1866-2000 a) Acidity test b) Sludge test c) Crackle test d) Flash point test. e) Dielectric strength test. 3.12 Methods of purification and filtration of insulating oil a) Centrifugal purifier b) Stream line filter or vacuum type
SECTION - II	
UNIT 4. Fault Finding and Trouble Shooting	**HRS -12 MARKS-14**
4a. State conditions of normal working of electrical equipment & permissible limits electrical parameters for safe working of electrical machines.	4.1 Normal working of electrical equipment. 4.2 Permissible limits for safe working of electrical machines w.r.t following parameters: a) voltage b) frequency c) current d) speed. 4.3 Effect of variations of above parameters on performance of a) 3-phase transformer b) 3-phase I.M. c) DC motor
4b.Know the causes of faults, different types of faults and Locate faults in electrical machines.	4.4 Causes of faults and types of faults 4.5.Mechanical faults, Electrical faults & Magnetic faults in the electrical equipment
4c. Define and state the significance trouble shooting. 4d. Use various tools for fault finding in electrical machines	4.6. Trouble shooting & its significance 4.8 Tools and equipment used in trouble shooting and repairs:- a) Bearing puller, b)Filler gauges, c)Dial test indicator, d) Spirit level, e)Megger, f)Earth tester, g) Growler.
4e. Prepare trouble shooting charts for rotating machines and transformers	4.9 Common troubles in electrical equipment 4.10 Trouble shooting charts for following electrical equipment and machines. 1) D.C. Motor 2) 1 phase&3 phase I.M. 3) 1 phase& 3 phase Transformer 4) Underground cables.

Unit Outcomes (UOs) (in cognitive domain)	**Topics and Sub-topics**
UNIT 5. Installation of Electrical equipment	**HRS -12 MARKS-14**
5a. To know the Installation of static and rotating electrical machines . 5b. Use the devices and tools for handling of electrical equipment 5c. Know the foundation for different electrical machines and effects of factors to be taken in to consideration while doing foundation. 5d. Know the requirements for installation of transformer and rotating electrical machines as per IS. 5e. Know the importance of safety precaution while installation.	5.1 Standard procedure for installation of various electrical machines 5.2 Inspection of equipment/machine on arrival at site and before installation. 5.3 Preparation of technical report for above situation. 5.4 Tools / equipment required for installation a) loading b)unloading c)lifting and d)carrying heavy electrical equipment/ machines. 5.5 Precautions to be taken while handling equipment/ machines. 5.6 Requirements of dimensions of foundation for static & rotating machines. 5.7 Factors to be taken in to account in designing machine foundations. 5.8 Procedure of leveling & aligning. 5.9 Alignment of direct coupled drive and belt & gear drives 5.10 Installation of transformer (as per IS) for : a) indoor substation b) pole mounted substation. 5.11 Installation of rotating electrical machines as per IS . 5.12 Installation of overhead transmission lines and underground cables. 5.13 Safety precautions & their importance while working on electrical installations.
UNIT 6. Prevention Accidents and Safety Precautions	**HRS -08 MARKS-12**
6a. Know acts & rules regarding safety of persons & equipment 6b. Know the types and causes of electrical accidents 6c. Follow electrical safety measures while working on electrical installations. 6d. Rescue electrocuted person and follow artificial respiration methods	6.1 I.E Act & statutory regulations for safety of persons &equipment followed while working on electrical installation. 6.2 General safety practices in electrical work. 6.3 Types and causes of electrical accidents 6.4 Preventive measures against electrical accident. 6.5 General and specific safety rules to avoid electrical accident as per I.E. Act. 6.6 Safety signs and symbols used in industry. 6.7 Do's & don’ts regarding safety while working on electrical installations 6.8 Electrical shocks and factors affecting its severity. 6.9 Method of rescuing electrocuted person & different methods of artificial respiration. 6.10 Importance of "permit to work" in power station and electrical installation. **a.** Concept of Permit system, **b.** It’s preparation & regulation for attending to electrical work Safety tools and devices with their applications

Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
6e. To know causes of fire, chemistry of fire & use of fire extinguisher.	like Slogan, Notice on Board, Fire extinguisher. Causes of fire and Precautions to be taken to avoid fire due to electrical reasons. 6.11 List out different types of fire extinguishers and explain the working of each type.

8. SUGGESTED SPECIFICATION TABLE FORQUESTION PAPER DESIGN-

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Testing of Electrical Machines	20	04	08	08	20
II	Maintenance of Electrical Machines	06	02	04	04	10
III	Testing and Maintenance of Insulation	06	02	04	04	10
IV	Fault Finding and Trouble Shooting	12	02	04	08	14
V	Installation of Electrical equipment	12	04	04	06	14
VI	Prevention Accidents and Safety	08	04	08	--	12
Total		**64**	**18**	**32**	**30**	**80**

9. SUGGESTED STUDENT ACTIVITIES

Other than the classroom and laboratory learning, following are the suggested student-related ***co-curricular*** activities which can be undertaken to accelerate the attainment of the various outcomes in this course: Students should conduct following activities in group and prepare reports of about 5 pages for each activity, also collect/record physical evidences for their (student's) portfolio which will be useful for their placement interviews:

Prepare journal based on practical performed in Electrical laboratory. Journal consists of drawing, observations, required equipment's, date of performance with teacher signature.

10. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are sample strategies, which the teacher can use to accelerate the attainment of the various outcomes in this course:

These are sample strategies, which the teacher can use to accelerate the attainment of the various outcomes in this course:

a. Massive open online courses (***MOOCs***) may be used to teach various topics/sub topics.
b. About ***15-20% of the topics/sub-topics*** which is relatively simpler or descriptive in nature is to be given to the students for ***self-directed learning*** and assess the development of the COs through classroom presentations (see implementation guideline for details).
c. With respect to item No.8, teachers need to ensure to create opportunities and provisions for ***co-curricular activities***.

d. Guide student(s) in undertaking micro-projects.
e. Correlate subtopics with power plant system and equipment.
f. Use proper equivalent analogy to explain different concepts.
g. Use Flash/Animations to explain various components, operation and
h. Teacher should ask the students to go through instruction and Technical manuals

11. SUGGESTED MICRO-PROJECTS :

Only one micro-project is planned to be undertaken by a student that needs to be assigned to him/her. In the first four semesters, the micro-projects are group-based. However, in the fifth and sixth semesters, it should be preferably be individually undertaken to build up the skill and confidence in every student to become problem solver so that s/he contributes to the projects of the industry. In special situations where groups have to be formed for micro-projects, the number of students in the group should not exceed three.

The micro-project could be industry application based, internet-based, workshop-based, laboratory-based or field-based. Each micro-project should encompass two or more COs which are in fact, an integration of PrOs, UOs and ADOs. Each student will have to maintain dated work diary consisting of individual contribution in the project work and give a seminar presentation of it before submission. The total duration of the micro-project should not be less than 16 (sixteen) student engagement hours during the course. The student ought to submit micro-project by the end of the semester to develop the industry oriented COs.

A suggestive list of micro-projects is given here. Similar micro-projects could be added by the concerned faculty(Any one by one batch):

a. Testing of any one electrical machine as per Indian Standards in concerned manufacturing industry.
b. Collect Preventive Maintenance Schedule for any two machines as per Indian Standards performed in industry. Prepare report in detail.
c. State various faults occurred on electrical machines during its operation and remedy for the same. Case study from industry.
d. Make actual installation of electrical machine in industry. Prepare a detail report on it.
e. i) Collect latest information on electrical safety from internet. State latest I.E. rules for safety.
ii) Demonstration of fire extinguisher with the help of corporation and write a detail report on it.
f. Prepare at least three case studies on electrical accidents in :
i) Industry ii) Substation iii) Commercial complex. Prepare a report on it.

12. SUGGESTED LEARNING RESOURCES

Sr.No.	Title of Book	Author	Publication
1	Electrical Technology Vol.II	B. L. Theraja	S. Chand Publication, Delhi ISBN 978812192
2	Electrical Machines	S. K. Bhattacharya	McGraw Hill Education, New Delhi. ISBN 9780074600320 ,
3	Performance of A.C Machines	M. G. Say	CBS Publications ISBN 9788123910277
4	IS Codes for Transformers	IS2026(part-I 2011,part II2010) IS10028(part—III)--1981	
5	IS Codes for induction motor	IS325—1996 IS4029—2010IS900--1992	

13. SOFTWARE/LEARNING WEBSITES

www.nptel.ac.in
www.wikipedia.com
www.electricaltechnology.org
https://www.electrical4u.com

14. PO - COMPETENCY- CO MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	2	1	3	2	1	3
CO2	2	3	3	2	2	2	3
CO3	2	2	2	2	1	1	2
CO4	3	3	2	2	2	1	3
CO5	2	3	2	2	2	1	2
CO6	2	3	2	2	2	1	3

CO	PSO1	PSO2	PSO3	PSO4
CO1	3	2	1	2
CO2	3	2	1	2
CO3	2	2	1	2
CO4	3	3	2	2
CO5	3	2	2	2
CO6	1	1	1	3

Sign: Name: 1. Shri. S. B. Kale 2. Smt. S. P. Phadnaik 3. Shri R.B. Chouthmal (Course Experts)	Sign: Name:Dr. S. S. Bharatkar/Shri.R. U. Shelke (Head of Department)
Sign: Name: Dr.S. S. Bharatkar/Shri.R. U. Shelke (Program Head) (Department of Electrical Engineering)	Sign: Name: Shri. A. S. Zanpure (CDC Incharge)

Government Polytechnic, Pune

'180 OB' – Scheme

Programme	Diploma in ET/CE/**EE**//ME/MT/CM/IT/DDGM
Programme code	01/**02**/03/04/05/06/07/08/15/**16**/17/18/19/21/**22**/23/24/26
Name of Course	**Switchgear and Protection**
Course Code	**EE4107**
Prerequisite course code and name	No
Class Declaration	**Yes**

1. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P)		Examination Scheme				
					Theory		Practical		Total Marks
L	T	P	C		ESE	PA	$ ESE	PA	
04	00	02	06	Marks	80	20	25	25	150
				Exam Duration	3 Hrs	1 Hr	-	--	

Legends: L- lecture, T-Tutorial/teacher guided theory practice, P-practical, C-Credits, ESE-End semester examination, PA- Progressive Assessments(Test I, II/Term Work), * - Practical Exam, $ - Oral Exam. # - Online Exam., Each lecture/practical period is of one clock hour.

2. COURSE RATIONALE:

Presentlyelectricalpowersystemisgrowingfastduetoincreasingindustries,needs,population.Adiplomapassoutmayhavetoworkinthefieldofgeneration,transmissiondistributionmaintenance,testing.Sothestudentmustknowabouttheswitchgear&protection.Itisexpectedthattheknowledgeoffacts,concepts, principles and procedural aspects of switchgear and protection system must be known to the students it will ultimately help the students in discharging their duties such as technicians, engineer in power house, substation, testing service sectors.

3. COMPETENCY

The aim of this course is to attend following industry identified competency through various teaching learning experiences:

- **Maintain switchgear and protection schemes used in electrical power system.**

4. COURSE OUTCOMES (COs)

The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry oriented COs associated with the above mentioned competency**:**

1: Identify various types of faults in electrical power system.
2: Suggest suitable protection scheme for existing fault.
3: Test the performance of different protective relays.
4: Maintain the protection scheme for alternators, transformers and motors and transmission lines.
5: Understand working and maintenance of the lightening arrestors for HV protection.

5. SUGGESTED PRACTICALS/ EXERCISES

Pr. No	**Unit No.**	**Practical Exercises** (Learning Outcomes in Psychomotor Domain)	**Relevent CO**	**Approx. Hrs. required**
1	2	To plot operating current-time characteristics of fuse	1,2	02
2	2	Visit to L&T Switchgear Training Centre and write visit report comprising function, working operation, testing & maintenance of MCB, ELCB, MCCB and Contactor.	1,2	04
3	2	Drawing sheet on circuit breakers–MCB,ELCB, SF6CircuitBreakerandVacuumCircuitBreaker.	2	04
4	2	Settingofthermaloverloadrelayandplotthecharacteristic softhermaloverloadrelay.	3	02
5	3	Drawing sheet on Relays:–Electromagnetic Relays (Any Two), Induction disc type Relay, Thermal Relay, Buchholz Relay.	2	04
6	4	Demonstration &Testing of static a) over current /under current relay. b)Under voltage & over voltage relay. c) Phase failure relay	4	02
7	4	Drawing sheet on Protection Schemes of Alternator in AutoCAD:- Biased differential Protection, Restricted earth fault, Unbalanced load.	4	02
8	5	DrawingsheetonProtectionSchemesofTransformerinAu toCAD:-BiaseddifferentialProtection,Earth fault protection.	2	04
9	5	Connect MCB, DOL starter & single phase preventer in I.M. circuit and check operation for short-circuit, overload & single phasing faults.	2	02
10	5	Visittohighvoltagesubstation&drawsinglelinediagramo fsubstation.Statefunction&technicalspecificationofequi pmentsused therein.	5	02
11	5	Drawing Sheet on Lightening Arresters–Rod Gap, Horn Gap, Expulsion Type, Thyrite Type, metal oxide type.	5	04
Total				32

6. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

S.No.	Performance Indicators	Weightage in %
a.	Arrangement of available equipment or model for testing	20
b.	Setting and operation	15
c.	Safety measures	20
d.	Observations and Recording	15
e.	Interpretation of result and Conclusion	15
f.	Submission of report in time	15
Total		**100**

The major equipment with broad specification mentioned here will usher in uniformity in conduct of practicals, as well as aid to procure equipment by authorities concerned**.**

Sr. No	Equipment Name with Broad Specifications	Pr. No.
1	HRC fuse, Static relay, DOL starter	**1 , 6, 9**
2	Visits To Substations, Switchgear Industry	**2, 3, 4, 5, 7, 8, 10**

7. THEORY COMPONENTS

SECTION-1	
Unit Outcomes (UOs) (in cognitive domain)	**Topics and Sub-topics**
UNIT-1 Fundamentals of Protection	**HRS -05 Marks-06**
1a Aware of the need and function of protection system. 1b.Differentiate between the normal & abnormal conditions of power system. 1c. List the types of fault &state their causes 1d. Determine short circuit current , short circuit KVA 1e. What is the use of current limiting reactors and draw their arrangements?	1.1 Necessity and functions of protective system. 1.2 Primary and backup protection. 1.3 Normal & abnormal conditions, 1.4 Type of faults and their causes. 1.5 Short circuit calculations (Numerical on faults only). 1.6 Use of current limiting reactors & their arrangements
UNIT-2 Circuit Interrupting Devices	**HRS -15 Marks-18**
2a. What is fuse? state its different types and describe construction and working of HRC fuse. 2b.Enlist the Characteristics of HRC fuse and its applications. 2c.Explain the necessity of isolators and write its function. 2d.State the types of Isolators and describe their working 2e.Describe the process of an Arc formation. 2f.Understand the various methods of arc extinction and define terms related with it. 2g.Understand the construction, working principle and applications of different types of circuit breakers. To know the sequence of operation & interlocking of CBs, isolators & earthing switch. 2h. Select switchgears as per application& understand the ratings of CBs. 2i. To Compare fuse &MCCB 2j.To know about HVDC circuit breakers	2.1Fuse: basic terminology w.r.t. fuse, types, Construction and working of HRC fuse. 2.2 Characteristics, selection and applications of HRC fuse. 2.3 Necessity and functions of Isolators. 2.4 Types of Isolators:-Vertical break, horizontal break, and pantograph type. 2.5 Arc formation process. 2.6 Methods of arc extinction – High resistance method and current zero method. Definition: Arc voltage, Recovery voltage, Restriking voltage, RRRV. 2.7 Circuit breakers: - Concept, Classification, Working principle. Construction, working of principle, Specification & Applications of following circuit breakers. L.T.- Air circuit breakers (ACB), Miniature circuit breakers, Moulded case circuit breaker, Earth leakage circuit breaker .b) H.T – Sulpher Hexa Fluoride (SF6) circuit breaker and Vacuum circuit breaker. 2.8 Selection of switchgears for particular applications. Ratings of Circuit Breaker. 2.9 Comparison of fuse & MCCB 2.10 HVDC CBS: Introduction, problems with arc interruption, HVDC circuit breaker.
UNIT-3- Protective Relays	**HRS -12 Marks-16**
.State the need and function of protective relays system 3b.List the essential qualities of protective relaying& their importance. To know the relay terminology. 3c.Classify various types relays 3d.Understand the working principle,	3.1 Necessity, function& single line diagram of protective relay system. 3.2 Quality requirements of relay system: selectivity, speed, sensitivity, reliability, and simplicity, economy: meaning of the term and its signi in protective relaying.Basic Relay Terminology: - Protective relay, relay time, reset time, pick

Characteristics, and application of different types of relays. 3e.Understand the operation of over current relay. Understand the PSM & TSM and its effects on characteristics.	up value, reset value, Auxiliary relay. 3.3 Classification of relays based on terminology used, principle of operation, times of operation, functions, protective schemes, characteristics. 3.4 Characteristics, working principle & applications of following relays: Electromechanical relay(Hinged armature type only),induction disc relay, thermal relay, Static Relays: Introduction, advantages & disadvantages of static relays. Numerical Relays: Introduction, general block diagram, classifications of numerical relays. Advantages& disadvantages of numerical relays. Comparison among the above relays. 3.5 Over current relay: -Time current characteristics & its classifications. Current setting, plug setting multiplier (PSM) ,Time setting multiplier (TMS)Numerical on PSM &TMS. Static over current relay with all types. Numerical over current relay (μC based) with block diagram, flow chart.
SECTION-2	
UNIT-4 Protection of Alternator	**HRS -06 Marks-08**
4a. To know various faults and Abnormalities of alternator. 4b. Uunderstand the protection schemes of alternator against different types of faults. 4c. To know the concept of reverse power protection	4.1 Abnormalities and faults in alternators. 4.2 Differential protection, biased differential Protection, Protection against prime mover failure, field failure and unbalanced load, restricted earth fault protection, overcurrent, inter turn fault, over heating protection, over voltage& motoring action. 4.3 Concept of power protection when it happens. • Directional relay: electromagnetic & numerical (μC based with block diagram & flow chart only) types .
UNIT-05 Protection of Transformer	**HRS -06 Marks-08**
5a.Identify various faults & abnormalities of transformer 5b.Understand the various protection schemes of transformer 5c.Understand the Importance of Buchholz Relay	5.1 Abnormalities& faults in transformers, 5.2 Differential and Biased differential protection. Limitations of differential protection of transformer. Simple numerical on differential protection. Over current, Earth fault, inter turn, over heating protection. 5.3 Buchholz relay: construction, working principle & its installation location.
UNIT-06 Protection of Induction Motor	**HRS -03 Marks-04**
6a. Identify various faults &	6.1 Abnormalities and faults in induction motors.,

abnormalities of I.M. 6b. Identify various protection provided for motors. Observe the behaviour of protective devices provided for motor.	6.2 Protections against following faults in motor. Short circuit & earth fault. Over load protection. Single phasing.
UNIT-07 Protection of Busbar &Transmission Line HRS -07 Marks-08	
7a. Identify the faults & abnormalities of Transmission lines 7b. Understand the working principle of distance & pilot wire protections. 7c. Understand the Distributionline Protection scheme& auto reclosing. 7d.Understand the Protection scheme for Bus Bar.	7.1 Abnormalities& Faults on transmission lines. 7.2 Distance Relay: working principle, electromagnetic type, static and numerical (μC based with block diagram & flow chart only) types. Pilot wire protection of transmission lines: a) working principle of current circulating & balanced voltage b) carrier current protection. 7.3 Distribution line: Over current protective scheme for feeders. Auto-reclosing. 7.4 Bus Bar Protection: Faults & Operation of Differential Protection
UNIT-08 Over Voltage Protection and Neutral Earthing HRS -10 Marks-12	
8a. State the causes of over voltage 8b.To know the protection from direct stroke and travelling wave of power system equipment's. 8c.List types of lightning arrester 8d.State the need and function of surge absorbers 8e.Understand the insulation co-ordination& BIL. 8f.Understand the importance of Neutral earthing & its types, 8g.Distinguish between equipment earthling and neutral earthing	**8.1** To lightening its wave shape. Protection of transmission line and substation from direct stroke. Protection against traveling wave. 8.2 Types of lighting arresters 1) Rod Gap 2) Horn Gap 3) Expulsion Type 4) Thyrite Type 5) Metal oxide surge arrester. 8.3 Principle & operation of surge absorbers Insulation co-ordination and BIL 8.4 Introduction & importance Neutral earthing. Types of neutral earthing-resistance, reactance, Peterson coil etc Substation earthing. 8.5 Difference between Equipment earthing and Neutral earthing.

8 SUGGESTED SPECIFICATION TABLE FORQUESTION PAPER DESIGN-

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
1	Fundamentals of Protection	5	02	00	04	06
2	Circuit Interrupting Devices	15	04	12	02	18
3	Protective Relays	12	04	08	04	16
4	Protection of Alternator	6	02	04	02	08
5	Protection of Transformer	6	02	04	02	08
6	Protection of Induction Motor	3	02	00	02	04
7	Protection of Bus-Bar and Transmission line	7	02	04	02	08
8	Over Voltage Protection and Neutral Earthing	10	02	04	06	12
Total		**64**	**18**	**32**	**30**	**80**

9 SUGGESTED STUDENT ACTIVITIES

Other than the classroom and laboratory learning, following are the suggested student-related ***co-curricular*** activities which can be undertaken to accelerate the attainment of the various outcomes in this course: Students should conduct following activities in group and prepare reports of about 5 pages for each activity, also collect/record physical evidences for their (student's) portfolio which will be useful for their placement interviews:
Prepare journal based on practical performed in Electrical laboratory. Journal consists of drawing, observations, required equipment's, date of performance with teacher signature.

a) Collect specifications of different switchgear equipment used in electrical power system through market survey/visit and write a technical report.
b) Visit 400/220/132/66/33 kV substation and take the help of sub-station in-charge to understand various switchgears, protective schemes and occurrences of faults.
c) Collect data of different protective schemes used for alternator, transformer, bus bar and transmission lines through internet/ industrial visit.
d) Write all the safety precautions which are to be taken while working with different switchgears and protective schemes.

10 SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are sample strategies, which the teacher can use to accelerate the attainment of the various outcomes in this course:

a. Massive open online courses (***MOOCs***) may be used to teach various topics/sub topics.
b. About ***15-20% of the topics/sub-topics*** which is relatively simpler or descriptive in nature is to be given to the students for ***self-directed learning*** and assess the development of the COs through classroom presentations (see implementation guideline for details).
c. With respect to item No.8, teachers need to ensure to create opportunities and provisions for ***co-curricular activities***.
d. Guide student(s) in undertaking micro-projects.
e. Correlate subtopics with power plant system and equipment's.
f. Use proper equivalent analogy to explain different concepts.
g. Use Flash/Animations to explain various components, operation and
h. Teacher should ask the students to go through instruction and Technical manuals

11. SUGGESTED MICRO-PROJECTS :

Only one micro-project is planned to be undertaken by a student that needs to be assigned to him/her. In the first four semesters, the micro-projects are group-based. However, in the fifth and sixth semesters, it should be preferably be individually undertaken to build up the skill and confidence in every student to become problem solver so that s/he contributes to the projects of the industry. In special situations where groups have to be formed for micro-projects, the number of students in the group should not exceed three.

The micro-project could be industry application based, internet-based, workshop-based, laboratory-based or field-based. Each micro-project should encompass two or more COs which are in fact, an integration of PrOs, UOs and ADOs. Each student will have to maintain dated work diary consisting of individual contribution in the project work and give a seminar presentation of it before submission. The total duration of the micro-project should not be less than 16 (sixteen) student engagement hours during the course. The student ought to submit micro-project by the end of the semester to develop the industry oriented COs.

A suggestive list of micro-projects is given here. Similar micro-projects could be added by the concerned faculty(Any one by one batch):

- **a.** Prepare a document for testing of LT swicthgears in detail as per IS.
- **b.** Prepare a document for testing of protective relays in detail as per IS and visit relay manufacturing industry..
- **c.** Prepare a document for testing of Lightening Arrestors in detail as per IS.
- **d.** Case study of various protection schemes of various equipments used in substation and generating station..

11 SUGGESTED LEARNING RESOURCES

Sr. No.	**Title**	**Author**	**Publication**	**ISBN Number**
1	Switchgear and protection	Sunil S. Rao	Khanna Publishers, Delhi.	ISBN: 978-93-87394-72-8
2	Priciples of power systems	Mehta V.K., Rohit Mehta	S. Chand & Co. New Delhi	ISBN : 9788121924962
3	Switchgear and protection	Gupta J.B.	S.K. Kataria and Sons, New Delhi 2014	ISBN : 9789350143728

12. SOFTWARE/LEARNING WEBSITES

www.nptel.ac.in
www.wikipedia.com
www.electricaltechnology.org
https://www.electrical4u.com

13. PO - COMPETENCY- CO MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
1	3	2	1	3	2	1	3
2	2	3	3	2	2	2	3
3	2	2	2	2	1	1	2
4	3	3	2	2	2	1	3
5	2	3	2	2	2	1	2

CO	PSO1	PSO2	PSO3	PSO4
1	3	2	1	2
2	3	2	1	2
3	2	2	1	2
4	3	3	2	2
5	3	2	2	2

Sign: Name: 1. Smt. U.S.Tulangekar 2. Mr.S.B.Kale (Course Experts)	Sign: Name:Dr. S.S.Bharatkar/Shri.R.U. Shelke (Head of Department)
Sign: Name:Dr. S.S.Bharatkar/Shri.R.U.Shelke (Program Head) (Department of Electrical Engineering)	Sign: Name: Shri. A. S. Zanpure (CDC Incharge)

Government Polytechnic, Pune

'180 OB'– Scheme

Programme	Diploma in ET/CE/**EE**//ME/MT/CM/IT/DDGM
Programme code	01/**02**/03/04/05/06/07/08/15/**16**/17/18/19/21/**22**/23/24/26
Name of Course	**Electrical Estimation & Costing**
Course Code	**EE4108**
Prerequisite course code and name	**EE2104 (Electrical Wiring and Domestic Appliances)**
Class Declaration	No

1. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P)		Examination Scheme				
					Theory		Practical		Total Marks
L	**T**	**P**	**C**		**ESE**	**PA**	**$ ESE**	**PA**	
03	00	02	05	**Marks**	80	20	25	25	150
				Exam Duration	3 Hr	1 Hr	-	--	

Legends: L- lecture, T-Tutorial/teacher guided theory practice, P-practical, C-Credits, ESE-End semester examination, PA- Progressive Assessments(Test I, II/Term Work), * - Practical Exam, $ - Oral Exam. # - Online Exam., Each lecture/practical period is of one clock hour.

2. RATIONALE

Electrical engineer has to work as an estimator in preparing estimation and costingof electrical installation. This course deals with estimation and costing of O.H & U.G. service connection, residential, commercial and industrial installation , substation , street lighting etc. In this course student will be able to develop the skills of filling Quotation & Tender as per need in their jobs.

3. COMPETENCY

The aim of this course is to attain the following industry identified competency through various teaching learning experience.

- **Apply basic wiring techniques and its maintenance for residential, commercial, industrial electrical installations and service connection with estimation and costing.**

4. COURSE OUTCOMES (COs)

The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry oriented COs associated with the above mentioned competency**:**

1. Interpret the essential elements of estimation & costing and apply IE rules related to different types of electrical installation & service connection.
2. Prepare estimate with cost of electrical installation of residential buildings .
3. Prepare estimate with cost of electrical installation of commercial complex
4. Prepare list of materials and components of industrial electrical installations.
5. Prepare estimate with cost of H.T & L.T. feeders & distribution substations.
6. Interpret the concepts of Quotation & Tender

5. SUGGESTED PRACTICALS/ EXERCISES

Pr. No	Unit No	**Practical Exercises** (Learning Outcomes in Psychomotor Domain)	Relevant CO	Approx. Hrs. required
1	1	a). Collect the catalogs of different wiring accessories& prepare a table of wiring accessories with specifications and comparing costs of different manufactures. b). Collect the catalogs of different domestic appliances & prepare a table of domestic appliances with specifications and comparing costs of different manufactures.	**1**	**08**
2	1	Estimation & costing of overhead lines & underground service connection- Report and Drawing sheet.	**1**	**02**
3	2	Estimation & costing of electrical installation of 2BHK residential flat – Report & Drawing sheet.	**2**	**02**
4	3	Estimation & costing of commercial complex– Report & Drawing sheet.	**3**	**02**
5	4	Estimation & costing of workshop consisting of 10 machines – Report & Drawing sheet.	**4**	**02**
6	5	Estimation & costing of H.T. Or L.T. overhead distribution line- Report.	**5**	**02**
7	5	Estimation & costing of H.T. Or L.T. underground distribution line- Report.	**5**	**02**
8	5	Estimation & costing of street lighting- Report& Drawing sheet.	**5**	**02**
9	5	Estimation & costing of pole mounted distribution substation- Report& Drawing sheet.	**5**	**02**
10	6	a). Case study : To prepare quotation , call quotation , make comparative statement. b). Collect Tender notice from Newspaper, study tender document, fill tender form.	**6**	**08**
Total Hrs				**32**

S.No.	Performance Indicators	Weightage in %
a.	Arrangement of available equipment or model for testing	20
b.	Setting and operation	15
c.	Safety measures	20
d.	Observations and Recording	15
e.	Interpretation of result and Conclusion	15
f.	Submission of report in time	15
Total		**100**

6. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

The major equipment with broad specification mentioned here will usher in uniformity in conduct of practical, as well as aid to procure equipment by authorities concerned**.**

Sr. No	Equipment Name with Broad Specifications	Pr. No.
1	The course is having term work consisting of data collection and drawing sketches so **No** practical in laboratory.	All

7. THEORY COMPONENTS-

Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
UNIT 1. Introduction to Elements of Estimating and Costing , Estimating and Costing of Service connections HRS -08 MARKS-16	
1a. Define Estimation and Costing . 1b. State the purchase system of organisation. 1c. State the function & qualities of estimators. 1d.Give the classification of electrical installations. 1e.State and explain general requirements of electrical installation. 1f.State and explain IE rules related to electrical installation for wiring and Electricity supply act-1948. 1g. Define Service Connection 1h. Select appropriate method for service connection with their diagrams.	1.1 Definition of "Estimation" & costing 1.2 Types of estimation and estimation tools. 1.3 Overhead and service charges. 1.4 Purchase procedure 1.5 Purpose of estimating and costing. 1.6 Qualities of good estimator. 1.7 Essential elements of estimating and costing. 1.8 Classification of electrical installations. 1.9 General requirements of electrical installation. 1.10 General electric symbols 1.11 Definitions with suitable example : a) Schematic Diagram b) Wiring Diagram c) Block Diagram d) Circuit Diagram 1.12 IE rules related to electrical installation for wiring, including Electricity supply act-1948. Rule no.43,47,56 & 90 1.13 Concept of Service connections 1.14 Types of service connections with diagrams. 1.15 Differentiate between underground and overhead service connection. 1.16 Estimation & Costing of a) Overhead service connection b) Underground service connection. 1.17 Advantages & Disadvantages of each type of

<table>
<tr><th>Unit Outcomes (UOs)
(in cognitive domain)</th><th>Topics and Sub-topics</th></tr>
<tr><td>1i. State the Advantages & Disadvantages of each type of service connection.
1j. Know IE rules w.r.t. service connections.</td><td>service connection.
1.18 IE rules for service connection
Rule no. 30, 31, 33, 34, 35</td></tr>
<tr><td colspan="2">UNIT 2.Estimation & Costing of Residential Installation And Different types of earthing
HRS -08 MARKS-12</td></tr>
<tr><td>2a. Select wires and wiring methods as per the requirement
2b. Describe the design of residential installation as per IS.
2c. Prepare total estimation and costing of residential installation.
2d. To state the purpose of earthing and types of earthing .
2e. To know the IS.
2f. Determine length and size of earth wire.</td><td>2.1 Wiring accessories used with specifications & cost
2.2 Design of residential installation.
a) General guidelines for residential installations.
b) Electrical plan layout.
c) Single line diagram.
d) Schematic wiring diagram.
e) Distribution of load as per I.E.Rules.
f) Size of wires, selection of wires, Selection of rating for main switch, distribution board , MCB, ELCB, fuses and wiring accessories.
2.3 Estimation and costing of residential electrical installation
a) cost of material , b) labour charges ,
c) contingencies charges.
2.4 Earthing and its types.
2.5 Indian Standard specifications regarding earthing of electrical installations.
2.6 Estimation & costing 0o pipe & plate earthing
2.7 Measurement of Earth resistance & methods of reducing earth resistance.
2.8 I.E. rules for earthing.
2.9 Factors affecting the length and size of earth wire & earthing electrodes.</td></tr>
<tr><td colspan="2">UNIT 3. Estimation & Costing of commercial building, Installation and testing of installation
HRS -08 MARKS-12</td></tr>
<tr><td>3a. Define commercial installation and differentiate it from residential installation</td><td>3.1 Concept of commercial installation.
3.2 Examples of commercial installation.
3.3 Difference between residential and commercial installation
3.4 Electrical plan layout.
3.5 Load calculation and selection of size of cable.
3.6 Decide number of lighting and power sub circuits
3.7 Decide size of wire of each sub circuit
3.8 Decide ratings of main switch, bus bar , sub switches , MCB, ELCB etc
3.9 Estimation & costing of commercial installation
a) Cost of material b) Labour cost
c) contingencies charges</td></tr>
</table>

Unit Outcomes (UOs) (in cognitive domain)	**Topics and Sub-topics**
3b. To be aware of testing of installation.	3.10 Testing of installation as per Indian Standards
UNIT 4.Estimation & Costing of Industrial Installation HRS - 10 MARKS-16	
4a. Understand the guidelines for industrial installation. 4b.Design industrial installation 4c. Prepare estimation for different ratings, size & other technical specification 4d. Draw single line diagram for electrical installation in small industries.	4.1 Guidelines for industrial installations. 4.2 Power wiring for motors or any industrial loads. 4.3 Distribution of supply in power wiring. 4.4 Design consideration for electrical installation in small industries, 4.5 Calculate motor current, selection and size of cable, size of conduit, fuse rating, selection of starter, distribution board, main switch, MCB etc. 4.6 Plan layout, single line diagram, wiring diagram, material schedule. 4.7 Estimation and costing of industrial wiring.
UNIT 5. Estimation & Costing of Overhead/underground distribution lines and Substation HRS -08 MARKS-14	
5a. Aware about the materials of HT /LT feeders. 5b. Understand the design parameters of overhead distribution lines/feeders 5c. Prepare estimation and costing overhead / underground distribution lines/feeder State the types of substations from installation point of view. Prepare estimation and costing for substation.	5.1 Components required for overhead / underground distribution with specification. 5.2 Design consideration of overhead & underground distribution lines/feeders 5.3 Estimation and costing of overhead / underground distribution lines. 5.4 Estimation and costing of street lighting. 5.5 Types of substations–pole mounted substations, indoor& outdoor substations. 5.6 Estimation and costing of above substations.
UNIT 6. Tender and Quotation HRS - 06 MARKS-10	
6a. Understand Tender and Quotation terminology 6b. Prepare a quotation with the reference to purchase requisition. 6c. To understand tendering procedure and Filling tender. 6d. Differentiate between tender and quotation.	a. Definitions: a) Earnest money deposit. b) Security deposit. c) Warranty period. d) contract e) Agreement f)Goods & Sales Tax (GST) g) Tender h) Quotation b. **Quotation -** Requisition, call of quotation, opening of quotation, comparative statement, purchase order, delivery period. c. **Tender**– Procedure to prepare tender document, floating of tender, terms and conditions- commercial & technical, filling of tender, e-tendering. d. Difference between quotation and tender.

8. SUGGESTED SPECIFICATION TABLE FORQUESTION PAPER DESIGN-

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Introduction to Elements of Estimating and Costing Estimating and Costing Service connections	08	04	06	06	16
II	Estimation & Costing of Residential Installation And Different types of	08	02	04	06	12
III	Estimation & Costing of commercial building / Installation and testing of installation	08	02	04	06	12
IV	Estimation & Costing of Industrial Installation	10	02	06	08	16
V	Estimation & Costing of Overhead/underground distribution lines and Substation	08	04	04	06	14
VI	Tender and Quotation	06	02	04	04	10
Total		**48**	**16**	**28**	**36**	**80**

9. SUGGESTED STUDENT ACTIVITIES

Other than the classroom and laboratory learning, following are the suggested student-related ***co-curricular*** activities which can be undertaken to accelerate the attainment of the various outcomes in this course: Students should conduct following activities in group and prepare reports of about 5 pages for each activity, also collect/record physical evidences for their (student's) portfolio which will be useful for their placement interviews:

a) Prepare abstract of Indian standards related to industrial and non-industrial installations.
b) Prepare report on market survey of various electrical accessories, wires and cables (Specification, manufacturer, quality, cost)
c) Collect any one electrical drawing of existing electrical installation and prepare estimate for the same.
d) Prepare power point presentation for acquiring electrical installation work.

Prepare journal based on practical performed in Electrical laboratory. Journal consists of drawing, observations, required equipment's, date of performance with teacher signature.

10. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are sample strategies, which the teacher can use to accelerate the attainment of the various outcomes in this course:

These are sample strategies, which the teacher can use to accelerate the attainment of the various outcomes in this course:

a. Massive open online courses (***MOOCs***) may be used to teach various topics/sub topics.
b. About ***15-20% of the topics/sub-topics*** which is relatively simpler or descriptive in nature is to be given to the students for ***self-directed learning*** and assess the development of the COs through classroom presentations (see implementation guideline for details).
c. With respect to item No.8, teachers need to ensure to create opportunities and provisions for ***co-curricular activities***.
d. Guide student(s) in undertaking micro-projects.
e. Correlate subtopics with power plant system and equipment.
f. Use proper equivalent analogy to explain different concepts.
g. Use Flash/Animations to explain various components, operation and
h. Teacher should ask the students to go through instruction and Technical manuals

11. SUGGESTED MICRO-PROJECTS :

Only one micro-project is planned to be undertaken by a student that needs to be assigned to him/her.In the first four semesters, the micro-projects are group-based. However, in the fifth and sixth semesters, it should be preferably be **individually** undertaken to build up the skill and confidence in every student to become problem solver so that s/he contributes to the projects of the industry. In special situations where groups have to be formed for micro-projects, the number of students in the group should **not exceed three.**

The micro-project could be industry application based, internet-based, workshop-based, laboratory-based or field-based. Each micro-project should encompass two or more COs which are in fact, an integration of PrOs, UOs and ADOs. Each student will have to maintain dated work diary consisting of individual contribution in the project work and give a seminar presentation of it before submission. The total duration of the micro-project should not be less than **16 (sixteen) student engagement hours** during the course. The student ought to submit micro-project by the end of the semester to develop the industry oriented COs.

A suggestive list of micro-projects is given here. Similar micro-projects could be added by the concerned faculty(Any one by one batch):

a. Prepare a booklet consisting of price lists and catalogs of different electrical accessories (at least 100 items)
b. Prepare a booklet sharing electrical symbols of electrical machines, equipments, motors, accessories , wiring components etc. (At least 200 items)
c. Prepare a detail project report on a residential building consisting of at least 12 flats.
d. Prepare a detail project report on commercial complex with load more than oe equal to 250 kW
e. Prepare a detail project report on industrial installation of at least 25 different types of working motors. (e.g. DC motor, 1-phase and 3-phase AC motors)
f. Prepare a booklet on Quotation, comparative statement of different items. Also making a tender.Case study.

12. SUGGESTED LEARNING RESOURCES

Sr.No.	Title of Book	Author	Publication
1	Electrical Design and estimation	K.B.Raina &S.K.Battacharya	New age international ISBN: 9788122403633
2	A Course in Electrical Installation, Estimating and costing	J. B. Gupta	S. K Kataria & Sons New Delhi. ISBN: 9789350142790
3	Electrical Wiring, Estimating and Costing	S.L. Uppal& G.C. Garg	KHANNA PUBLISHERS ISBN :9788174092403

13. SOFTWARE/LEARNING WEBSITES

a) https://www.electricalresources.com/Help/Electrical_Estimating_Techniques/NetHelp /default.htm
b) https://www.darshan.ac.in/DIETDS/EE/SubjectDetail/3350901
c) https://www.inspirenignite.com/vtu/15ee54t-electrical-estimation-and-costing-electrical-5th-sem-syllabus-for-diploma-dte-karnataka-c15-scheme/
d) https://www.youtube.com/watch?v=dzZkX0LKsWE
e) https://totaltakeoffs.com/building-materials/division-16-electrical/
f) https://www.scribd.com/doc/7225083/Building-Wiring-Estimating-Costing

14. PO - COMPETENCY- CO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
1	2	2	-	-	1	1	1
2	2	2	3	1	2	1	2
3	2	2	3	1	2	1	2
4	1	2	3	1	2	1	2
5	2	2	3	1	2	1	2
6	-	1	-	-	1	2	1

CO	PSO1	PSO2	PSO3	PSO4
1	3	1	3	1
2	3	1	3	3
3	3	1	3	3
4	3	1	3	3
5	3	1	3	2
6	-	-	3	-

Sign: Name: 1. Shri. S. B. Kale 2. Dr. V. K. Jadhav (Course Experts)	Sign: Name:Dr. S. S. Bharatkar/Shri. R. U. Shelke (Head of Department)
Sign: Name: Dr. S. S. Bharatkar/Shri. R. U. Shelke (Program Head) (Department of Electrical Engineering)	Sign: Name: Shri A. S. Zanpure (CDC Incharge)

Government Polytechnic, Pune

'180OB' – Scheme

Programme	Diploma in ET/CE/**EE**/ME/MT/CM/IT/DDGM
Programme code	01/**02**/03/04/05/06/07/08/15/**16**/17/18/19/21/**22**/23/24/26
Name of Course	**Utilization of Electrical Energy**
Course Code	**EE4109**
Prerequisite course code and name	No
Class Declaration	**Yes**

1. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P)		Examination Scheme				
					Theory		Practical		Total Marks
L	T	P	C		ESE	PA	$ ESE	PA	
03	00	01	04	Marks	80	20	25	25	150
				Exam Duration	3 Hrs	1 Hr	-		

Legends: L- lecture, T-Tutorial/teacher guided theory practice, P-practical, C-Credits, ESE-End semester examination, PA- Progressive Assessments(Test I, II/Term Work), * - Practical Exam, $ - Oral Exam. # - Online Exam., Each lecture/practical period is of one clock hour.

2. RATIONALE

Electrical energy is the most widely used form of energy by human being. It is used in every walk of life whether it is home, office, industry or farm. Electrical energy is utilized in various forms such as for lighting, cooking, heating, welding, refrigeration, air conditioning, traction, irrigation, operating machines and computers and so on. In this era of energy crisis it is very essential to utilise electricity efficiently. Every diploma electrical engineer therefore should know to operate and maintain the various electrical utilities for their efficient operations. This course will enable the students to acquire the essential theoretical and practical knowledge with respect to the topics covered for utilization of electrical energy. The course will enable the students to develop skills to select appropriate electrical utility in domestic, commercial and industrial sector.

3. COMPETENCY

The aim of this course is to attend following industry identified competency through various teaching learning experiences:

- **Select and utilize different types of electrical utilities and systems.**

4. COURSE OUTCOMES (COs)

The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry oriented COs associated with the above mentioned competency**:**

1. Describe various electrical heating systems and identify a suitable heating scheme for a given application.
2. Describe various electrical welding systems and identify a suitable welding scheme for a given application.
3. Distinguish between electric drives and Select appropriate drive for given application.
4. Classify elevators and escalators and identify a suitable elevator and escalator for given application.
5. Use different electric traction systems.

5. SUGGESTED PRACTICALS/ EXERCISES

Pr. No.	**Unit No.**	**Practical Exercises** (Outcomes in Psychomotor Domain)	**Relevant CO**	**Approx. Hours Required**
1.	1	Identify the different components required for various types of heating furnaces.	1	01
2.	1	Observe construction and working of various heating furnaces by watching video programs.	1	01
3.	2	Identify the different accessories and safety devices required for various types of welding systems.	2	01
4.	2	Prepare a report of specification of various electrical welding machines available in college workshop.	2	01
5.	3	Visit a small manufacturing unit to observe various electrical drives and prepare a technical report.	3	02
6.	3	Prepare a report on technical data of drives required for various applications (any 4) such as water lifting pump, elevator, saw mill, floor mill, concrete mixer etc.	3	02
7.	4	Prepare a comparative chart of two different manufacturing companies in India of elevator with technical data.	4	01
8.	4	Prepare a report on various safety devices, switches used and the counter weight determination in elevator.	4	01

9.	4	Prepare a comparative chart of two different manufacturing companies in India of escalator with technical data.	4	01
10	4	Prepare a report on various safety devices and switches used and driving mechanism employed in escalator.	4	01
11.	5	Visit a traction substation and draw a single line diagram of substation and write a report.	5	02
12.	5	Visit a railway electric loco shed to study power circuit of electric locomotive.	5	02
13		Microproject planning & Execution as written in suggested microproject list		01
14		Microproject report writing		01
15		Suggested student activity report		01
Total Hrs				**19**

Sr.No.	Performance Indicators	Weightage in %
a.	Arrangement of available equipment / test rig or model	15
b.	Setting and operation	15
c.	Safety measures	15
d.	Observations and Recording	15
e.	Interpretation of result and Conclusion	20
f.	Answer to sample questions	10
g.	Submission of report in time	10
Total		**100**

6. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

Sr. No.	Major Equipment/ Instruments Required	Pr. No.
1	Video programme / Internet information on various types of heating furnaces.	1, 2
2	Video programme / Internet information on various types of welding systems	3, 4
3	Market survey / Internet information of various drives elevators, escalators ,as per application.	5, 6, 7, 8, 9, 10
4	Visit to Khadaki Traction substation for understanding layout and equipment and protective measures used in traction substation.	11, 12

7. THEORY COMPONENTS

Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
SECTION-1	
UNIT-1: Electrical Heating Systems	**HRS -10 Marks-16**
1a. State the advantages and types of electric heating. 1b. Explain with sketches and broad specifications, the working principle of the specified electrical heating system. 1c. Describe with sketches construction of the specified electrical heating system. 1d. Enumerate the advantages and disadvantages of the specified electrical heating system. 1e. Recommend the relevant heating system for the specified application with justification. 1f. Design the heating element of the given type of furnace for the specified data. 1g. Calculate the power rating of Induction furnace from the basic concepts and given data.	1.1 Modes of heat transfer, Concept of electric heating, Advantages and Types of electric heating. 1.2 Resistance heating and its types- Working principle, Construction and Applications. 1.3 Requirements of heating elements, Different types of heating elements, Causes of failure of heating elements. 1.4 Operation of Resistance oven, Temperature control of resistance oven. 1.5 Design of heating element and numerical. 1.6 Arc heating- Working principle, Properties of material used for electrode, Advantages of graphite electrode over carbon electrode 1.7 Arc furnaces-Types, Construction, Operation, Specifications and applications. 1.8 Induction heating- Working principle 1.9 Induction furnaces- Types, Construction, Operation, Specifications, Advantages, Disadvantages andapplicationsof each type. 1.10 Power rating of Induction furnace and numerical 1.11 High frequency eddy current heating- Working principle, Advantages, Disadvantages and Applications. 1.12 Microwave heating- Working principle, Advantages, Disadvantages and Applications, Microwave oven. 1.13 Dielectric heating- Working principle, Advantages, Disadvantages and Applications.
Unit 2:Electrical Welding Systems	**HRS-08 Marks-12**
2a. State the advantages and types of electric welding. 2b. Explain with sketches the working principle of the specified electrical welding system. 2c. Recommend the relevant welding system for the specified application with justification. 2d. Know quality of welding and types of electrodes. 2e. Know the welding	2.1 Introduction to electric welding system, Advantages and Disadvantages of electric welding, Classification of electrical welding system, Types of welding systems- Plastic and Fusion. 2.2 Quality of a good weld, welding defects. 2.3 Resistance welding – Spot, Seam, Projection and Butt welding, their Working principles and Applications. 2.4 Arc welding- Working principle, Characteristics of arc, Factors on which arc length depends, Methods of arc stabilization, Types of electrodes, Advantages of coated electrodes. 2.5 Types of Arc welding and their Applications-Carbon arc, Metal arc, Bare metal arc, Shielded metal arc, Automatic

Unit Outcomes (UOs) (in cognitive domain)	**Topics and Sub-topics**
Equipment 2f. Compare DC and AC welding, Resistance and Arc welding.	hydrogen or Arc atom welding, Inert gas metal arc welding, Submerged arc welding and Electron beam welding. 2.6 New techniques in welding and their Applications- Ultrasonic welding, Laser welding, Electronic welding current, Pulsation welding, Energy storage welding. 2.7 Requirements of good welding 2.8 Electric welding equipment, Power supply requirements, DC and AC welding set, Arc welding with AC and DC 2.9 Comparison between DC and AC welding and also Comparison between resistance and arc welding.
Unit 3:Electric Drive	**HRS-06 Marks-12**
3a. Differentiate the salient features between the given types of electric drives. 3b.Recommend the relevant motor for the given application with justification. 3c. Select the relevant enclosure, power transmission drive and bearing of electric motor for the given application with justification. 3d. Estimate the size and rating of the motor for the specified load cycle.	3.1 Electric drive- Introduction, Advantages and disadvantages of electrical drive 3.2 Types of drive- Group drive and Individual drive 3.3 Mechanical features of drives- Purpose, Types and Applications of various types of enclosures. 3.4 Transmission of mechanical power- Direct and Indirect drive (Belt, Rope, Chain, Gear), Vertical drives and Applications 3.5 Bearings- Types and Applications 3.6 Requirement of mechanical load 3.7 Load equalization- Meaning, Methods and Condition of Load equalization 3.8 Different types of mechanical loads 3.9 Electrical characteristics, Nature of load torque, Service capacity, Rating of motor, Definition of Standard rating as per IS 3.10 Study of following home appliances with regard to operation and drive employed- Vacuum cleaner, Washing machine and Air conditioner. 3.11 Characteristic of different drives and Selection of drive for particular application. 3.12 Duty cycle- Concept, Types of duty cycles, Numerical on determination of size of motor by using duty cycle,
SECTION-2	

Unit Outcomes (UOs) (in cognitive domain)	**Topics and Sub-topics**
Unit 4:Elevators and Escalators	**HRS-06 Marks-12**
4a. Classify types of elevator Machines and their motors. 4b. Identify the factors affecting size and shape of elevator car. 4c. Know components and safety considerations and requirements of lift installation. 4d. Classify escalators and know components, capacity and safety requirements in escalators. 4e. Know concept of hydraulic elevator, freight elevators and moving walkway.	4.1 Elevators- Function, Types of electric elevator machines, Components of elevator, Motors used for elevators 4.2 Concept of Hydraulic elevator. 4.3 Size and shape of elevator car, Typical dimensions of elevator for- Office building, Apartment building, Hotels, Hospital passenger, Hospital vehicle elevators, speed of elevators, location of elevator machine 4.4 Safety in elevators, Requirements of lift installation as per law 4.5 Bombay Lift Act 1939 (Latest Amendments) 4.6 Concept of Freight elevators 4.7 Escalators- Function, Benefits, Types of escalators, Components of escalators, Escalator capacity 4.8Safety in escalators 4.9 Concept of Moving walkway and its applications.
Unit 5: Electric Traction	**HRS-10 Marks-16**
5a. Recommend relevant traction system for the given conditions with justification. 5b. Select the relevant track electrification system for the specified traction services with justification. 5c. Differentiate the salient features between the given types of track electrification system. 5d. Explain power supply arrangement for traction system 5e. Specify the protection system for A.C. traction. 5f. Recommend relevant OHE construction for the specified speed limit. 5e. Select appropriate current collecting device and traction motor for the given electric traction system and know the braking system.	5.1 Requirements of an ideal traction system, Different types of Traction systems used in India, Advantages of electric traction and electric drive, Choice of traction system in India 5.2 Systems of Track electrification- DC system, Single phase AC system, Three phase AC system and composite system 5.3 25 KV A.C.,50 Hz system, Advantages and Disadvantages 5.4 Power supply arrangement - High voltage supply, constituents of supply system, Miscellaneous and Major equipment at control post or switching station 5.5 Protection system for A.C. traction 5.6 Overhead equipment (OHE) – Systems of stringing, Different catenary constructions, OHE supporting structure 5.7 Current collecting system- Overhead wire, Conductor rail system, Current collectors for overhead system- Pole collector, Bow collector, Diamond type pantograph collector, Faively type pantograph collector 5.8 Traction motors- Requirements of motors for traction purpose, Suitability of following motors for traction purpose - D.C. series, A.C. series, 3 phase I.M., linear I.M. 5.9 Braking- Requirements of braking system, Types of electrical braking systems, Conditions necessary to achieve regenerative braking, Suitability of D.C. series motor and Three phase induction motor for electric braking systems, Advantages and disadvantages of regenerative braking.
Unit 6: Traction Mechanics	**HRS-08 Marks-12**

Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
6a. Differentiate between the given types of traction services based on the given criteria. 6b. Determine average and schedule speed for given traction services. 6c. Determine the required tractive effort, power of traction motor and specific energy consumption for given conditions.	6.1 Types of traction services 6.2 Speed-time curve, Simplified speed-time curves and their applications, Definition of Average speed, Schedule speed and Factors affecting Schedule speed 6.3 Tractive effort- for acceleration, to balance the gravitational pull, to overcome train resistance, to overcome curve resistance 6.4 Power of the traction motor. 6.5 Specific energy consumption, Factors affecting specific energy consumption of an electric train, Mechanics of train movement, Coefficient of adhesion, Factors affecting coefficient of adhesion 6.6 Numerical on above content coverage of the topic.

8. SUGGESTED SPECIFICATION TABLE FORQUESTION PAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
1	Electrical Heating System	10	4	8	4	16
2	Electrical Welding System	08	4	4	4	12
3	Electric Drive	06	4	4	4	12
4	Elevators	06	4	4	4	12
5	Electric Traction	10	4	8	4	16
6	Traction Mechanics	08	4	4	4	12
Total		**48**	**24**	**32**	**24**	**80**

9. SUGGESTED STUDENT ACTIVITIES

Other than the classroom and laboratory learning, following are the suggested student-related ***co-curricular*** activities which can be undertaken to accelerate the attainment of the various outcomes in this course: Students should conduct following activities in group and prepare reports of about 5 pages for each activity, also collect/record physical evidences for their (student's) portfolio which will be useful for their placement interviews:

a. Prepare chart of various heating systems.
b. Prepare chart of various electrical equipment used for heating.
c. Preparing reports based on tutorial practices.
d. Assignments for solving numerical.
e. Note the ratings of various types of welding machines in the Institute workshop.

f. Seminar on various electric drives.
g. Prepare a chart of hydraulic elevator.
h. Prepare a chart of components of elevators.
i. Prepare a chart of components of escalators
j. Seminar on latest electric traction trends in India.

10. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are sample strategies, which the teacher can use to accelerate the attainment of the various outcomes in this course:

a. Massive open online courses (***MOOCs***) may be used to teach various topics/sub topics.
b. About ***15-20% of the topics/sub-topics*** which is relatively simpler or descriptive in nature is to be given to the students for ***self-directed learning*** and assess the development of the COs through classroom presentations (see implementation guideline for details).
c. With respect to item No.8, teachers need to ensure to create opportunities and provisions for ***co-curricular activities***.
d. Guide student(s) in undertaking micro-projects.
e. Use proper equivalent analogy to explain different concepts.
f. Use Flash/Animations to explain working of electric locomotive, elevators.
g. Teacher should ask the students to go through instruction and Technical manuals.
h. Pre-guided visits to a.c. traction substation and railway electric loco trip shed.

11. SUGGESTED MICRO-PROJECTS

Only one micro-project is planned to be undertaken by a student that needs to be assigned to him/her. In the first four semesters, the micro-project are group-based. However, in the fifth and sixth semesters, it should be preferably be individually undertaken to build up the skill and confidence in every student to become problem solver so that s/he contributes to the projects of the industry. In special situations where groups have to be formed for micro-projects, the number of students in the group should not exceed three.

The micro-project could be industry application based, internet-based, workshop-based, laboratory-based or field-based. Each micro-project should encompass two or more COs which are in fact, an integration of PrOs, UOs and ADOs. Each student will have to maintain dated work diary consisting of individual contribution in the project work and give a seminar presentation of it before submission. The total duration of the micro-project should not be less than 16 (sixteen) student engagement hours during the course. The student ought to submit micro-project by the end of the semester to develop the industry oriented COs.

A suggestive list of micro-projects is given here. Similar micro-projects could be added by the concerned faculty:

a. **Electric heating :** Prepare a power point presentation related to various types of heating furnaces.

b. **Electric welding :** Prepare a power point presentation related to various types of welding methods, equipment and accessories.

c. **Electric drives :** Prepare a report on market survey of various drives (specification, manufacturer, application and cost.

d. **Elevators and escalators:** Prepare a report on market survey of various elevators and escalators (specification, manufacturer, application and cost)

e. **Electric traction :**Prepare a power point presentation and the report related to electric traction systems in India and comparison between them.

12. SUGGESTED LEARNING RESOURCES

Sr. No.	Title	Author	Publication	ISBN No.
1	Art and Science of Utilization of Electrical Energy	H..Partab	DhanpatRai and Sons, New Delhi	ISBN-9788177001440
2	Utilization of Electric Power and Electric Traction	J.B.Gupta	S.K.Kataria and Sons, New Delhi	ISBN- 978-9350142585
3	Utilization of Electric Power and Electric Traction	G. C. Garg	Khanna Publishers, New Delhi	ISBN- 8174091645
4	Fundamentals of Electrical Drives	G. K. Dubey	Narosa Publishing House. New Delhi	ISBN- 8177640054, 9788177640052
5	Modern Electric Traction	H..Partab	DhanpatRai and Sons, New Delhi	ISBN-1234567147206

13. SOFTWARE/LEARNING WEBSITES

1.www.nptel.com
2.www.howstuffworks.com
3.www.khanacademy.com

IS, BIS and International Codes :

1. IS 1860-1980 code of practice for installation, operation and maintenance of electric passenger and goods lifts.

2. IS 3534-1976 code of outline dimensions of electric lifts.

14. PO - COMPETENCY- CO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	1	3	1	3	3	3
CO2	1	1	2	1	3	3	3
CO3	3	1	3	3	3	3	3
CO4	1	1	1	1	3	3	3
CO5	3	1	1	2	3	3	3

	PSO1	PSO2	PSO3	PSO4
CO1	3	2	3	2
CO2	3	1	1	2
CO3	2	2	3	3
CO4	3	2	2	3
CO5	2	2	1	3

Sign: Name: Mrs. M. H. Bilgi, Mrs. A. N. Duraphe (Course Experts)	Sign: Name: Dr. S. S. Bharatkar/Shri.R. U. Shelke (Head of Department)
Sign: Name:Dr. S. S. Bharatkar/Shri. R. U. Shelke (Program Head) (Department of Electrical Engineering)	Sign: Name: Shri A. S. Zanpure (CDC Incharge)

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Government Polytechnic, Pune

'180 OB' – Scheme

Programme	Diploma in ET/CE/**EE**//ME/MT/CM/IT/DDGM
Programme code	01/**02**/03/04/05/06/07/08/15/**16**/17/18/19/21/**22**/23/24/26
Name of Course	**Energy Conservation & Audit**
Course Code	**EE4110**
Prerequisite course code and name	No
Class Declaration	**Yes**

1. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			**Total Credits (L+T+P)**		**Examination Scheme**				
					Theory		**Practical**		**Total Marks**
L	**T**	**P**	**C**		**ESE**	**PA**	**$ ESE**	**PA**	
03	00	02	05	**Marks**	80	20	25	25	150
				Exam Duration	3 Hr	1 Hr	-	--	

Legends: L- lecture, T-Tutorial/teacher guided theory practice, P-practical, C-Credits, ESE-End semester examination, PA- Progressive Assessments(Test I, II/Term Work), * - Practical Exam, $ - Oral Exam. # - Online Exam., Each lecture/practical period is of one clock hour.

2. RATIONALE

We depend on energy for almost everything in our lives. We wish to make our lives comfortable, productive and enjoyable.Hence the consumption of energy is increasing day by day. Unfortunately, we have started wasting energy unnecessarily. Most of us have forgotten that energy is available in abundance but it is limited and hence to maintain the quality of life, it is important that we use our energy resources wisely. Conserving energy is an important way to reduce strain on the environment and bring down electricity expenses. Energy conservation supports the Eco-friendly lifestyle by providing energy, which saves money and at the same time saves the earth. Essential theoretical and practical knowledge about the concept of energy conservation, energy management, and different approaches of energy conservation in industries, economic aspects of energy conservation project and energy audit and measuring instruments in commercial and industrial sector will be achieved by this course.

3. COMPETENCY

The aim of this course is to attain following industry identified competency through various teaching learning experiences:

- **Carry out electrical energy conservation activities.**

4. COURSE OUTCOMES (COs)

The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry-oriented
COs associated with the above-mentioned competency**:**

1: Interpret the energy scenario in India with respect to the energy conservation policy.
2: Implement energy conservation techniques in electrical power system.
3: Implement energy conservation techniques in electrical & thermal utility.
4: Evaluate the techno economic feasibility of the energy conservation technique adopted for the energy conservation project.
5: Use appropriate energy conservation equipment in practice for utility/ facility.
6: Carry out energy audit for electrical system.

5. SUGGESTED PRACTICALS/ EXERCISES

Pr No	**Unit No**	**Practical Exercises** (Learning Outcomes in Psychomotor Domain)	**Relevant CO**	**Approx. Hrs. required**
1	1	Search on website of power ministry or MNRE for energy conservation act 2001& its amendments. Write a report on features of the act, functions of Government organization like MNRE, MPC, BEE, MEDA &Non-government organizations.	**1**	4
2	3,4	To determine the energy saving by use of electronic ballast as compared to magnetic choke. Calculate payback period.	**3, 4**	2
3	3,4	To determine the reduction in energy consumption by replacement of lamps in the class room / laboratory. Find out cost saving &payback period also.	**3, 4**	4
4	2	Search on website for gathering information of intelligent power factor controller & write a brief report on it.	**2**	4
5	3,4	Measurement of power in induction motor at a particular load without p.f improvement device & with p.f. improvement device. Compare the energy consumption in both the cases & determine the energy saving.	**3, 4**	2
6	3	Analysis of mechanical load on three phase induction motor & decide whether it should be connected in star or delta so that motor should operate at maximum efficiency.	**3**	2

7	3	Search on website the various opportunities of energy saving in pumping system.	**3**	4
8	3	Search on website https://kredlinfo.inthe various opportunities of energy saving in industry.	**3**	4
9	4	Analysis of electricity bill of any industry / commercial complex /public water works /irrigation scheme / educational institute as well as residential consumer & prepare a report on its applicability & all charges,	**4**	4
10	3	Search on website https://energy.rajasthan.gov.in/ for Energy Saving in Domestic Sector & write a report on it	**3**	4
11	6	Prepare a sample energy audit questionnaire for the given industrial facility.	**6**	4
12	4&5	Perform market survey on Induction Motor, collect the catalogue of induction motor & Energy Efficient Induction motor of different manufacturers & prepare a report comprising i) Comparison on technical aspects ii) Cost / benefit analysis Justification for use of energy efficient motor.	**4, 5**	4
13	4&6	Study of any one energy audit report of electric motors / lighting system /HVAC system from web site in Indian scenario & prepare a report comprising i) Benefits of Energy Audit ii) Cost / benefit analysis.	**4 , 6**	4
14	2	Visit to receiving substation / small industry, prepare DSM programme & list out the possible obstacles to implement the program.	**2**	4
		Total Hrs		**32**

Note: Perform any ten practical / assignments

S.No.	**Performance Indicators**	**Weightage in %**
a.	Arrangement of available equipment or model for testing	20
b.	Setting and operation	15
c.	Safety measures	20
d.	Observations and Recording	15
e.	Interpretation of result and Conclusion	15
f.	Submission of report in time	15
	Total	**100**

6. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

The major equipment with broad specification mentioned here will usher in uniformity in conduct of practical, as well as aid to procure equipment by authorities concerned**.**

Sr. No.	Equipment Name with Broad Specifications	Pr. No.
1	Computer with internet facility	**1**
2	Electronic ballast, magnetic choke, dimmerstat, wattmeter, ammeter, voltmeter	**2 & 3**
3	Lux meter, measuring tape	**2 & 3**
4	Computer with internet facility	**1**
5	Three phase induction motor 3 kw, 230 V 17 Amp 1500r.p.m, 2-watt meters, AC & DC Ammeters & voltmeters, rheostat, lamp load.	**2& 3**
6	Three phase induction motor 3 kw, 230 V 17 Amp 1500r.p.m, 2-watt meters, AC & DC Ammeters & voltmeters, rheostat, lamp load.	**2 & 3**
7	Computer with internet facility	**1**
8	Computer with internet facility	**1**
9	LT, HT Electricity Bill.	**4**
10	Computer with internet facility	**1**
11	Computer with internet facility.	**5**
12	Computer with internet facility, catalogues of induction motor & EEM	**6**
13	Computer with internet facility	**3,5**
14	substation / small industry	**3**

7. THEORY COMPONENTS

Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
SECTION - I	
UNIT 1. Energy Conservation Basics HRS -2 MARKS-04	
1a. Explain the given energy problem in India 1b. Identify the scope for energy conservation in the given situation / industry. 1c. Explain the concept of energy conservation, its benefits& strategies for the given application. 1d. State the objectives of Energy conservation act 2001with reference to given criteria. 1e. Explain salient features of Energy conservation Act 2001 1f.Identify the roles of Government & non-Government organizations working on energy conservation.	1.1 Indian Energy ScenarioGeneral energy problem, Sector wise Energy consumption, demand supply gap. 1.2 Scope for energy conservation. 1.3 Definition of conservation. Objectives of energy Conservation, its benefits & strategies. 1.4 Objectives of Energy conservation act 2001. 1.5 Salient features of Energy conservation act 2001. 1.6 Functions of Government & non-Government Organizations working on energy conservation, (NPC, MNRE, BEE, MEDA, TERI, IIEC etc.)
UNIT 2. Energy Conservation in Electrical Power System HRS -12 MARKS-18	
2a. State the methods of energy conservation in the specified portion of generation system. 2b.Identify the objectives for the Supply side management for the given utility. 2c.Explain the need for cogeneration in the given situation/type of utility. 2d. Identify the co-generation system for the given facility. 2e. State the advantages of the given type of co-generation system. 2f. Explain the suitability of the Demand side management for the given situation. 2g. Interpret the losses in the given power system. 2h. Explain the causes of the given type of losses in the transmission and distribution systems. 2i. Explain the methods to reduce the specified technical & commercial losses in power system. 2j. Find the rating of capacitor to improve the p.f	2.1 Performance improvement of existing power station by a. Optimization of load, b. Optimal distribution of load among different units. c. Periodical maintenance. d. using renewable energy sources e. Increasing the capacity by adopting technology f. Implementing supply-side management g. Adopting use of co-generation & DG set 2.2 Meaning of supply side management. Objectives of Supply side management 2.3 Definition of co-generation, need of co-generation. 2.4 Types of cogeneration on basis of sequence of energy use: topping cycle & bottoming cycle. Types of cogeneration ,basis of technology: Steam turbine cogeneration, Gas turbine Cogeneration, reciprocating engine cogeneration. 2.5 Advantages of co-generation. 2.6 Definition of demand-side management. Objectives of demand side management Advantages of demand side management to consumers, enterprises, utilities,society, globe & environment. 2.7 Scenario of transmission and distribution losses at state level, national level and at global level Classification of Transmission & Distribution losses.

	2.8 Causes of technical & commercial losses. 2.9 Methods of energy conservation in transmission & distribution system on the basis of following points- i) Reducing I^2R losses ii) Compensating reactive power. iii) Improving p.f. of utility & consumers. iv) Optimizing distribution voltage. v) Balancing phase currents. vi) Energy conservation techniques related to commercial losses. 2.10 Numerical on Power factor improvement.
UNIT 3. Energy Conservation in Electrical &Thermal Utility	**HRS -12 MARKS-18**
3a.Explain the energy conservation techniques for specified lighting installation. 3b. Describe the techniques for energy conservation for the given electrical machine. 3c. Select the relevant conservation technique for the given electrical machine with justification. 3d. Select the techniques to improve the performance /efficiency for the given type of electrical machine. 3e. Select the relevant conservation techniques for the given industrial resistance oven. 3f. Select the relevant conservation techniques for the given furnace.	3.1 Energy conservation in lighting installation on the following basis- i) By replacing Lamp sources. ii) Using energy efficient luminaries. iii)Using light controlled gears. iv) By installation of separate transformer / servo stabilizer for lighting. v) Periodic survey and adequate maintenance programs. 3.2 Need for energy conservation in three phase induction motor. 3.3 Various energy conservation techniques in three phase induction motor a. By improving Power quality. b. By motor survey. c. By matching motor with loading. d. By minimizing the idle and redundant running of motor. e. By operating in star mode. f. By rewinding of motor. g. By improving mechanical power and transmission efficiency. h. Replacement by energy efficient motor. i. By Periodic maintenance. 3.4 Energy conservation in transformer A) By optimization of loading of transformer i) By proper Location of Transformer preferably close to the load centre considering other features like centralized control, operational flexibility etc. ii)By Maintaining maximum efficiency by adjusting % loading on transformer iii)Connecting transformers in parallel under fluctuating load condition. iv) By periodic maintenance. B) By reducing the losses in transformer i) By selecting proper core & winding material. C) By replacing the transformer by energy efficient transformer. (Only the names to be identified, no details.) i)By using Amorphous core distribution transformer ii)By using Epoxy resin cast / encapsulated dry type

	transformer. 3.5 Energy conservation in industrial oven. i) By use of heat recovery system. ii) By use of adjustable exhaust rate. iii)By use of humidity control system. iv) By use of Lower Explosive Limit (LEL) Monitor v) By use of proper thermal insulating material. vi) By sealing oven openings. vii) By use of variable speed recirculation fan. viii) By incorporating idle mode. 3.6 Energy conservation in furnace by: i) Waste heat recovery from the flue gases ii) Use of regenerative Burners iii) Selecting the right refractory ceramic coatings. iv) Reducing heat storage in Refractory material. v) Reducing heat losses from furnace openings by proper sand and mechanical sealing. vi) Complete combustion with minimum excess air. vii) Maintaining correct amount of furnace draft. viii) Operation at the optimum furnace temperature.
UNIT 4 Economics of Energy Conservation HRS- 06 MARKS-12	
4a. Select the appropriate analytical tools to assess the financial and economic viability of a proposed investmentt for the given energy conservation project. 4b. Determine the energy price of the given facility for energy saving.	4.1Definitions, formula ,selection criterion, simple numerical, advantages & limitations of analytical tools required for financial appraisal of energy conservation project i) Simple payback period. ii) Time value of money - Present & future value iii) Profitability index or Benefit- cost ratio iv) Net present value or discounted cash flow v) Internal rate of return 4.2 Tariff structure- L.T & H.T. Application of following special tariffs to reduce the energy bill.Time- off- day tariff, Peak-off-day tariff, Power factor tariff, Maximum demand tariff, Load-factor tariff, availability-based tariff. (ABT Tariff)
UNIT 5 Energy Conservation Equipment HRS 08 MARKS 14	
5a.Select the relevant energy conservation equipment for the given system /machines with justification. 5b. Describe the various losses in three phase induction motor with percentage of total losses, their reason & remedies to reduce the losses 5c. Describe the constructional features,	5.1 Introduction to energy conservation equipment. 5.2 Energy conservation equipment related to Lighting system. i) Occupancy sensors/Motion Detectors. ii) Photocell iii)Control gears: Dimmers, electronic ballast and Stabilizers. iv) Dusk to dawn Monitor.

working & applications of given energy efficient machine / equipment with justification. . 5d. Describe the constructional features, working & applications of given energy efficient machine / equipment for the given T & D system with justification. .5e. Describe working of the given energy conservation equipment for specific work.	5.3 Losses in three phase induction motor with percentage of total losses, reasons of presence of these losses & suggested modifications in the design features to reduce these losses. 5.4 Energy conservation equipment related to electrical machines, Construction, working and advantages of each energy conservation equipment listed below: i) Energy Efficient Motor. ii) Soft starter for induction motors iii) Static capacitor iv) Automatic star delta converter. vi) Variable Frequency Drives. vii)Amorphous core distribution transformer. viii)Epoxy resin cast / encapsulated dry type transformer. 5.5 Energy conservation equipment in T&D system: i) Maximum Demand Controller ii) KVAR Controller iii) Automatic Power Factor controller iv) Energy Monitor. 5.6 Welding equipment monitor.
UNIT 6 Energy Audit	**HRS. 08 MARKS:14**
6a. Suggest the relevant type of energy audit for the given utility. 6b. Suggest the relevant energy audit instruments for the specified energy audit with justification. .6c. Specify& group the equipment /machines of the given facility as per the norms of ABC analysis. 6d. Develop questionnaire for the energy audit of the given facility. .6e. Develop energy flow diagram (Sankey diagram)for the given facility / apparatus. 6f. Specify the roles & responsibilities of energy manager of the given facility. 6g. Specify the roles & responsibilities of energy auditor of the given facility. 6h. Calculate the simple payback period in the given situation 6i. Prepare the energy audit report for the given facility /apparatus.	6.1Energy audit- Definition & objectives. Classification of energy audit. Preliminary audit or walk-through audit - objectives & procedure.Detailed audit- objectives & procedure. 6.2 Energy audit instruments & their use. 6.3. ABC Analysis 6.4 Questionnaire for energy audit projects 6.5 Energy flow diagram or Sankey diagram. 6.6 Roles & responsibilities of energy manager. 6.7 Roles& responsibilities of energy auditor. 6.8 Numerical on calculation of simple pay back period after adopting energy conservation measures. 6.9 Energy audit report format.

8. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN-

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Energy Conservation Basics	02	02	02	--	04
II	Energy Conservation in Electrical System	12	04	08	06	18
III	Energy Conservation in Electrical & Thermal Utility	12	04	10	04	18
IV	Economics of Energy Conservation	06	02	04	06	12
V	Energy Conservation Equipment	08	02	10	02	14
VI	Energy Audit	08	02	06	06	14
Total		**48**	**16**	**40**	**24**	**80**

9. SUGGESTED STUDENT ACTIVITIES

Other than the classroom and laboratory learning, following are the suggested student-related ***co-curricular*** activities which can be undertaken to accelerate the attainment of the various outcomes in this course: Students should conduct following activities in group and prepare reports of about 5 pages for each activity, also collect/record physical evidences for their (student's) portfolio which will be useful for their placement interviews:

Prepare journal based on practical performed in Electrical laboratory. Journal consists of drawing, observations, required equipment's, date of performance with teacher signature.

a) Carry out internet survey (BEE/MEDAwebsite) to collect information related Energy conservation projects.
b) Collect the catalogues of star labelled equipment(min.2)
c) Write the report on performance of motor after rewinding.
d) Collect videos to demonstrate working of Energy Conservation Equipment (any 2)
e) Prepare PPT presentation on energy efficient motors
f) Prepare PPT presentation on energy efficient transformers.
g) Collect information about energy efficient luminaries.
h) Collect list different Manufactures of energy saving equipment.
i) Collect list different suppliers of energy saving equipment.
j) Collect videos to demonstrate working of Energy Audit instruments.
k) Visit a facility adopting cogeneration system and prepare a presentation.

10. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are sample strategies, which the teacher can use to accelerate the attainment of the various outcomes in this course:

These are sample strategies, which the teacher can use to accelerate the attainment of the various outcomes in this course:

a. Massive open online courses (***MOOCs***) may be used to teach various topics/sub topics.
b. About ***15-20% of the topics/sub-topics*** which is relatively simpler or descriptive in nature is to be given to the students for ***self-directed learning*** and assess the development of the COs through classroom presentations (see implementation guideline for details).
c. With respect to item No.8, teachers need to ensure to create opportunities and provisions for ***co-curricular activities***.
d. Guide student(s) in undertaking micro-projects.
e. Correlate subtopics with power plant system and equipment.
f. Use proper equivalent analogy to explain different concepts.
g. Use Flash/Animations to explain various components, operation and
h. Teacher should ask the students to go through instruction and Technical manuals

11. SUGGESTED MICRO-PROJECTS

Only one micro-project is planned to be undertaken by a student that needs to be assigned to him/her. In the first four semesters, the micro-projects are group-based. However, in the fifth and sixth semesters, it should be preferably be individually undertaken to build up the skill and confidence in every student to become problem solver so that s/he contributes to the projects of the industry. In special situations where groups have to be formed for micro-projects, the number of students in the group should not exceed three.

The micro-project could be industry application based, internet-based, workshop-based, laboratory-based or field-based. Each micro-project should encompass two or more COs which are in fact, an integration of PrOs , UOs and ADOs. Each student will have to maintain dated work diary consisting of individual contribution in the project work and give a seminar presentation of it before submission. The total duration of the micro-project should not be less than 16 (sixteen) student engagement hours during the course. The student ought to submit micro-project by the end of the semester to develop the industry orientedCOs.

A suggestive list of micro-projects is given here. Similar micro-projects could be added by the concerned faculty (Any one by one batch):

a. Energy efficient lamps:Prepare comparative charts with ratings, cost and manufacturer details.
b. Energy conservation campaign: Prepare charts/slogans to create energy conservation awareness in polytechnic
c. Energy efficient electrical machines: Prepare technical presentation on details of energy efficient transformers& motors
d. Energy conservation policies. Prepare report on energy conservation policies of Govt. Maharashtra 2017
e. Energy Manager and Energy Auditor: Identify from available resources their roles and responsibilities.

12. SUGGESTED LEARNING RESOURCES

Sr. No.	Title of Book	Author	Publication
1	Guide books no.1 to 4 for National Certification examination for Energy Managers &Energy auditors	Bureau of Energy Efficiency (BEE)	Bureau of Energy Efficiency (Forth Edition 2015)
2	Energy Resources &Management	Renu Dhupper	Cbs Publication ISBN - 978812392575
3	Energy management & Conservation	K V Sharma P Venkataseshaiah	I.K. International Publishing House Pvt. Ltd. ISBN:978-93-81141-29-8
4	Energy Management	Umesh Rathore	SK Kataria& Sons ISBN 978-93-5014-101-4
5	Electrical Energy Conservation & Auditing	Er. Udit Mamodiya	Ashirwad Publication ISBN -139788194250692

13. SOFTWARE/LEARNING WEBSITES

1. .https://beeindia.gov.in/ 2. https://www.mahaurja.com/
3 www.nptel.ac.in 4. https://www.worldenergy.org/

14. PO - COMPETENCY- CO MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	2	2	1	1	3	1	3
CO2	3	2	3	2	3	3	3
CO3	3	3	2	2	2	1	2
CO4	3	3	2	2	2	1	3
CO5	2	3	2	2	2	1	2
CO6	2	3	2	2	2	1	3

CO	PSO1	PSO2	PSO3	PSO4
CO1	3	2	1	2
CO2	3	2	1	2
CO3	2	2	1	2
CO4	3	3	2	2
CO5	3	2	2	2
CO6	1	1	1	3

Sign: Name: 1. Smt. A. N. Duraphe 2. Dr. V.K Jadhav (Course Experts)	Sign: Name: Dr. S. S. Bharatkar/Shri.R. U. Shelke (Head of Department)
Sign: Name:Dr. S.S. Bharatkar/Shri.R. U. Shelke (Program Head) (Department of Electrical Engineering)	Sign: Name: Shri. A. S. Zanpure (CDC Incharge)

Level 5 - A Curriculum

Government Polytechnic, Pune

'180 OB'– Scheme

Programme	Diploma in ET/CE/**EE**//ME/MT/CM/IT/DDGM
Programme code	01/**02**/03/04/05/06/07/08/15/**16**/17/18/19/21/**22**/23/24/26
Name of Course	**Microcontroller & its Applications**
Course Code	**EE5101**
Prerequisite course code and name	**ET3101 (Digital Techniques & Applications)**
Class Declaration	**Yes**

1. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P)		Examination Scheme				
					Theory		Practical		Total Marks
L	T	P	C		ESE	PA	* ESE	PA	
03	01	02	06	Marks	80	20	25	25	150
				Exam Duration	3 Hr	1 Hr	--	--	

Legends: L- lecture, T-Tutorial/teacher guided theory practice, P-practical, C-Credits, ESE-End semester examination, PA- Progressive Assessments(Test I, II/Term Work), * - Practical Exam, $ - Oral Exam. # - Online Exam., Each lecture/practical period is of one clock hour.

2. RATIONALE

Microcontroller is used in almost all the domestic, industrial, consumer goods and other high end products. Automation is used in every field of engineering and microcontroller is inbuilt element of these systems and devices. Diploma engineers have to deal with various microcontroller based systems and maintain them. This course is intended to develop the skills to maintain and solve the application problems related to microcontrollers.

3. COMPETENCY

The aim of this course is to attain following industry identified competency through various teaching learning experiences:

- **Code assembly language program for required application**
- **Use microcontroller & IOT in different applications**

4. COURSE OUTCOMES (COs)

The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry oriented COs associated with the above mentioned competency**:**

1: Analyze architecture of microcontroller ICs & its comparison with microprocessor
2: Interpret special features of 8051 Microcontroller.
3: Execute different instructions of 8051 .
4: Interpret the program for 8051 in assembly language for given operations.
5: Use microcontroller in different applications.
6: Use IOT & Arduino in different applications

5. SUGGESTED PRACTICALS/ EXERCISES

Pr. No	**Unit No.**	**Practical Exercises** (Learning Outcomes in Psychomotor Domain)	**Relevant CO**	**Approx. Hrs.**
1	3	Introduction to keil software	1,4	02
2	4	Write an assembly language program using various addressing modes and assembler directives.	3, 4	04
3	4	Write an assembly language program to perform arithmetic operations such as addition, subtraction, multiplication and division.	3, 4	04
4	4	Write an assembly language program to transfer data from source to destination location of internal / external data memory.	2, 3, 4	04
5	4	Write an assembly language program to find smallest / largest number from the given data bytes stored in internal / external data memory locations.	2, 3, 4	04
6	4	Write an assembly language program for arranging numbers in ascending and descending order stored in external memory locations.	2, 3, 4	04
7	5	Interface LED with microcontroller and turn it ON with microcontroller interrupt.	2,4,5	02
8	4	Develop an assembly language program to generate pulse and square wave by using Timer Delay.	2,3, 4,5,	02
9	5	Interface 7-Segment display to display number from 0 to 9.	4,5	02
10	5	Interface relay with microcontroller and Turn it ON/OFF.	4,5	02
11	5	Interface LCD with 8051 microcontroller to display characters and decimal numbers.	4,5	02
12	5	Interface given keyboard with 8051 and display the key pressed.	4,5	02
13	5	Interface ADC with 8051 microcontroller and verify input/output.	4,5	02
14	5	Interface stepper motor to microcontroller and rotate in clockwise and anti-clockwise direction.	4,5	02
15	6	Study of IOT based water level control.	6	02
16	6	Study of ardiuno based home automation.	6	02
17		Microproject planning & Execution as written in suggested microproject list		02
18		Microproject report writing		02
19		Suggested student activity report		02
(Note : Sr. No.**1 to 6compulsory** and any **5** from the remaining **)**			**Total**	38

S.No.	Performance Indicators	Weightage in %
a.	Arrangement of available equipment or model for testing	20
b.	Setting and operation	15
c.	Safety measures	20
d.	Observations and Recording	15
e.	Interpretation of result and Conclusion	15
f.	Submission of report in time	15
Total		**100**

6. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

The major equipment with broad specification mentioned here will usher in uniformity in conduct of practical, as well as aid to procure equipment by authorities concerned**.**

S. No.	Equipment Name with Broad Specifications	Pr. No.
1	Microcontroller kit :- single board systems with 8K RAM, ROM with battery backup, 16*4, 16*2, LCD display, PC keyboard interfacing facility, Hex keypad facility, Single user cross c compiler, RS232, USB interfacing facility with built in power supply or any other equivalent.	1 to 14
2	Desktop PC with microcontroller simulation software	1 to 14
3	Stepper motor	14
4	Keyboard 4*4 Trainer Board	12
5	Relay Trainer board suitable to interface with 8051 trainer kit.	10
6	7-segment LED display Common anode/common cathode	7
7	ADC(0808) Trainer board	13
8	LCD Trainer board	11

7. THEORY COMPONENTS-

The following topics/sub topics should be taught and assessed in order to develop UOs for achieving the COs to attain the identified competency**.**

Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
SECTION - I	
Unit -1 Introduction to Microcontrollers Hrs 04Marks 04	
1a. Define the terms 1b. List the differences between microcontroller and microprocessor. 1c. Draw the Schematic block diagram of a microcontroller and explain its features 1d. Explain the difference between Von-Neumann and Harvard architecture 1e. Explain the difference between	1.1 Review of the terms: CPU, Memory, Input unit, Output unit, BUS,RAM, ROM. 1.2 Comparison between a microcontroller and microprocessor. 1.3 Schematic block diagram of a microcontroller. Features of microcontroller 1.4Von-neumann (Princeton) and Harvard architecture. 1.5 Reduced Instruction Set Computer (RISC) and

RISC and CISC machines 1f. Compare features of Commercial microcontroller	Complex Instruction Set Computer(CISC) machines. 1.6 Features of Commercial microcontroller.
Unit Outcomes (UOs) (in cognitive domain)	**Topics and Sub-topics**
Unit-2 8051 Architecture	**Hrs : 12 Marks : 22**
2a. Explain the Architecture of 8051 Microcontroller with its block diagram 2b. Explain the pin diagram of 8051 Microcontroller 2c. Explain the memory organization of the 8051 Microcontroller 2d. Explain the internal I/O port structure and configuration 2e. Define the stack and explain its uses 2f. Define the timers and counters and explain its uses 2g.Define the Interrupts and explain its uses 2h. Describe the additional features of the 8052 microcontroller	2.1 Block diagram of internal architecture 2.2 Pin diagram, function and alternate function of pins 2.3 System clock, machine cycles and reset circuit. 2.4 Memory Organization :Internal program and data memory, external memory interface 2.5 Register banks, bit and byte addressable area. 2.6 Registers: PC, DPTR, A&B, PSW and other Special function , registers(SFR) 2.7 I/O port structure and configuration of P0, P1,P2,P3 2.8 Stack and stack pointer register 2.9 Timer/counter control logic and interrupts. 2.10 TMOD and TCON SFR map. 2.11 Timer modes of operation. 2.12 Interrupt sources. 2.13 IE and IP SFR map 2.14 Interrupt priorities 2.15 Comparison of 8051 with 8052 microcontroller
Unit-3 Instruction Set & Addressing Modes of 8051	**Hrs : 08 Marks : 14**
3a. Explain the Instruction syntax and data types of the 8051 3b. Explain the use of given assembler directives with examples. 3c. Explain the Addressing modes of the 8051 3d. Explain the Instruction set of 8051 microcontroller	3.1 Instruction syntax and data types : Op-code, Operand, label, comment. 3.2 Assembler directives -ORG,DB, EQU, END 3.3 Data types and data range 3.4 Addressing modes: Immediate, register, direct, indirect, indexed, relative, absolute, bit inherent, bit direct. 3.5 Definition of basic parameters: T-State, machine cycle, instruction cycle. 3.6 Instruction set.(Data moving instructions, logical & arithmetic Instructions, Jump, call instructions, subroutines, Bit related instructions, stack operation)
SECTION – II	
Unit-4 Assembly Language Programming	**Hrs : 06 Marks : 12**
4a. Explain the structure of an Assembly language program 4b. Develop assembly language programs to perform simple operations	4.1 Assembly language programming process 4.2 Develop assembly language programs for the following commonly used applications: i) Addition and subtraction of two 8 bit, 16 bit signed/unsigned numbers. ii) Multiplication and division on two 8 bit/16 bit unsigned numbers.

4c.Write an ALP to generate a delay for the given crystal frequency	iii) Find largest and smallest number integer of an array. iv) Average of 8-bit numbers. v) Data transfer from one location to other. vi) Display required output on given port vii) Set / mask the given bit 4.3 Incrementing and decrementing the contents of registers and RAM. Programming for the same. 4.4 Calls and Subroutines, Programming for the same. 4.5 Simple programs on timer to generate time delay : i) Programmable delay generation. ii) Program to generate square wave on the port pin using timer. iii) Simple program for demonstrating interrupt service.
Unit-5 Memory , IO Device Interfacing & Industrial Applications Hrs : 12 Marks : 18	
5a. Describe with sketch interfacing of the given external memory. 5b. Explain with sketch interfacing of external IO devices. 5c.Write an assembly language program to operate the given IO device. 5d. Draw interfacing diagram and develop flowchart for measurement application	5.1 Draw a neat diagram and describe : Memory Interfacing : Program and data memory 5.2 Draw interfacing diagram and develop flowchart to interface following with 8051 i) LED ii) LCD iii) Relay iv) 4x4 Matrix Keyboard v) DAC (0808) vi) ADC (0809) vii) Stepper Motor viii) DC Motor 5.3 Develop assembly language program for Stepper Motor control to rotate clockwise / anticlockwise 5.4 Draw interfacing diagram and develop flowchart for the following measurement applications: i) Angular speed measurement, ii) Temperature measurement, iii) current, voltage, power & Energy measurement
Unit-6 IOT & Arduino	**Hrs : 06 Marks : 10**
6a.Define IOT 6b. State applications of IOT 6c. Describe IOT application with Android & Arduino board 6d. Describe Arduino based IOT 6e. State the protocols in wireless sensor network 6f. Explain the physical design of IOT with Android & Arduino 6g.Describe logical design & functional blocks of IOT.	6.1 Definition of IOT & concept of Internet of Things. 6.2 Applications of IOT in different fields, 6.3 Implement a basic IOT application with Android and Arduino board 6.4 Introduction to Arduino & Arduino based IOT . 6.5 Basic protocols in wireless sensor network . 6.6 Physical design of IOT :Components of IOT with Android and Arduino such as i) Arduino , ii) ESP8266 ESP-01(Wi-Fi module for Internet access), iii)3.3 V voltage regulator, iv) 10K resistances , v) connectors,wires, buttons, LED's , PCB etc. 6.7 Logical design of IOT ,functional blocks of IOT

8. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN :

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Introduction to Microcontrollers	4	02	02	00	04
II	8051 Architecture	12	08	08	06	22
III	8051 instruction set &addressing modes of 8051	8	04	04	06	14
IV	Assembly language programming	6	02	04	06	12
V	8051 memory & I/O device interfacing	12	04	04	10	18
VI	IOT & Arduino	6	02	02	06	10
Total		48	**22**	**24**	**34**	**80**

9. SUGGESTED STUDENT ACTIVITIES

Other than the classroom and laboratory learning, following are the suggested student-related ***co-curricular*** activities which can be undertaken to accelerate the attainment of the various outcomes in this course: Students should conduct following activities in group and prepare reports of about 5 pages for each activity, also collect/record physical evidences for their (student's) portfolio which will be useful for their placement interviews:

a. Prepare journal based on practical performed in laboratory. Journal consists of drawing, observations, required equipment's, date of performance with teacher signature.
b. Follow the safety precautions.
c. Give seminar on relevant topic.
d. Library / Internet survey regarding different data books and manuals.
e. Prepare power point presentation on applications of microcontroller.
f. Undertake a market survey of different microcontrollers.

10. SUGGSTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are sample strategies, which the teacher can use to accelerate the attainment of the various outcomes in this course:

a. Massive open online courses (***MOOCs***) may be used to teach various topics/sub topics.
b. About ***15-20% of the topics/sub-topics*** which is relatively simpler or descriptive in nature is to be given to the students for ***self-directed learning*** and assess the development of the COs through classroom presentations (see implementation guideline for details).
c. With respect to item No.8, teachers need to ensure to create opportunities and provisions for ***co-curricular activities***.
d. Guide student(s) in undertaking micro-projects.
e. Correlate subtopics with power plant system and equipment.
f. Use proper equivalent analogy to explain different concepts.
g. Use Flash/Animations to explain various components, operation and
h. Teacher should ask the students to go through instruction and Technical manuals

11. SUGGESTED MICRO-PROJECTS –

Only one micro-project is planned to be undertaken by a student that needs to be assigned to him/her in the beginning of the semester. In the first four semesters, the micro-project are group-based. However, in the fifth and sixth semesters, it should be preferably be ***individually*** undertaken to build up the skill and confidence in every student to become problem solver so that s/he contributes to the projects of the industry. In special situations where groups have to be formed for micro-projects, the number of students in the group should ***not exceed three.***

The micro-project could be industry application based, internet-based, workshop-based, laboratory-based or field-based. Each micro-project should encompass two or more COs which are in fact, an integration of PrOs, UOs and ADOs. Each student will have to maintain dated work diary consisting of individual contribution in the project work and give a seminar presentation of it before submission. The total duration of the micro-project should not be less than ***16 (sixteen) student engagement hours*** during the course. The student ought to submit micro-project by the end of the semester to develop the industry oriented COs.

A suggestive list of micro-projects is given here. Similar micro-projects could be added by the concerned faculty:

a. Prepare a chart of various features using data sheets of 8051 microcontroller and its derivatives.
b. Prepare a chart showing historical evolution of microcontrollers.
c. Prepare a chart of stepper motor to display its features and steps for its operations using data sheets.
d. Prepare a chart of various features and operations of temperature sensors using data sheets.
e. Prepare a chart of various types of LCDs to display its features, pin functions and steps of operations using data sheets.
f. Prepare a chart of various types of 7-segment displays, keyboard to display its features and steps for its operations using data sheets.
g. Build a class period bell using microcontroller.
h. Build a room temperature circuit using microcontroller.
i. Design ardiuno based switching panel.

12. SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication
1	8051 Microcontroller: Hardware, Software and application.	V. Udayashankara M. S. Mallikarjuna Swamy	Tata McGraw Hill Education Pvt Ltd ISBN 978-0-07-008681-4
2	8051 Microcontroller, Architecture, programming and application.	Kenneth J Ayala	PHI learning NEW DELHI,july 2004,ISBN: 978-1401861582
3	Microcontroller Theory and Application	Ajay V. Deshmukh	McGraw Hill ,New Delhi,2011,ISBN-9780070585959
4	Microcontroller Principle and Application	AjitPal	PHI Learning ,New Delhi,2014,ISBN: 978-81-203-4392-4

S. No.	Title of Book	Author	Publication
5	The 8051 Microcontroller and Embedded system Using Assembly and C	Mumhammad Ali Mazidi, Janice Gillispie Mazidi, Rolin D. Mackinlay	Pearson/Prentice Hall , 2nd edition ,Delhi,2008,ISBN 9788177589030
6	Internet Of Things : A Hands-On Approach	Arshdeep Bahga , Vijay Madisetti VPT	Paperback 2015, ISBN: 978-0996025515

13. SOFTWARE/LEARNING WEBSITES

- www.circuitstody.com/8051-microcontroller
- www.nptel.comwww.nptel.com
- www.8051projects.net/files/public/1252055169_5507_FT25871_12_times_and_counte rspdf
- www.dauniv.ac.in/downloads/MController_PPTs/MicroC2_eCH03L02Memort.pdf
- www.microdigitaled.com/8051/Software/keil_tutorial_v2.pdf

14. PO - COMPETENCY- CO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	2	1	3	2	3	--	3
CO2	2	2	3	2	2	2	3
CO3	1	2	3	2	2	3	3
CO4	1	3	3	3	3	3	3
CO5	3	2	3	3	3	3	3
CO6	1	2	3	3	3	3	3

	PSO1	PSO2	PSO3	PSO4
CO1	1	3	2	--
CO2	2	2	1	1
CO3	1	2	3	2
CO4	3	3	3	3
CO5	3	3	3	3
CO6	1	3	1	--

Sign: Name: 1. Smt. S.P.Phadnaik 2. Shri. J. G. Momin (Course Experts)	Sign: Name:Dr.S. S. Bharatkar/Shri.R. U. Shelke (Head of Department)
Sign: Name: Dr.S. S. Bharatkar/Shri.R. U. Shelke (Program Head) (Department of Electrical Engineering)	Sign: Name: Shri A. S. Zanpure (CDC Incharge)

Government Polytechnic, Pune

'180 OB'– Scheme

Programme	Diploma in ET/CE/**EE**//ME/MT/CM/IT/DDGM
Programme Code	01/**02**/03/04/05/06/07/08/15/**16**/17/18/19/21/**22**/23/24/26
Name of Course	**Industrial Automation**
Course Code	**EE5102**
Prerequisite course code and name	**EE 4105 (AC Machines)**
Class Declaration	**Yes**

1. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P)		Examination Scheme				
					Theory		Practical		Total Marks
L	T	P	C		ESE	PA	$ ESE	PA	
03	01	02	06	Marks	80	20	25	25	150
				Exam Duration	3 Hrs	1 Hr	--	-	

Legends: L- lecture, T-Tutorial/teacher guided theory practice, P-practical, C-Credits, ESE-End semester examination, PA- Progressive Assessments(Test I, II/Term Work), * - Practical Exam, $ - Oral Exam. # - Online Exam., Each lecture/practical period is of one clock hour.

2. RATIONALE

Diploma holder, employed in the industry, needs to operate, test and maintain the industrial control circuits. It is very essential for him/her to know the PLC programming and logic of process control circuits. The aim of this course is to develop competencies in the technician, to carry out various responsibilities in the industry, related to industrial control and automation.

3. COMPETENCY

The aim of this course is to attend following industry identified competency through various teaching learning experiences:

Design, develop, interpret diagrams, install, troubleshoot and maintain PLC based industrial control systems used in the industry and power systems

4. COURSE OUTCOMES (COs)

The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry-oriented COs associated with the above mentioned competency**.**
After studying this course, the student will be able to:

1: Identify control circuit components.
2: Develop control circuit using contactors & relays.
3: Develop ladder diagram for various logics.
4: Connect input/output devices to PLC and test it in different applications.
5: Carry out installation, troubleshooting and maintenance of PLCs.
6: Identify components of SCADA system.

5. SUGGESTED PRACTICALS/ EXERCISES

Pr. No	Unit No.	**Practical Exercises** (Learning Outcomes in Psychomotor Domain)	Relevant CO	Approx. Hrs. required
1	1	To Identify symbols used in industrial control diagrams.	1	02
2	1	To develop control circuit for DOL Starter	2	02
3	2	To develop control circuit for Forward-Reverse control of 3-phase induction motor.	2	04
4	2	To develop control circuit for Semi-Automatic Star-Delta Starter	2	02
5	2	To develop control circuit for Fully Automatic Star-Delta starter.	2	02
6	3	To develop ladder diagram for all logic gates	3	02
7	2	To develop ladder diagram for DOL Starter	3	02
8	2	To develop ladder diagram for i) Semi-Automatic and ii) Fully Automatic Star-Delta starter	2, 3	02
9	2	To develop ladder diagram for Forward-Stop-Reverse control of 3-phase induction motor.	2, 3	02
10	4	To develop ladder diagrams using PLC (Software) Counters	2,	02
11	4	To develop ladder program for running a stepper motor in clockwise/ anticlockwise direction	3, 4	02
12	5	To develop ladder program for simulating traffic light control	3,4	02
13	5	To develop ladder program for Automatic control of water pump.	3,4	02
14	6	To develop ladder program for ON/OFF temperature control	3, 4	02
15	5 ,8	To develop ladder for a Pneumatic system and develop SCADA for the same	3,6	02
16		Micro-project planning & Execution as written in suggested micro-project list		02
17		Micro-project report writing		02
18		Suggested student activity report		02

6. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

The major equipment with broad specification mentioned here will usher in uniformity in conduct of practicals, as well as aid to procure equipment by authorities concerned**.**

Sr. No.	Equipment Name with Broad Specifications	Pr. No.
1	Control components: Push buttons (6 Nos.), Indicating Lamps (6 Nos.), Limit Switches (2 Nos.), Proximity Switches (inductive proximity switches,2 Nos. and capacitive proximity switches ,2 Nos.)	2,14
2	Stepper Motor Drive model	11
3	3-Ø A.C. Contactors (3Nos.)	3, 5, 6, 7, 8
4	Traffic Light Simulation Model	13
5	3-Ø Induction Motor of small rating (<1HP)	3, 5, 6, 7, 8
6	PLC with minimum 8 I/Os and HMI and its programming software	1, 4, 6, 9,15
7	Temperature measurement and control system	12

Sr. No.	Performance Indicators	Weightage in %
a.	Arrangement of available equipment or model for testing	20
b.	Setting and operation	15
c.	Safety measures	20
d.	Observations and Recording	15
e.	Interpretation of result and Conclusion	15
f.	Submission of report in time	15
	Total	**100**

7. THEORY COMPONENTS

The following topics/sub-topics should be taught and assessed in order to develop UOs for achieving the COs to attain the identified competency**.**

Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
SECTION-I	
UNIT- 1: Introduction to Control Circuits and Its Components Hrs : 07 Marks :10	
1a. Explain general idea of controls. 1b. State the advantages of magnetic control over manual control. 1c. Develop control circuits for DOL Starter using contactor & relay	1.1 General idea of controls. 1.2 Manual controls, Magnetic controls, Relay Logic. Advantages of magnetic control 1.3 Concept of Power circuit and Control circuit. Development of control circuits. Control of Induction motor by DOL Starter using contactor & relay

Unit Outcomes (UOs) (in cognitive domain)	**Topics and Sub-topics**
	Remote control operation of motor.
1d. Develop control circuit with interlocking.	1.4 Concept of interlocking of drives, necessity and development of control circuit.
1e. List types of switches.	1.5 Input devices – Push button switches their working, uses and ratings. Concept of NO, NC. Foot switches, Selector switches – working and applications 1.6 Simple Limit switch. Its working, uses and ratings.
1f. Explain working of Proximity switches. 1g. Explain working of Proximity switches.	1.7 Proximity switches- Inductive, Capacitive, Photoelectric, Ultrasonic. Their working, uses and ratings. 1.8 Pressure switches - their working, uses and ratings.
1h. Explain working of Pressure switches, 1i. Explain construction and working of Solenoid type Contactors.	1.9 Output devices – Solenoid type Contactors. Their construction, working applications and ratings 1.10 Relays as output devices of PLC.
1j. Explain use of Relays as output devices of PLC. 1k. Use Timers in control circuits. 1l. Use Pilot lamps, Indicating lights, 1m. Draw symbols of devices.	1.11 Use of Timers in control circuits. 1.12 Use of Pilot lamps, Indicating lights, Alarms. 1.13 Symbols of control devices.
UNIT-2: Design of Control Circuits (Magnetic control)	**Hrs : 04 Marks : 06**
2a. Design Power and Control circuit for Star-Delta Starter – Manual, Semi-automatic, Automatic.	2.1 Star-Delta Starter – Manual, Semi-automatic, Fully-automatic.
2b. Design Power and Control Circuit for Forward – Reverse control of 2 phase induction motor.	2.2 Forward – Reverse control of 3phase induction motor.
2c. Design control circuit for water level control system	2.3 Forward – Reverse control of 1 phase induction motor – Universal motor
UNIT-3 :Fundamentals of PLC	**Hrs : 06 Marks : 12**
3a. Define PLC. 3b. List PLC manufacturers. 3c. Compare PLC with Relay Logic.	3.1 PLC Definition. 3.2 PLC manufacturers 3.3 Advantages and disadvantages of PLC over relay logic.
3d. Compare PLC with PC.	3.3 Advantages and disadvantages of PLC over PC.
3e. List types of PLCs. 3f. Describe architecture of PLC.	3.5 Type of PLCs. 3.6 Architecture of PLC. – block diagram, Input image file, output image file, scan cycle and watchdog timer.

Unit Outcomes (UOs) (in cognitive domain)	**Topics and Sub-topics**
3g. Explain sink/source concept. 3h. Show connections of I/O devices to PLC. 3i. Explain power supply for PLC systems. 3j. Compare communication protocol cables for PLC. 3k. List Programming languages of PLC.	3.7 Input, output modules – Types, sink/source concept. 3.8 Connection of I/O devices to PLC. 3.9 Function of Power supply in PLC – Load Power supply, PLC Power supply. Technical specifications of power supply. 3.10 Communication protocols – RS 232, RS385, Ethernet. Features, limitations, cables and terminations. 3.11 Programming languages of PLC. IEC 61131-3
UNIT-4 :Programming of PLC	**Hrs : 07 Marks : 12**
4a. Explain rules for ladder programming. 4b. Draw and explain simple ladder diagrams.	4.1 Rules for proper construction of PLC Ladder Diagram. 4.2 Programming On-Off inputs to produce On-Off outputs. NO, NC, Latch, Unlatch, Memory. Addressing systems. Programming Logic gates.
4c. Draw and explain ladder diagrams for logic gates. 4d. Draw and explain ladder diagrams using Timers. 4e. Draw and explain ladder diagrams using Counters. 4f. Draw and explain ladder diagrams for Arithmetic functions. 4g. Draw and explain ladder diagrams for Comparison Functions.	4.3 PLC Logic gates. Types of logic gates 4.4 PLC Timer function block, Types of timers. 4.5 PLC Counter function block, Types of Counters. 4.6 PLC Arithmetic functions - Addition, Subtraction, Multiplication, Division. 4.7 PLC Number comparison functions - Equal to, Not equal, Greater than, Greater than equal to, Less than, Less than equal to.
SECTION-II	
Unit-5:Ladder Diagram for Process Control	**Hrs : 12 Marks : 16**

Unit Outcomes (UOs) (in cognitive domain)	**Topics and Sub-topics**
5a. Draw flowchart of a process. Create basic ladder diagram from sequence of operational steps. Describe these steps. 5b. Develop ladder diagram for Sequential operation of motors. 5c. Develop ladder diagram for Automatic control of water pump. 5d. Develop ladder diagram for Skip hoist control 5e. Develop ladder diagram for Air Compressor. 5f. Develop ladder diagram for Conveyor system. 5g. Develop ladder diagram for Pneumatic / Hydraulic System.	5.1 Creating ladder diagram from process control description. Flow charting and development of ladder diagram. 5.2 Sequential operation of motors. 5.3 Automatic control of water pump. 5.4 Skip hoist control 5.5 Air Compressor. 5.6 Conveyor system. 5.7 Pneumatic / Hydraulic System.
UNIT-6: PLC Analog Operation Basics	**Hrs : 04 Marks : 06**
6a. Differentiate between discrete and analog operation of PLC. 6b. List and define the various major types of analog inputs. 6c. PLC analog inputs and outputs with their ranges. 6d. Develop ladder diagram for analog application.	6.1 Discrete and Analog signals. 6.2 Types of Analog modules and systems and their rages. 6.3 Analog signal processing. 6.4 PLC Analog output applications.
UNIT-7:PLC Installation, Troubleshooting and Maintenance	**Hrs : 04 Marks : 12**
7a. Describe operating environment for PLC. List and discuss the procedure for checking the parts of PLC as received from the manufacturer. 7b. Describe the procedure for assembling and interconnecting the PLC system. 7c. List the reasons for grounding and suppression and how they both are accomplished. 7d. List and describe PLC troubleshooting procedures. 7e. List and describe general and preventive maintenance procedure for PLCs. 7f. List factors to be considered for selection of PLC.	7.1 Consideration of the operating environment. Receiving and checking of PLC. 7.2 Testing and assembly: Electrical connections. 7.3 Grounding and suppression: Circuit protection and wiring. 7.4 Troubleshooting, PLC malfunctions. 7.5 PLC maintenance. 7.6 Factors to be considered in selecting PLC.
UNIT-8: Introduction to SCADA and DCS	**Hrs : 04 Marks : 06**
8a. Identify the specified components of SCADA system	8.1 SCADA overview

Unit Outcomes (UOs) (in cognitive domain)	**Topics and Sub-topics**
8b. Explain architecture of SCADA. 8c. State advantages and limitations of SCADA. 8d. Identify the specified components in the given DCS diagram Compare the salient features of given types of SCADA and DCS Systems using block diagram	8.2 Architecture of SCADA(Monolithic, Distributed and Networked) 8.3 Advantages and limitations of SCADA. 8.4 Concept of DCS (Distributed Control System)

8. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
1	**Introduction to Control Circuits and Its Components**	07	04	02	04	10
2	**Design of Control Circuits (Magnetic Control)**	04	02	02	02	06
3	**Fundamentals of PLC**	06	04	04	04	12
4	**Programming of PLC**	07	04	06	02	12
5	**Ladder Diagram for Process Control**	12	06	06	04	16
6	**PLC Analog Operations**	04	02	02	02	06
7	**PLC Installation, Troubleshooting and Maintenance**	04	08	04	----	12
8	**Introduction to SCADA and DCS**	04	04	02	----	06
Total		**48**	**34**	**28**	**18**	**80**

9. SUGGESTED STUDENT ACTIVITIES

Other than the classroom and laboratory learning, following are the suggested student-related ***co-curricular*** activities which can be undertaken to accelerate the attainment of the various outcomes in this course: Students should conduct following activities in group and prepare reports of about 5 pages for each activity, also collect/record physical evidences for their (student's) portfolio which will be useful for their placement interviews:
Prepare journal based on practical performed in Electrical laboratory. Journal consists of drawing, observations, required equipment's, date of performance with teacher signature.

a) Visit any manufacturing plant having PLC automation.
b) Visit any manufacturing plant with SCADA and HMI.
c) Make a survey of industrial control components based on their specification.
d) Make a survey of commercially available PLC's.
e) Make a library or Internet survey of industrial automation systems.
f) Prepare PPT's on any automation circuits and their behavior.

10. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are sample strategies, which the teacher can use to accelerate the attainment of the various outcomes in this course:

a. Massive open online courses (***MOOCs***) may be used to teach various topics/sub topics.
b. About ***15-20% of the topics/sub-topics*** which is relatively simpler or descriptive in nature is to be given to the students for ***self-directed learning*** and assess the development of the COs through classroom presentations (see implementation guideline for details).
c. With respect to item No.8, teachers need to ensure to create opportunities and provisions for ***co-curricular activities***.
d. Guide student(s) in undertaking micro-projects.
e. Correlate subtopics with power plant system and equipment.
f. Use proper equivalent analogy to explain different concepts.
g. Use Flash/Animations to explain various components, operation and
h. Teacher should ask the students to go through instruction and Technical manuals

11. SUGGESTED MICRO-PROJECTS :

Only one micro-project is planned to be undertaken by a student that needs to be assigned to him/her in the beginning of the semester. In the first four semesters, the micro-project are group-based. However, in the fifth and sixth semesters, it should be preferably be individually undertaken to build up the skill and confidence in every student to become problem solver so that she/he contributes to the projects of the industry. In special situations where groups have to be formed for micro-projects, the number of students in the group should not exceed three.

The micro-project could be industry application based, internet-based, workshop-based, laboratory-based or field-based. Each micro-project should encompass two or more COs which are in fact, an integration of PrOs, UOs and ADOs. Each student will have to maintain dated work diary consisting of individual contribution in the project work and give a seminar presentation of it before submission. The total duration of the micro-project should not be less than 16 (sixteen) student engagement hours during the course. The student ought to submit micro-project by the end of the semester to develop the industry oriented COs.

A suggestive list of micro-projects is given here. Similar micro-projects could be added by the concerned faculty:

a. PLC based colour mixing plant.
b. PLC based bottle filling plant.
c. PLC based water supply system.
d. PLC based induction motor control.
e. PLC based soft starting of induction motor.
f. PLC based series parallel control of traction motors.

12. SUGGESTED LEARNING RESOURCES

S.No.	Title of Book	Author	Publication	ISBN code
1	Control of Machines	S. K. Bhattacharya and Brijinder Singh	New Age International Publication	ISBN 81-224-0363-8
2	Programmable Logic Controllers-Principles and Applications	John W. Webb and Ronald A. Reis	Prentice-Hall of India Private Limited, New Delhi,2003	ISBN: 9780130416728
3	Handbook of Electrical Motor Control Systems	U. S. Eshwar	Tata McGraw-Hill Publishing Company Limited, New Delhi,2013	ISBN: 9780074604380
4	Programmable Logic Controllers	Hackworth. J.R.; Hackworth. F;	Pearson Education, New Delhi,2015	ISBN: 9788177587715
5	Programmable Logic Controllers	Bolton,W.	Elsevier India Pvt. Ltd. New Delhi,2016	ISBN: 9780128029299
6	Programmable Logic Controllers	Petruzella. F.D.	McGraw Hill Education (India) Edition,New York,2016	ISBN: 9780073510880
7	Introduction to PLC	Dunning. G.	Cengage India (2009),	ISBN: 9788131503027

13. SOFTWARE/LEARNING WEBSITES

1. http://etap.com/student-edition ETAP student edition electrical engineering software
2. Powerworld simulator-version21
3.PSS/E (An electrical Engineering software for Power system simulation

14. PO - COMPETENCY- CO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	3	2	1	-	2	2
CO2	3	3	2	3	3	2	3
CO3	3	3	2	-	1	2	2
CO4	3	-	1	3	1	2	2
CO5	3	2	2	2	1	-	3
CO6	3	2	3	1	2	1	3

	PSO1	PSO2	PSO3	PSO4
CO1	1	3	1	3
CO2	3	3	2	3
CO3	-	3	2	3
CO4	3	3	2	1
CO5	3	1	2	3
CO6	2	2	3	2

Sign: Name: 1. Shri. J.G. Momin (Course Expert)	Sign: Name: Dr. S. S. Bharatkar/Shri. R. U. Shelke (Head of Department)
Sign: Name: Dr. S. S. Bharatkar/Shri.R. U. Shelke (Program Head) (Department of Electrical Engineering)	Sign: Name: Shri A. S. Zanpure (CDC Incharge)

Government Polytechnic, Pune

'180OB' – Scheme

Programme	Diploma in ET/CE/**EE**//ME/MT/CM/IT/DDGM
Programme code	01/**02**/03/04/05/06/07/08/15/**16**/17/18/19/21/**22**/23/24/26
Name of Course	**Power System Operation & Control**
Course Code	**EE5103**
Prerequisite course code and name	EE3104 - Generation of Electrical Power & EE3106 - Transmission & Distribution of Electrical Power
Class Declaration	**Yes**

1. TEACHING AND EXAMINATION SCHEME

<table>
<tr><th colspan="3">Teaching Scheme (In Hours)</th><th>Total Credits (L+T+P)</th><th></th><th colspan="5">Examination Scheme</th></tr>
<tr><th colspan="3"></th><th></th><th></th><th colspan="2">Theory</th><th colspan="2">Practical</th><th>Total Marks</th></tr>
<tr><th>L</th><th>T</th><th>P</th><th>C</th><th></th><th>ESE</th><th>PA</th><th>$ ESE</th><th>PA</th><th rowspan="2">150</th></tr>
<tr><td rowspan="2">03</td><td rowspan="2">01</td><td rowspan="2">02</td><td rowspan="2">06</td><td>Marks</td><td>80</td><td>20</td><td>25</td><td>25</td></tr>
<tr><td>Exam Duration</td><td>3 Hrs</td><td>1 Hr</td><td>--</td><td>-</td><td></td></tr>
</table>

Legends: L- lecture, T-Tutorial/teacher guided theory practice, P-practical, C-Credits, ESE-End semester examination, PA- Progressive Assessments(Test I, II/Term Work), * - Practical Exam, $ - Oral Exam. # - Online Exam., Each lecture/practical period is of one clock hour.

2. RATIONALE

The diploma electrical engineers working in power sector, they should be able to aware of active and reactive power flow control mechanisms and methods to analyze power system stability. They should also be aware of load flow studies and load dispatch. Hence, this course is designed to develop awareness about these concepts in diploma pass outs so that they may ensure power system stability. Thus this course is important for diploma electrical engineers, who wish to work in power generation and transmission companies.

3. COMPETENCY

The aim of this course is to attend following industry identified competency through various teaching learning experiences:

1. **Maintain the power system network for stability and load dispatch.**

4. COURSE OUTCOMES (COs)

The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry oriented COs associated with the above mentioned competency**:**

1:- Interpret the representation of power system by using diagram and PU method.

2- Interpret real and reactive power flow in power system

3- Illustrate the functioning of automatic generation control.

4- Understand the development of load flow studies.

5- Apply different techniques to maintain stability of power system

6- Identify and describe factors involved in load dispatch.

5. SUGGESTED PRACTICALS/ EXERCISES

Pr. No.	**Unit No.**	**Practical Exercises** (Outcomes in Psychomotor Domain)	**Relevant CO**	**Approximate Hours Required.**
1.	1	Use CAD/software drawing tools to prepare the representation of power system by using single line schematic diagram of the two bus/three bus/ four bus power system. (any one)	1	02
2.	2	Identify the different voltage controls of H.V. substation with respect to the given video clip with justifications.	2	02
3.	2	Identify the different frequency controls of a power plant with respect to the given video clip with justifications.	2	02
4	3	Identify different components of turbo generator control with respect to the given video clip/animation/chart with justification	3	02
5.	3	Identify different components of turbine speed governing system with respect to the given video clip/animation/chart with justification	3	02
6.	3	Use CAD/software drawing tools to prepare the schematic diagram of the Automatic Voltage Control (AVC) for the given condition.	3	02
7.	3	Use CAD/software drawing tools to prepare the schematic diagram of the Automatic Load Frequency Control (ALFC) for the given condition.	3	02
08.	3	Use CAD/software drawing tools to prepare the schematic diagram of the Automatic Generation Control (AGC) for the given condition.	3	02
09.	4	Use SCILAB to develop Y_{bus} matrix for given 3-bus /4-bus system	4	04
10.	4	During the maintenance outages, determine the effect on SLFE for given power system using relevant software.	4	04
11.	5	Indentify the factors affecting stability of power	5	02

		system through given video clips.		
12	6	Identify the specific function of Load Dispatch Center through given video clips.	6	02
13.	6	Identify the specific reasons for Load Shedding adopted by DISCOM in specific area from given video clip.	6	02
14.		Microproject planning, Execution & Report Writing as suggested in microproject list	1-6	02
		Total Hrs		**32**

Sr.No.	Performance Indicators	Weightage in %
a.	Arrangement of available equipment / test rig or model	20
b.	Setting and operation	20
c.	Safety measures	10
d.	Observations and Recording	10
e.	Interpretation of result and Conclusion	20
f.	Answer to sample questions	10
g.	Submission of report in time	10
Total		**100**

6. MAJOR EQUIPMENT/ INSTRUMENTSREQUIRED

The major equipment with broad specification mentioned here will usher in uniformity in conduct of practical, as well as aid to procure equipment by authorities concerned**.**

Sr.No.	Major Equipment/ Instruments Required	Pr. No.
1	Chart relevant to practical	1 & 3
2	Electrical CAD	1 to 13
3	SCILAB software	9
4	Videos relevant to different practical	1 to 13
5	Internet facility	1 to 13

7. THEORY COMPONENTS

The following topics/sub topics should be taught and assessed in order to develop UOs for achieving the COs to attain the identified competency**.**

Unit Outcomes (UOs) (in cognitive domain)	**Topics and Sub-topics**
Section -I	
UNIT 1 Representation of Power System	**(Marks -10 , Hrs -06)**
1a. Draw and explain the representation of power system by single line diagram. 1b. Describe the per unit impedance of power system by using single line diagram. 1c. Explain the power flow between two bus system through a transmission line and mathematical expression of the real and reactive power at sending and receiving ends. 1d. Illustrate the voltage control methods by using static VAR generator, rotating VAR generator and transformer.	1.1 Representation of power system by single line diagram, impedance or reactance diagram. 1.2 Per unit method for representing power system 1.3 Power flow through a transmission line. 1.4 Methods of voltage control
UNIT 2 Power Flow	**(Marks -18 , Hrs- 10)**
2a. Explain the adverse impact of real and reactive power imbalance in the given situation for the power system. 2b. Explain the adverse impact of variation in frequency on consumers and supply agencies. 2c. Explain the effect of change in voltage on consumers and supply and supply agencies. 2d. Suggest type of compensations for the reactive power under given condition with justification	2.1 Complex power fed to three phase load. 2.2 Concept of power flow, real & reactive power balance and its adverse impact. 2.3 Relation between real power balance and frequency of the system (derivation) 2.4 Need of constant frequency control, adverse impact of variation in frequency on consumers and supply agencies. 2.5 Relation between reactive power balance and voltage of the system. (derivation) 2.6 Effect of change in voltage on consumers and supply agencies. 2.7 Reactive power compensation for load and line.
UNIT 3 Automatic Generation and Voltage Control	**(Marks - 12 , Hrs- 08)**
3a. Draw and describe the schematic diagram of load frequency and excitation voltage regulation of a turo-generator. 3b.Describe the speed governing system of a steam turbine. 3c. Explain with sketches the application of load –frequency control for the given type of control area. 3d. Explain the specified method for voltage control of given alternator using block diagram. 3e. Explain the function of the automatic load frequency control and economic despatch control using the block diagram for	3.1 Schematic diagram of of load frequency and excitation voltage regulation of a turo-generator. 3.2 Turbine speed governing system 3.3 Load frequency control (single area case) 3.4 Load frequency control and economic despatch control. 3.5 Automatic voltage control.

Unit Outcomes (UOs) (in cognitive domain)	**Topics and Sub-topics**
the given type of generator. 3f. Draw the block diagram of automatic generation control for the specified generating system.	
Section –II	
UNIT 4 Load flow studies	**(Marks - 12 , Hrs- 08)**
4a. Identify the significance of load flow analysis for the given power system. 4b. Draw and explain the four bus network model formulation. 4c. Develop the static load flow equation for a simple two bus system. 4d. Indentify significant features of the given Y_{bus} matrix and develop for given four bus system. 4e. Indentify the information obtained from the given load flow study.	4.1 Concept of load flow studies and is need. 4.2 Network model formulation. (simple three or four bus system) 4.3 Formation of Y_{BUS} by singular transformation 4.4 Load flow problem and solution. 4.5 Information obtained from load flow studies.
UNIT 5 Power system Stability	**(Marks - 18 , Hrs- 10)**
5a. Explain the specified type of stability of given power system. 5b. Describe the adverse effects of instability of given power system on consumers and on power utility companies 5c. Draw and explain the power angle curve and indentify the torque angle at which maximum power transfer. 5d. Indentify the type of power system stability condition for the given power system. 5e.Identify factors affecting the stability of power system.	5.1 Illustration of terms: Power system stability, overall stability, stability limit and instability. 5.2 Adverse effects of instability of power system. 5.3 Power angle curve 5.4 Classification of Stability i) Steady state stability ii) Transient stability 5.5 Methods of improving steady state and transient stability condition. 5.6 Factors affecting stability.
UNIT 6 Load Dispatch	**(Marks - 10 , Hrs- 06)**
6a. Explain the idea of load dispatch in the given power system. 6b. Explain impact of specified factors on the load forecasting of the given power system. 6c. Explain impact of the specified factors on load shedding in power system operation. 6d. Explain the role of load dispatch center in power system operation for the given situation. 6e Write any four differences between brownout and blackout of power supply.	6.1 Concept of load dispatch 6.2 Load forecasting i) Significance of forecasting ii) Use of load curve iii) Environment and social factors in load forecasting. 6.3 Load shedding and its governing factors. 6.4 Load shedding by Single phasing approach 6.5. Illustration of terms: Electrical Power blackout and brownout.

8. SUGGESTED SPECIFICATION TABLE FORQUESTION PAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
1	**Representation of Power System**	06	02	04	04	10
2	**Power Flow**	10	04	10	04	18
3	**Automatic Generation and Voltage Control**	08	-	08	04	12
4	**Load flow studies**	08	04	04	04	12
5	**Power system Stability**	10	04	10	04	18
6	**Load Dispatch**	06	02	04	04	10
Total		48	**16**	**40**	**24**	**80**

9. SUGGESTED STUDENT ACTIVITIES

Other than the classroom and laboratory learning, following are the suggested student-related ***co-curricular*** activities which can be undertaken to accelerate the attainment of the various outcomes in this course: Students should conduct following activities in group and prepare reports of about 5 pages for each activity, also collect/record physical evidences for their (student's) portfolio which will be useful for their placement interviews:

a. Prepare case study by collecting the information about impact of variation in frequency.
b. Prepare case study by collecting information about impact of variation in voltage
c. Write report on awareness of load shedding.
d. To collect and write report on information related LDCs and their location with Indian scenario.
e. Write report on causes of power failure in nearby area.
f. Write report on blackout occurred in India/world
g. Prepare a power flow chart of all power plants in India.

10. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are sample strategies, which the teacher can use to accelerate the attainment of the various outcomes in this course:

a. Massive open online courses (***MOOCs***) may be used to teach various topics/sub topics.
b. About ***15-20% of the topics/sub-topics*** which is relatively simpler or descriptive in nature is to be given to the students for ***self-directed learning*** and assess the development of the COs through classroom presentations (see implementation guideline for details).
c. With respect to item No.8, teachers need to ensure to create opportunities and provisions for ***co-curricular activities***.
d. Guide student(s) in undertaking micro-projects.
e. Correlate subtopics with power plant system and equipments.
f. Use proper equivalent analogy to explain different concepts.
g. Use Flash/Animations to explain various components, operation and
h. Teacher should ask the students to go through instruction and Technical manuals

11. SUGGESTED MICRO-PROJECTS

Only one micro-project is planned to be undertaken by a student that needs to be assigned to him/her in the beginning of the semester. The micro project should be preferably being ***individually*** undertaken to build up the skill and confidence in every student to become problem solver so that she/he contributes to the projects of the industry. In special situations where groups have to be formed for micro projects, the number of students in the group should ***not exceed three.***

The micro-project could be application based, internet-based, and field based. Each micro-project should encompass two or more COs. Each student will have to maintain dated work diary consisting of individual contribution in the project work and give a seminar presentation of it before submission. The student ought to submit micro-project report by the end of the semester.

A suggestive list of micro-projects is given here. Similar micro-projects could be added by the concerned faculty:

a) Indian National grid and Regional grid: Collect information and prepare charts with significant details.
b) Major power failure: Collect information about power failure in/outside India.
c) Load dispatch center: Prepare technical presentation on details of functioning of RLDCs.
d) Social impact on load forecasting: Collect information about nearby social activities which affect load forecasting.
e) Environment impact on load forecasting: Collect information about changes in environment which affect load forecasting.
f) Load shedding: Collect information about strategy adopted in specific area.

12. SUGGESTED LEARNING RESOURCES

S.N.	Title	Author, Publisher, Edition and Year of publication	ISBN Number
1	Modern power system analysis	I.J. Nagrath , D. P. Kothari	McGraw Hill Education, New Delhi 2003. ISBN-0-07-049489-4
2	Elements of Power System Analysis e-book	Stevenson William	McGraw-Hill Book Company, New York, 2014 (4^{th} addition) , ISBN 10:0070612781/ ISBN 13:9780070612785
3	Power system Analysis, operation and control	Chakrabarty, Abhijit	PHI Learning, New Delhi, 2010 ISBN: 788120340152
4	An introduction to reactive power control and voltage stability in power transmission systems	Chakrabarti , D. P. Kothari , A. K. Mukhopadhyay , D. E. Abhinandan	PHI Learning, New Delhi, 2015 ISBN: 9788120340503
5	Power Generation Operation and control	A. J. Wood, B. F. Woolenberg	John Wiley and Sons, UK ISBN: 978-0-471-79055-6

13. SOFTWARE/LEARNING WEBSITES

1. www.nptel.com
2. https://youtu.be/qJiK8svb5PE
3. www.scilab.com

14. PO - COMPETENCY- CO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	1	3	2	3	1	-	2
CO2	1	2	2	3	1	1	-
CO3	2	2	-	2	-	-	1
CO4	1	3	-	-	1	-	1
CO5	-	2	1	2	1	2	1
CO6	-	2	2	-	2	1	1

	PSO1	PSO2	PSO3	PSO4
CO1	1	-	2	-
CO2	2	3	-	2
CO3	1	1	-	-
CO4	1	1	-	-
CO5	1	1	-	-
CO6	2	3	-	2

Sign: Name: Dr. V. K. Jadhav (Course Expert)	Sign: Name:Dr. S. S. Bharatkar/Shri.R. U. Shelke (Head of Department)
Sign: Name:Dr. S. S. Bharatkar/Shri.R. U. Shelke (Program Head) (Department of Electrical Engineering)	Sign: Name: Shri A. S. Zanpure (CDC Incharge)

Government Polytechnic, Pune

'180OB' – Scheme

Programme	Diploma in ET/CE/**EE**/ME/MT/CM/IT/DDGM
Programme code	01/02/03/04/05/06/07/08/15/16/17/18/19/21/22/23/24/26
Name of Course	**Special Purpose Machines**
Course Code	**EE5104**
Prerequisite course code and name	No
Class Declaration	**Yes**

1. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			**Total Credits (L+T+P)**		**Examination Scheme**				
					Theory		**Practical**		**Total Marks**
L	**T**	**P**	**C**		**ESE**	**PA**	**$ ESE**	**PA**	
03	01	02	06	**Marks**	80	20	25	25	150
				Exam Duration	3 Hrs	1 Hr	--		

Legends: L- lecture, T-Tutorial/teacher guided theory practice, P-practical, C-Credits, ESE-End semester examination, PA- Progressive Assessments(Test I, II/Term Work), * - Practical Exam, $ - Oral Exam. # - Online Exam., Each lecture/practical period is of one clock hour.

2. RATIONALE

Nowadays advanced electric machines are required to operate, maintain and control by technicians. Hence it is necessary for them to know working principle, operation, characteristics and applications of special purpose electric machines. These machines are used in manufacturing industries, paper industries, process industries, chemical industries etc. So this course will help technicians to update the knowledge and skills related with these machines.

3. COMPETENCY

The aim of this course is to attend following industry identified competency through various teaching learning experiences:

- **Operate, Control and maintain various types of special purpose machines in industries.**

4. COURSE OUTCOMES (COs)

The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry oriented COs associated with the above mentioned competency:

1. Analyse the performance of AC series motor.
2. Operate and maintain the Universal motor and Repulsion motor.
3. Describe the construction, working principle and operation of Induction Generator.
4. Analyse the performance of Synchronous motor.
5. Describe the construction, working principle and operation of LIM and Stepper motor.
6. Analyse the performance of AC and DC Servo motor.

5. SUGGESTED PRACTICALS/ EXERCISES

pr. No.	Unit No.	Practical Exercises (Outcomes in Psychomotor Domain)	Relevant CO	Approximate Hours Required.
1	1	To perform load test on AC series motor.	1	04
2	2	To study the construction of Universal motor and Repulsion motor.	2	04
3	4	To plot V-curves for Synchronous motor.	4	04
4	4	To plot Inverted V-curves for Synchronous motor.	4	04
5	5	To demonstrate the working principle of Stepper motor.	5	04
6	6	To plot Torque-Speed characteristics of DC Servo motor.	6	04
7	6	To plot Torque-Speed characteristics of AC Servo motor.	6	04
8	6	To demonstrate the working principle of Synchros	6	04
9		Microproject planning & Execution as written in suggested microproject list		02
10		Microproject report writing		02
11		Suggested student activity report		02
		Total Hrs		**38**

Sr. No.	Performance Indicators	Weightage in %
a	Arrangement of available equipment / test rig or model	15
b	Setting and operation	15
c	Safety measures	15
d	Observations and Recording	15
e	Interpretation of result and Conclusion	20
f	Answer to sample questions	10
g	Submission of report in time	10
Total		**100**

6. MAJOR EQUIPMENT/ INSTRUMENTSREQUIRED

The major equipment with broad specification mentioned here will usher in uniformity in conduct of practical, as well as aid to procure equipment by authorities concerned**.**

Sr. No.	Major Equipment/ Instruments Required	Pr. No.
1	AC series motor, Single phase, 230V	1
2	Universal motor	2
3	Repulsion motor	2
4	Synchronous motor	3, 4
5	Stepper motor	5
6	AC and DC Servo motor	6, 7
7	Synchros	8

7. THEORY COMPONENTS

The following topics/subtopics should be taught and assessed in order to develop UOs for achieving the COs to attain the identified competency**.**

Unit Outcomes (UOs) (in cognitive domain)	**Topics and Sub-topics**
SECTION-1	
UNIT-1: A.C. Series Motor	**HRS -10 Marks-16**
1a. Explain constructional features of Plain series motor and describe the modifications and Improvements in the design of AC series motor. 1b. Understand the process of Commutation. 1c. Derive torque and induced emf equation and accordingly draw the phasor diagram. 1d. Understand the Speed-Torque , Speed- Current and Power factor characteristic. 1e. State the applications of AC series motor.	1.1 Plain series motor- General construction. 1.2 Modification and Improvements in the design of AC series motor . 1.3 Commutation. 1.4 Torque equation. 1.5 Equation of induced emf 1.6 Phasor diagram 1.7 Characteristics- i. Speed-Torque ii. Speed- Current iii. Power factor characteristic. 1.8 Application.
Unit 2:Universal motor and Repulsion motor	**HRS-06 Marks-12**
2a. For Universal motor- i. Explain the construction and working ii. Understand the Torque-Speed characteristics and process of reversal of direction of rotation. iii. Explain the methods of speed	2.1 Universal motor- 2.1.1 Construction 2.1.2 Working 2.1.3 Torque-Speed characteristics 2.1.4 Reversal of direction of rotation 2.1.5 Speed control methods 2.1.6 Application

<table>
<tr><th>Unit Outcomes (UOs)
(in cognitive domain)</th><th>Topics and Sub-topics</th></tr>
<tr><td>control and state applications.
2b. For Repulsion motor-
i. Explain the construction and working of Repulsion start, induction run motor
ii. Understand the process ofreversal of direction of rotation.
iii. Explain the construction and characteristics of brush riding motor.
iv. State the applications of repulsion start, induction run motor and brush riding motor.</td><td>2.2 Repulsion motor-
2.2.1 Construction
2.2.2 Compensating winding
2.2.3 Operation of Repulsion start, induction run motor
2.2.4 Reversal of direction of rotation
2.2.5 Brush riding motor- Construction, Characteristics
2.2.6 Applications of Repulsion start, induction run motor and Brush riding motor</td></tr>
<tr><td colspan="2">Unit 3:Induction Generator HRS-08 Marks-12</td></tr>
<tr><td>3a. Know the concept of motoring and generating action of three phase Induction motor.
3b. Explain the Working of self -excited& separately excited Induction Generator
3c. Explain the Performance of I.G. at constant voltage and constant frequency.
3d. Understand the difference between Induction Generator and Synchronous Generator.
3e. State the advantages , disadvantages and applications of Induction generator</td><td>3.1 Motoring and Generating action of three phase Induction motor
3.2 Working of Induction Generator
3.2.1 Self-excited Induction Generator.
3.2.2 Separately excited Induction Generator
3.3 Performance of I.G. at constant voltage and constant frequency.
3.4 Difference between Induction Generator and Synchronous Generator
3.5 Advantages and disadvantages
3.6 Applications</td></tr>
<tr><td colspan="2">SECTION-2</td></tr>
<tr><td colspan="2">Unit 4: Synchronousmotor HRS-10 Marks-14</td></tr>
<tr><td>4a. Describe the construction, working principle and operation of synchronous motor.
4b. Know the concept of effect of Load angle with constant excitation
4c. Understand the characteristics of V-curves and Inverted V-curves
4d. Describe the construction of power lines
4e. Explain the methods of Starting
4f. Compare synchronous motor with three phase Induction motor
4g. Solve numerical on V- curves and inverted V-curves</td><td>4.1 Synchronous motor- Construction
4.2 Working
4.3 Operation
4.4 Concept of Load angle
4.5 Effect of Load angle with constant excitation
4.6 Effect of excitation on armature current (V- curves)
4.7 Effect of excitation on power factor (Inverted V- curves)
4.8 Construction of power lines
4.9 Methods of starting
4.10 Applications
4.11 Comparison between three phase Synchronous motor and three phase Induction motor
4.12 Numerical on 4.6 and 4.7</td></tr>
</table>

Unit Outcomes (UOs) (in cognitive domain)	**Topics and Sub-topics**
Unit 5: Linear Induction Motor and Stepper Motor	**HRS-06 Marks-14**
5a. For Linear Induction Motor- i. Describe the construction, working principle and operation and explain the torque-speed characteristics ii. State the advantages, disadvantages and applications 5b. Describe the construction, working principle and state the advantages and disadvantages and applications for various types of Stepper motors	5.1 Linear Induction Motor- 5.1.1 Construction 5.1.2 Working principle 5.1.3 Operation 5.1.4 Torque-Speed characteristics 5.1.5 Advantages and disadvantages 5.1.6 Applications 5.2 Stepper motor Construction, working principle, operation, advantages and disadvantages, applications of 5.2.1 Permanent magnet Stepper motor 5.2.2 Variable reluctance Stepper motor 5.2.3 Hybrid Stepper motor 5.2.4 Disc magnet Stepper motor 5.2.5 Electro Hydraulic Stepper motor
Unit 6: Servomotor	**HRS-08 Marks-12**
6a. For DC and AC Servo motor- i. Explain the construction, working principle and operation ii. Draw the schematic diagram iii. Understand the Torque-Speed characteristics iv. State the advantages and disadvantages and applications 6b. For Synchros- i. Explain the construction and operation ii. Know the Transmitter and Receiver connections and its effect in control system	6.1 DC Servo motor 6.1.1 Construction 6.1.2 Working principle 6.1.3 Operation 6.1.4 Schematic diagram 6.1.5 Torque-Speed characteristics 6.1.5 Advantages and disadvantages 6.1.6 Applications 6.2 AC Servo motor- 6.2.1 Construction 6.2.2 Working principle 6.2.3 Operation 6.2.4 Schematic diagram 6.2.5 Torque-Speed characteristics 6.2.5 Advantages and disadvantages 6.2.6 Applications 6.3 Synchros- 6.3.1 Construction 6.3.2 Operation 6.3.3 Transmitter and Receiver- Different connections and its effect in control system

8. SUGGESTED SPECIFICATION TABLE FORQUESTION PAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
1	AC series motor	10	4	4	8	16
2	Universal motor and Repulsion motor	06	2	4	6	12
3	Induction Generator	08	2	4	6	12
4	Synchronous motor	10	2	4	8	14
5	Linear Induction motor and Stepper motor	06	2	4	8	14
6	Servo motor	08	4	4	4	12
Total		**48**	**16**	**24**	**40**	**80**

9. SUGGESTED STUDENT ACTIVITIES

Other than the classroom and laboratory learning, following are the suggested student-related ***co-curricular*** activities which can be undertaken to accelerate the attainment of the various outcomes in this course: Students should conduct following activities in group and prepare reports of about 5 pages for each activity, also collect/record physical evidences for their (student's) portfolio which will be useful for their placement interviews:

a. Visit to manufacturing industries of AC and DC Servo motor.
b. Search on internet for working of Induction Generator.

10. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are sample strategies, which the teacher can use to accelerate the attainment of the various outcomes in this course:

a. Massive open online courses (***MOOCs***) may be used to teach various topics/sub topics.
b. About ***15-20% of the topics/sub-topics*** which is relatively simpler or descriptive in nature is to be given to the students for ***self-directed learning*** and assess the development of the COs through classroom presentations (see implementation guideline for details).
c. With respect to item No.8, teachers need to ensure to create opportunities and provisions for ***co-curricular activities***.
d. Guide student(s) in undertaking micro-projects.
e. Use proper equivalent analogy to explain different concepts.
f. Use Flash/Animations to explain working of different types of motors.
g. Teacher should ask the students to go through instruction and Technical manuals.

11. SUGGESTED MICRO-PROJECTS

Only one micro-project is planned to be undertaken by a student that needs to be assigned to him/her. In the first four semesters, the micro-project are group-based. However, in the fifth and sixth semesters, it should be preferably be individually undertaken to build up the skill and confidence in every student to become problem solver so that s/he contributes to the projects of the industry. In special situations where groups have to be formed for micro-projects, the number of students in the group should not exceed three.

The micro-project could be industry application based, internet-based, workshop-based, laboratory-based or field-based. Each micro-project should encompass two or more COs which are in fact, an integration of PrOs, UOs and ADOs. Each student will have to maintain dated work diary consisting of individual contribution in the project work and give a seminar presentation of it before submission. The total duration of the micro-project should not be less than 16 (sixteen) student engagement hours during the course. The student ought to submit micro-project by the end of the semester to develop the industry oriented COs.

A suggestive list of micro-projects is given here. Similar micro-projects could be added by the concerned faculty:

a. Comparative study of all types of special motors with respect to –
   i. H.P. ii. Type of supply iii. Name of manufacturer iv. Cost.
b. Study of starters used for various motors wherever applicable.
c. Dissemble and Assemble – AC series motor / Universal motor.

Many more……

12. SUGGESTED LEARNING RESOURCES

Sr. No.	Title	Author	Publication	ISBN No.
1	Electrical Machines	Nagrath, Kothari	Tata McgrawHill, Publishing Co	ISBN- 13: 9789352606405
2	Electrical Machines	J. B. Gupta	S. K. Kataria & sons, New Delhi,	ISBN-10: 9350142775ISBN 13: 9789350142776 0-470-85163-5
3	Electrical machines - Theory and Practice	M.N. Bandyopadhyay	PHI publication.	ISBN 812032997X, 9788120329973

13. SOFTWARE/LEARNING WEBSITES

1. www.nptel.com
2. www.wikipidia.org

14. PO - COMPETENCY- CO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	2	2	2	2	1	3
CO2	3	2	2	2	2	1	3
CO3	2	2	1	1	1	1	2
CO4	3	2	1	2	2	1	3
CO5	2	2	1	2	2	1	2
CO6	2	2	1	2	2	1	2

	PSO1	PSO2	PSO3	PSO4
CO1	2	2	1	2
CO2	2	2	1	2
CO3	2	2	1	2
CO4	2	2	1	2
CO5	2	2	1	2
CO6	2	2	1	2

Sign: Name: 1. Shri. S.B. Kale 2. Smt. A.N. Duraphe (Course Experts)	Sign: Name:Dr. S. S. Bharatkar/Shri. R.U.Shelke (Head of Department)
Sign: Name: Dr.S.S. Bharatkar/Shri. R. U. Shelke (Program Head) (Electrical Engineering Dept.)	Sign: Name: Shri A. S. Zanpure (CDC Incharge)

Level 5 - B Curriculum

Government Polytechnic, Pune

'180OB' – Scheme

Programme	Diploma in ET/CE/**EE**//ME/MT/CM/IT/DDGM
Programme code	01/**02**/03/04/05/06/07/08/15/**16**/17/18/19/21/**22**/23/24/26
Name of Course	**Illumination Engineering**
Course Code	**EE 5105**
Prerequisite course code and name	No
Class Declaration	**Yes**

1. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			**Total Credits (L+T+P)**		**Examination Scheme**				
					Theory		**Practical**		**Total Marks**
L	**T**	**P**	**C**		**ESE**	**PA**	**$ ESE**	**PA**	
03	01	02	06	**Marks**	80	20	25	25	150
				Exam Duration	3 Hrs	1 Hr	--		

Legends: L- lecture, T-Tutorial/teacher guided theory practice, P-practical, C-Credits, ESE-End semester examination, PA- Progressive Assessments(Test I, II/Term Work), * - Practical Exam, $ - Oral Exam. # - Online Exam., Each lecture/practical period is of one clock hour.

2. RATIONALE

This course is intended to teach students various aspects of Illumination scheme. Students will be in a position to apply principles and laws of illumination and illumination schemes. Students will also have a knowledge of various types of lamps lighting accessories and control circuits. This will also enable them to use knowledge for preparing an illumination scheme, requirements of lighting circuits, develop the skill of designing illumination scheme for specific application. She/he will become aware of his role in adapting new changes in Illumination scheme necessitated due to technical innovations brought out by Research and Development in Illumination technology.

3. COMPETENCY

The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

Design illumination schemes and associated electrification of buildings,

4. COURSE OUTCOMES (COs)

The course content should be taught and learning imparted in such a manner that students are able to acquire required learning outcome in cognitive, psychomotor and affective domain to demonstrate following course outcomes:

1- Select the relevant Illumination levels for various applications
2- Select relevant lamps for various applications
3- Select the lighting accessories required for selected wiring scheme,
4- Design a control circuit for Illumination.
5- Design and interpret Illumination schemes for various applications

5. SUGGESTED PRACTICALS/ EXERCISES

Pr. No.	Unit No.	Title of Experiment	Relevent CO	Hours required
1	1	Conduct illumination level assessment in workplace using lux meter	1,2,3	4
2	3	Fit the given lamp in the selected mounting	3	2
3	2	Interpret the polar curves of the given type of lamp and verify it by using the lux meter	2,4	2
4	2	Measure the illumination output of different lamps (incandescent, Fluorescent, CFL) and compare it with their wattage.	1,2,4	4
5	2	Measure the illumination output of different lamps (LED, HPSV, HPMY) and compare it with their wattage. __	1,2,3	2
6	4	Measure illumination level with and without reflectors used commercially with various Luminaries	1,2	4
7	3	Estimate and compare luminous efficiency of incandescent and compact fluorescent lamp	2	2
8	3	Prepare light dimmer arrangement using the relevant dimmer type of transformer	2,3,4,5	4
9	5	Build a single lamp control by two switches	3,4	4
10	5	Build a lamp control circuit for three point method	3,4	4
11		Microproject planning & Execution as written in suggested microproject list		2
12		Microproject report writing		2
13		Suggested student activity report		2
Total				**38**

S.No.	Performance Indicators	Weightage in %
a.	Arrangement of available equipment / test rig or model	20
b.	Setting and operation	20
c.	Safety measures	10
d.	Observations and Recording	10
e.	Interpretation of result and Conclusion	20
f.	Answer to sample questions	10
g.	Submission of report in time	10
Total		**100**

6. MAJOREQUIPMENT/ INSTRUMENTSREQUIRED

The major equipment with broad specification mentioned here will usher in uniformity in conduct of practical, as well as aid to procure equipment by authorities concerned**.**

Sr.No.	Major Equipment/ Instruments Required	Pr. No.
1	Lux meter, Different types of lamps, Accessories	1, 2, 4, 5, 6
2	Wattmeter, Ammeter	4, 7

7. THEORY COMPONENTS –

Unit Outcomes (UOs) (in cognitive domain)	**Topics and Sub-topics**
SECTION-I	
Unit 1 Fundamentals of Illumination	**Hours- 08 Marks- 14**
1a Identify the illumination level required for the given situation with justification. 1b Determine the wattage required for the given situation for the given data. 1c Interpret the polar curve required for the given type of lamp. 1d Select the type and number of luminaires required for the given area in sq. m. with justification. 1e Prepare the lighting calculation of the given situation.	1.1 Basic illumination, Terminology, Laws of illumination. 1.2 Polar curves, polar curve: its meaning and application for designing the lamp. 1.3 Concept of Photometry 1.4 Measurement of illumination 1.5 Lighting calculations methods a. Watt/m² method b. Lumens or Light flux method. c. Point to point method. 1.6 Standards of illumination
Unit Outcomes (UOs) (in cognitive domain)	**Topics and Sub-topics**
Unit 2 Types of Lamps	**Hours- 06 Marks-12**
2a Interpret with sketches the given types of lamps. 2b Explain the working of given type of lamp. 2c Select the relevant mounting for the given light	Construction, working and applications of- 2.1 Incandescent lamp 2.2 ARC lamps—AC and DC arc lamps 2.3 Fluorescent lamp 2.4 Types of other lamps:

source. 2d. Compare the salient features of the given types of lamps.	Mercury vapour lamp , HPMV LAMP Mercury iodide lamp, Halogen lamp Sodium vapour lamp, LED, CFL Neon lamps , Halides, Lasers 2.5 HID and Arc lamps 2.6 Energy efficient lamps 2.7 Selection Criteria for lamps
Unit 3 Illumination control and control circuits	**Hours- 10 Marks- 14**
3a. Select proper light source for given application 3b. Select controlling methods of brightness /colour of light source for the given requirement. 3c. Explain with sketches the working of given type of dimmer. 3d. Design control circuit for illumination. 3e. Explain with sketches the given type of control circuit for lamps.	3.1 Working principle and operation of Dimmer. 3.2 Transformer and their types, Dimmer transformer, Auto transformer dimmer, Two winding transformer dimmer. 3.3 Electronic Dimmer, working principle and operation a) Thyristor operated dimmer b) Triac operated dimmer 3.4 Control of Enhance Lighting 3.5 Methods used for light control 3.6 Single Lamp control by two point method, three point method and four point method.
SECTION - II	
Unit 4 Illumination for Interior Applications	**Hours- 12 Marks- 20**
4a. Select lux level required for given working plane as per application. 4b. Calculate total lux level required for the given working plane. 4c. Selection of proper light source with particular colour of light for the given situation. 4d. Estimate the illumination scheme for the given type of residence.	4.1 Standard for various locations of Interior illumination. 4.2 Design considerations for Interior location of residence, commercial, industrial premises. 4.3 Illumination scheme for different interior locations of residential, commercial and industrial units.
Unit Outcomes (UOs) (in cognitive domain)	**Topics and Sub-topics**
Unit 5 Lighting for Outdoor and Special purpose applications	**Hours- 12 Marks- 20**
5a Select proper wattage for the given number of light source for the given outdoor purpose. 5b Locate specific mountings of lighting sources for outdoor applications in specific environment. 5c Select relevant lamps in order to save energy for the given situation with justification.	5.1 Factory Lighting Lighting for given number of light sources 5.2 Street Lighting (Latest technology) Flood Lighting 5.3 Railway Lighting 5.4 Lighting for advertisement/ Hoardings/ sports lighting, Agriculture and Horticulture lighting, Health care centers/Hospitals,

5d State the safety measures and precautions to be followed for the given special purpose lamps.	Decorating purpose, Stage lighting, Aquarium and Shipyards lighting. 5.5 Special purpose lamps used in photography video films.

8. Specification Table

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	**U Level**	**A Level**	**Total Marks**
I	**Fundamentals of Illumination**	08	02	04	08	14
II	**Types of Lamps**	06	02	04	06	12
III	**Illumination control and control circuits**	10	04	04	06	14
IV	**Illumination for Interior Applications**	12	04	06	10	20
V	**Lighting for Outdoor and Special purpose applications**	12	04	06	10	20
Total		48	**16**	**24**	**40**	**80**

9. SUGGESTED STUDENT ACTIVITIES

Other than the classroom and laboratory learning, following are the suggested student-related ***co-curricular*** activities which can be undertaken to accelerate the attainment of the various outcomes in this course: Students should conduct following activities in group and prepare reports of about 5 pages for each activity, also collect/record physical evidences for their (student's) portfolio which will be useful for their placement interviews:
Prepare journal based on practical performed in Electrical laboratory. Journal consists of drawing, observations, required equipment's, date of performance with teacher signature.

a) Collect specifications of different illumination schemes used in various units and write a technical report.
b) Visit various units and take the help of unit in-charge to understand various illumination schemes.
c) Collect data of different illumination schemes used for residential, commercial , industrial units and various places such as gardens, garages , substations etc.
d) Write all the safety precautions which are to be taken while working with different illumination schemes.

10. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are sample strategies, which the teacher can use to accelerate the attainment of the various outcomes in this course:

a. Massive open online courses (***MOOCs***) may be used to teach various topics/sub topics.
b. About ***15-20% of the topics/sub-topics*** which is relatively simpler or descriptive in nature is to be given to the students for ***self-directed learning*** and assess the development of the COs through classroom presentations (see implementation guideline for details).
c. With respect to item No.8, teachers need to ensure to create opportunities and provisions for ***co-curricular activities***.
d. Guide student(s) in undertaking micro-projects.
e. Correlate subtopics with power plant system and equipments.

f. Use proper equivalent analogy to explain different concepts.
g. Use Flash/Animations to explain various components, operation and
h. Teacher should ask the students to go through instruction and Technical manuals

11. SUGGESTED MICRO-PROJECTS

Only one micro-project is planned to be undertaken by a student that needs to be assigned to him/her. In the first four semesters, the micro-projects are group-based. However, in the fifth and sixth semesters, it should be preferably be individually undertaken to build up the skill and confidence in every student to become problem solver so that s/he contributes to the projects of the industry. In special situations where groups have to be formed for micro-projects, the number of students in the group should not exceed three.

The micro-project could be industry application based, internet-based, workshop-based, laboratory-based or field-based. Each micro-project should encompass two or more COs which are in fact, an integration of PrOs , UOs and ADOs. Each student will have to maintain dated work diary consisting of individual contribution in the project work and give a seminar presentation of it before submission. The total duration of the micro-project should not be less than 16 (sixteen) student engagement hours during the course. The student ought to submit micro-project by the end of the semester to develop the industry oriented COs.

A suggestive list of micro-projects is given here. Similar micro-projects could be added by the concerned faculty (Any one by one batch):

a. Study construction of different types of lamps.
b. Design street lights for some location.
c. Case study of residential, commercial and industrial lighting schemes.
d. Study latest types of lamps used for street lighting.
e. Prepare control circuits of lamp.

12. SUGGESTED LEARNING RESOURCES

Sr. No.	**Title**	**Author**	**Publication**	**ISBN number**
1	Art and Science of Utilization of Electrical Energy	H.Partab	DhanpatRai and Sons, New Delhi	ISBN-9788177 001440
2	Utilization of Electric Power and Electric Traction	J.B.Gupta	S.K.Kataria and Sons, New Dehli	ISBN- 978-585
3	Utilization of Electric Power and Electric Traction	G.C.Garg	Khanna Publishers, New Delhi	ISBN-8174091645

13. SOFTWARE/LEARNING WEBSITES

1.www.nptel.com
2.w ww.howstuffworks.com
3.www.khanacademy.com

14. PO - COMPETENCY- CO MAPPING :

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	1	3	1	3	3	3
CO2	1	1	2	1	3	3	3
CO3	3	1	3	3	3	3	3
CO4	1	1	1	1	3	3	3
CO5	3	1	1	2	3	3	3

CO	PSO1	PSO2	PSO3	PSO4
CO1	*3*	*2*	*3*	*2*
CO2	3	1	1	2
CO3	2	2	3	3
CO4	3	2	2	3
CO5	2	2	1	3

Sign: Name: 1, Smt. U.S. Tulangekar 2. Shri.S.B.Kale (Course Experts)	Sign: Name: Dr.S. S. Bharatkar/Shri. R. U. Shelke (Head of Department)
Sign: Name: Dr.S. S. Bharatkar/Shri. R. U. Shelke (Program Head) (Department of Electrical Engineering)	Sign: Name: Shri. A.S. Zanpure (CDC Incharge)

Government Polytechnic, Pune

'180OB' – Scheme

Programme	Diploma in ET/CE/**EE**/ME/MT/CM/IT/DDGM
Programme code	01/**02**/03/04/05/06/07/08/15/**16**/17/18/19/21/**22**/23/24/26
Name of Course	**Electrical Machine Design**
Course Code	**EE5106**
Prerequisite course code and name	**EE4105 (A.C Machines)**
Class Declaration	**Yes**

1. TEACHING AND EXAMINATION SCHEME

<table>
<tr><th colspan="3">Teaching Scheme (In Hours)</th><th>Total Credits (L+T+P)</th><th></th><th colspan="5">Examination Scheme</th></tr>
<tr><th colspan="3"></th><th></th><th></th><th colspan="2">Theory</th><th colspan="2">Practical</th><th>Total Marks</th></tr>
<tr><th>L</th><th>T</th><th>P</th><th>C</th><th></th><th>ESE</th><th>PA</th><th>$ ESE</th><th>PA</th><th rowspan="2">150</th></tr>
<tr><td rowspan="2">03</td><td rowspan="2">01</td><td rowspan="2">02</td><td rowspan="2">06</td><td>Marks</td><td>80</td><td>20</td><td>25</td><td>25</td></tr>
<tr><td>Exam Duration</td><td>3 Hrs</td><td>1 Hr</td><td>--</td><td></td><td></td></tr>
</table>

Legends: L- lecture, T-Tutorial/teacher guided theory practice, P-practical, C-Credits, ESE-End semester examination, PA- Progressive Assessments(Test I, II/Term Work), * - Practical Exam, $ - Oral Exam. # - Online Exam., Each lecture/practical period is of one clock hour.

2. RATIONALE

Technical personnel operating any electrical equipment and machines in an industry should be well aware of the basic design principles. This knowledge may be used to improve operating efficiency of the machines, maintaining those machines in a better way. In case of breakdown, knowledge of design parameters helps in selection of proper replacement of materials and components.

This course attempts to create the awareness of these parameters in diploma holders so that they can apply the general principles of design and knowledge of design parameters for better operation and maintenance of electrical equipment and machines.

3. COMPETENCY

The aim of this course is to attend following industry identified competency through various teaching learning experiences:

Apply the general principles of design for selection, operation and maintenance of electrical equipment and machines.

4. COURSE OUTCOMES (COs)

The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented so that the student demonstrates the following industry-oriented CO's associated with the above-mentioned competency:

1. Analyze the general aspects of design of electrical machines.
2. Design the three-phase transformer with tank & tubes as per specification.
3 .Design small shell type single phase transformer as per specification.
4.Design three phase squirrel-cage (main dimensions only) &capacitor start, induction run Single phase induction motor as per specification.
5.Describe the concept of computer aided design of electrical machines.

5. SUGGESTED PRACTICALS/ EXERCISES

Pr. No.	**Unit No.**	**Practical Exercises** (Outcomes in Psychomotor Domain)	**Relevant CO**	**Approximate Hours Required.**
1	1	Draw a sheet showing constructional details of three phase transformer with all accessories on half imperial drawing sheet. Prepare a report of the parts of the transformer, material used for the parts & their function.	1	02
2	1	Draw a sheet showing square, cruciform, three stepped, four stepped core sections on half imperial drawing sheet & write a report on calculation of gross core area, net iron area, the ratio of net iron area/ area of circumscribing circle, Gross core area / area of circumscribing circle & tabulate your results.	1	02
3	2	Design of three phase transformer with detailed report on 1. Calculations of gross core area, net core area. 2. Calculation of depth & height of yoke. 3. Calculation of window dimensions. 4. Calculations of number of LV & HV turns & cross-sectional area of cross section of conductors 5. Calculations of number of tubes required. Prepare drawings as per design on half imperial size drawing sheet.	2	08
4	3	Design of small single-phase transformer with detailed report on 1) Calculations of net core area, gross core area, width of central limb 2) Primary & secondary turns & area of cross section of winding conductors. 3) Width	3	04

		& height of window & Prepare drawings as per design on half imperial size drawing sheet.		
5	2,4 & 5	Search on website & write a report on the specifications of i)Power transformer ii)Distribution transformer iii) Three phase squirrel cage induction motor. iv) Single phase induction motor. as per IS, & the name plate details of above with meaning.	1	04
6	4	Design of three phase induction motors with detailed report on 1) Calculations of main dimensions.	4	04
7	5	Design of single-phase induction motors with detailed report on 1) Calculations of main dimensions.	4	04
8	6	Prepare flow chart on designing three phase transformer, viz. for1. Core design,2. Window dimension design, 3. Yoke design,4. LV & HV winding design.	5	02
9	6	Prepare flow chart on designing three phase induction motor, viz. for finding main dimensions.	5	02
10		Microproject planning & Execution as written in suggested microproject list		02
11		Microproject report writing		02
12		Suggested student activity report		02
				38

Sr. No.	Performance Indicators	Weightage in %
a.	Quality of information	20
b.	Correctness of calculations	20
c.	Interpretation& presentation of results and Conclusions	20
d.	Quality of drawing sheets	20
e.	Submission of report in time	20
Total		**100**

6. MAJOR EQUIPMENT/ INSTRUMENTSREQUIRED

The major equipment with broad specification mentioned here will usher in uniformity in conduct of practical, as well as aid to procure equipment by authorities concerned**.**

Sr.No.	Major Equipment/ Instruments Required	Pr. No.
1	Model, cut view &/ or chart	All
2	Computer with internet facility	All

7. THEORY COMPONENTS

<table>
<tr><th>Unit Outcomes (UOs)
(in cognitive domain)</th><th>Topics and Sub-topics</th></tr>
<tr><td colspan="2">Section- 1</td></tr>
<tr><td colspan="2">UNIT-1 General Design Aspects of three phase transformer HRS -04 Marks-08</td></tr>
<tr><td>1a. Describe the factors to be considered while designing the given type of transformer & limitations in design.

1b. Describe the standard specifications of the given type of transformer.

1c. Describe the constructional details of the given type of transformer.

1d. Describe the factors governing the choice of winding for the given types of winding.

1e. Describe the details of positioning the given type of winding on the core of the transformer.
1f. Describe the features of the given type of transformers.
1g. Describe specific magnetic loading &specific electric loading of a given electric machine.
h. Describe the factors affecting the choice of specific magnetic loading of the given type of machine.
i. Describe the factors affecting the choice of specific electric loading of the given type of machine.</td><td>1.1 Brief information of Factors viz.
1. magnetic circuit i.e core
2. Electric circuit i.e windings
3. Dielectric circuit
4. Cooling arrangement
5. Mechanical design
Brief information of limitations in design.

1.2 Standard specifications of three -phase transformer.

1.3 Core construction.
• Core Cross Section
• Advantage of using stepped core over rectangular core
• Yoke cross section.
• Limb section
• Advantages of using metered joints in the core assembly of transformer,

1.4Transformer windings
• Factors governing choice of winding
• Types of windings

1.5Position of H.V & L.V windings & its importance.
1.6Power transformer & distribution transformer from design point of view.

1.7 Definition of specific magnetic loading & specific electric loading in case of transformer

1.8 Factors affecting the choice of specific magnetic Loading for transformer.

1.9 Factors affecting the choice of specific electric Loading for transformer.
Criteria for selection of specific loadings.</td></tr>
</table>

Unit Outcomes (UOs) (in cognitive domain)	**Topics and Sub-topics**
UNIT 2 Design of three phase Transformer	**Hrs- 16 Marks-22**
2a. Derive output equation of the given type of transformer.	2.1 Output equation of three-phase transformer
2b. Derive the relation between emf per turn & transformer rating	2.2 Relation between emf per turn & transformer rating.
2c. Describe the significance of Window space factor.	2.3 Window space factor: Definition & factors affecting window space factor.
2d. Write the step by step procedure to design three-phase transformer	2.4 Design of main dimensions- Core section, Window dimensions, Yoke dimensions, Overall core dimensions, L.V Winding & H.V Winding
2e. Describe the concept of stacking factor.	2.5 Stacking factor: Definition & meaning,
2f. Write the expressions to find the dimensions of core cross- section.	2.6 Expressions for gross core area & net core area for square, two stepped& three stepped core sections. Expressions to find the percentage utilization by gross core area& net core area of area of circumscribing circle.
2g. Describe the criterion for the Selection of window dimensions for the given type of a transformer	2.7 Tips for selection of values for the ratio of $H_{W/}W_{W}$ for distribution & power transformer.
2h. Write the expressions for dimensions of the yoke for the given type of a transformer.	2.8 Expressions for yoke area, for a transformer using hot rolled silicon steel as well as CRGO silicon steel. Expressions for depth of yoke using square cross section as well as cruciform cross sectioned yoke.
2i. State the expressions of overall core dimensions for the given type of transformer.	2.9 Expressions of the overall core dimensions (main dimensions) for three phase transformer.
2j. Describe the step by step procedure for design of H.V & L.V winding of the given type of a transformer	2.10 Procedure to find out total number turns of L.V as well as H. V winding. Estimation of area of cross-section & type of conductor
2k. Solve the simple numerical for finding main dimensions & winding dimensions of the given type of the transformer.	2.11 Simple numerical for finding main dimensions as well as winding dimensions of three-phase transformer
2l. Describe the necessity of cooling system for the transformer	2.12. Necessity of cooling system for the transformer
2m. Describe the various types of cooling systems for the given type of transformer.	2.13 AN & AB methods for dry type transformers. ONAN, ONAF, OFAN, OFAF, ONWF, OFWF, methods for oil immersed transformers
2n. Describe the phenomenon of heat Transfer in the given type of a transformer	2.14 Heat transfer in transformer by radiation & convection.
2o. Describe the step by step procedure to find out the number of	2.15 Procedure to find the number of tubes required to keep the temperature rise of the transformer

Unit Outcomes (UOs) (in cognitive domain)	**Topics and Sub-topics**
tubes required to keep the temperature rise within limits. 2p. Describe the procedure to find out the dimensions of the transformer tank. 2q. Solve the simple numerical to find the number of tubes & dimensions of the tank.	within limits. 2.16 Procedure to find the length & width of the transformer tank. 2.17 Simple numerical on above topic.
Unit-3 Design of small single-phase shell Type Transformer Hrs 04 Marks 10	
3a. Describe the step by step procedure to design a single-phase shell type transformer. 3b. Solve numerical on overall dimensions and winding details of given small single-phase shell type transformer.	3.1Core Design: Choice of turns per volt, determination of width of the central limb, selection of type of stamping. Winding Design: Determination of area of primary & secondary conductor & number of primary & secondary turns. Calculation of window area: Calculation of space required for primary, secondary winding, insulation & former. 3.2 Numerical on the design of small single- phase shell type transformer.
SECTION-2	
Unit-4 Introduction to design of Induction Motors (3 phase, Squirrel Cage) Hrs 12 Marks 16	
4a. Describe the notations used while designing the given 3 phase induction motor. 4b Describe the concept of total magnetic loading, specific magnetic loading, total electric loading, specific electric loading with respect to three phase induction motor. 4c. Derive output equation of the three phase induction motor. 4d. Describe the factors affecting the size of the induction motor. 4e. Describe the factors affecting specific magnetic loading & specific electric loading for the given induction motor. 4f. Describe the method of separation of D& L of three phase induction motor.	4.1 Notations used while designing 3 phase induction motor. Definition of main dimensions& specification. 4.2 Definitions of total magnetic loading, specific magnetic loading, total electric loading, specific electric loading in case of three phase induction motor. 4.3 Output equation of three phase induction motor. 4.4 Factors affecting the size of three phase induction motor. 4.5 Choice of specific magnetic loading & specific electric loading. 4.6 Separation of D& L by selecting specific values of l/τ

Unit Outcomes (UOs) (in cognitive domain)	**Topics and Sub-topics**
4g. Describe the step by step procedure of design of the stator of the given induction motor.	4.7 Stator Design: Calculation of stator winding turns per phase, area of stator conductor, shapes of stator slots, useful guidelines while selecting the number of stator slots, calculation of number of conductors per slot & area of stator slot, length of mean turn of winding on stator.
4h. Describe the step by step method of design of rotor of the given induction motor.	4.8 Rotor Design: Selection of length of air gap or factors affecting length of air gap. Selection of number of rotor slots. effect of harmonics &choice of rotor slots to minimize harmonics, vibration, noise & voltage ripples, rules for selecting number of rotor slots, shape & size of rotor slots, determination of rotor bar current, area of rotor bars, area of end ring.
4i. Solve the numerical to find the main dimensions of the given induction motor.	4.9 Numerical to find the main dimensions of the induction motor.
Unit-5 Introduction to design of single-phase Induction Motors Hrs 08 Marks 14	
5a. Derive the output equation of the single phase induction motor.	5.1 Output equation of the single-phase induction motor.
5b. Compare between three phase induction motor & single-phase induction motor with same rating &designed taking same values of specific loadings.	5.2 Comparison between three -phase & single-phase induction motor with same rating & designed taking same values of specific loadings.
5c. State the desired values of specific loadings.	5.3 Choice of specific loadings.
5d. Describe the procedure to find the main dimensions.	5.4 Determination of main dimensions, i.e design of core diameter & axial length.
5e. Explain the basis on which air gap, number of stator and rotor slots are chosen.	5.5 Choice of air gap, number of stator slots, rotor slots, area & depth of stator slots.
5f. Write the procedural steps for designing a single-phase capacitor start induction run motor.	5.6 Procedural steps for designing capacitor start induction run motor, viz. number of turns in main winding, resistance & size of running winding conductor, as well as starting winding conductor.
5g. Solve the numerical to find the main dimensions of the given motor.	5.7 Numerical to find the main dimensions of the given motor.
Unit-6 Introduction to computer aided design of transformer & Induction motor. Hrs 04 Marks 10	
6a Describe the need of computer aided design of electrical machines.	6.1 Necessity of computer aided design of electrical machines.
6b. Explain the advantages & disadvantages of computer aided design.	6.2 Advantages & disadvantages of computer aided design.
6c. Draw the generalized flow chart of computer aided design of	6.3 Generalized flow chart of computer aided design. 6.4 Analysis method & synthesis method of computer aided design with flow chart, & its advantages.

Unit Outcomes (UOs) (in cognitive domain)	**Topics and Sub-topics**
electrical machine. 6d. Explain the two methods of computer aided design. 6e. Describe the basic steps of design of given type of machine with basic parameters. 6f. Draw the flow chart of the given step of design of given type of machine.	6.5 Basic steps for design of transformer viz. core design, window dimensions, yoke design, LV winding design, HV winding design. & basic steps for design of three phase induction Motor viz. Input specifications/ design parameters Calculation of Main dimensions, Design of Stator, Design of rotor, with parameters, viz..no load current, losses, efficiency& temperature rise. 6.6 Flow chart of design of transformer for- Core Design, Window dimension design, Yoke design , LV winding design, HV winding design. 6.7 Generalized flow chart of design of three phase Induction motor.

8. SUGGESTED SPECIFICATION TABLE FORQUESTION PAPER DESIGN

Unit No.	**Unit Title**	**Teaching Hours**	**Distribution of Theory Marks**			
			R Level	**U Level**	**A Level**	**Total Marks**
I	General Design Aspects	04	04	04	--	08
II	Design of three phase transformer	16	04	08	10	22
III	Design of small single-phase shell Type Transformers	04	02	02	06	10
IV	Introduction to design of Induction Motors (3 phase,	12	04	06	06	16
V	Introduction to design of single-phase Induction Motors	08	02	04	08	14
VI	Introduction to computer aided design of machines	04	04	06	-	10
Total		**48**	**20**	**30**	**30**	**80**

9. SUGGESTED STUDENT ACTIVITIES

Other than the classroom and laboratory learning, following are the suggested student-related ***co-curricular*** activities which can be undertaken to accelerate the attainment of the various outcomes in this course: Students should conduct following activities in group and prepare reports of about 5 pages for each activity, also collect/record physical evidences for their (student's) portfolio which will be useful for their placement interviews:

a. Prepare journal based on design assignments given by faculty member.
b. Prepare chart displaying various parts of transformer, motors etc.& their functions.
c. Using internet find different materials used for construction of transformer and motors
in recent trends.
d. Survey the market and compare design of induction motors from different

manufacturers based on materials used (in winding, insulation, frame, slip rings/squirrel cage, etc.) Losses, efficiency, expected life, temperature rise, type of bearings, noise level, type of cooling, cost etc.

e. Prepare reports based on tutorial practices.
f. Complete assignments for solving numerical.
g. Survey the market and compare design of transformer from different manufacturers based on materials used (in winding, core, insulation, frame, etc.) Losses, efficiency, expected life, temperature rise, type of cooling, cost etc.

10. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are sample strategies, which the teacher can use to accelerate the attainment of the various outcomes in this course:

a. Massive open online courses (***MOOCs***) may be used to teach various topics/sub topics.
b. About ***15-20% of the topics/sub-topics*** which is relatively simpler or descriptive in nature is to be given to the students for ***self-directed learning*** and assess the development of the COs through classroom presentations (see implementation guideline for details).
c. With respect to item No.8, teachers need to ensure to create opportunities and provisions for ***co-curricular activities***.
d. Guide student(s) in undertaking micro-projects.
e. Correlate subtopics with power plant system and equipment.
f. Use proper equivalent analogy to explain different concepts.
g. Use Flash/Animations to explain various components, operation and
h. Teacher should ask the students to go through instruction and Technical manuals

11. SUGGESTED MICRO-PROJECTS

Only one micro-project is planned to be undertaken by a student that needs to be assigned to him/her.In the first four semesters, the micro-project are group-based. However, in the fifth and sixth semesters, it should be preferably be **individually** undertaken to build up the skill and confidence in every student to become problem solver so that s/he contributes to the projects of the industry. In special situations where groups have to be formed for micro-projects, the number of students in the group should **not exceed three.**

The micro-project could be industry application based, internet-based, workshop-based, laboratory-based or field-based. Each micro-project should encompass two or more COs which are in fact, an integration of PrOs, UOs and ADOs. Each student will have to maintain dated work diary consisting of individual contribution in the project work and give a seminar presentation of it before submission. The total duration of the micro-project should not be less than **16 (sixteen) student engagement hours** during the course. The student ought to submit micro-project by the end of the semester to develop the industry-oriented COs.

A suggestive list of micro-projects is given here. Similar micro-projects could be added by the concerned faculty:

a. Computer aided design of three phase transformer& prepare design drawings by using AutoCAD.
b. Computer aided design of three phase induction motor& prepare design drawings by using AutoCAD
c. Power point presentation on recent trends in transformer design.
d. Prepare seminar report on design of energy efficient transformer.
e. Prepare seminar report on design of energy efficient motor.

12. SUGGESTED LEARNING RESOURCES

Sr. No.	Title	Author	Publication	ISBN No.
1	**Electrical Machine Design**	A.K.Sawhney	**Dhanpat Rai &sons**	**ISBN-10: 8177001019 ISBN-13: 978-8177001013**
2	**Design and testing of electrical machines**	**M.V.Deshpande**	**Prentice Hall India Learning Private Limited;**	**IBBN-10: 8120336453 ISBN13: 978-8120336452**
3	**The performance & design of alternating current machines**	**M.G.Say**	**CBS Publishers and Distributors**	**9788123910277**
4	**Design of Electrical Machines**	**V.N. Mittle Arvind Mittal**	**Standard Publishers Distributors**	**ISBN-10: 8180141268 ISBN-13: 978-8180141263**
5	**Electrical Machine Design**	**Alexander Gray**	**Read Books, 2007**	**1406765341, 9781406765342**
6	**Design of Electrical Machines**	**K. G. Upadhyay**	**New Age International Publishers, first edition**	**ISBN-10: 8122422829 ISBN-13: 978-8122422825**
7	**Electrical Machine Design**	**V. Rajini, V. S. Nagarajan**	**Pearson Education; First edition**	**ISBN-10: 9332585571 ISBN-13: 978-9332585577**

13. SOFTWARE/LEARNING WEBSITES

1. https://electrical-engineering-portal.com/
2. https://nptel.ac.in/
3. http://vlabs.iitb.ac.in/vlab/labsee.html
4. https://www.academia.edu/9631135/DESIGN_OF_ELECTRICAL_MACHINES
5. https://www.oreilly.com/library/view/electrical-machine-design/9789353063740/
6. AutoCAD Electrical:softwareLatest version
7. MATLAB/SIMULINK: Latest version
8. Electrical CAD software: Latest version

14. PO - COMPETENCY- CO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
1	3	-	2	-	2	-	3
2	3	3	3	-	2	2	3
3	3	3	3	-	2	2	3
4	3	3	3	-	2	2	3
5	3	3	3	-	2	2	3

	PSO1	PSO2	PSO3	PSO4
1	-	2	3	2
2	2	2	3	*2*
3	2	2	3	2
4	2	2	3	*2*
5	2	2	3	*2*

Sign: Name: 1. Mrs. A. N. Duraphe 2. Mrs. M. H. Bilgi (Course Experts)	Sign: Name:Dr. S.S. Bharatkar/ Shri. R. U. Shelke (Head of Department)
Sign: Name : Dr. S. S. Bharatkar/ Shri. R. U. Shelke (Program Head) (Electrical Engineering Department.)	Sign: Name: Shri A. S. Zanpure (CDC Incharge)

Government Polytechnic, Pune

'180OB' – Scheme

Programme	Diploma in ET/CE/**EE**/ME/MT/CM/IT/DDGM
Programme code	01/**02**/03/04/05/06/07/08/15/**16**/17/18/19/21/**22**/23/24/26
Name of Course	**Electrical Mobility Systems**
Course Code	**EE5107**
Prerequisite course code and name	No
Class Declaration	**Yes**

1. TEACHING AND EXAMINATION SCHEME

<table>
<tr><th colspan="3" rowspan="2">Teaching Scheme (In Hours)</th><th rowspan="2">Total Credits (L+T+P)</th><th rowspan="2"></th><th colspan="5">Examination Scheme</th></tr>
<tr><th colspan="2">Theory</th><th colspan="2">Practical</th><th>Total Marks</th></tr>
<tr><th>L</th><th>T</th><th>P</th><th>C</th><th></th><th>ESE</th><th>PA</th><th>$ ESE</th><th>PA</th><td rowspan="2">150</td></tr>
<tr><td rowspan="2">03</td><td rowspan="2">01</td><td rowspan="2">02</td><td rowspan="2">06</td><th>Marks</th><td>80</td><td>20</td><td>25</td><td>25</td></tr>
<tr><th>Exam Duration</th><td>3 Hrs</td><td>1 Hr</td><td>--</td><td></td><td></td></tr>
</table>

Legends: L- lecture, T-Tutorial/teacher guided theory practice, P-practical, C-Credits, ESE-End semester examination, PA- Progressive Assessments(Test I, II/Term Work), * - Practical Exam, $ - Oral Exam. # - Online Exam., Each lecture/practical period is of one clock hour.

2. RATIONALE

Over the years, the exploitation and pollution of natural resources have created the need for renewable and environment-friendly products. One of these products is Electric vehicles; replacement for petroleum based vehicles. Electric mobility solutions are found essential in reducing emissions from the transport sector both for air pollution and climate change. Government of India is looking to promote electric mobility as one of the key solutions to reduce carbon emission. Schemes like FAME (faster adoption and manufacturing of hybrid and electric vehicles), FAME II, and several other tax benefits offered by the government have encouraged more and more people to switch to EVs from ICE (internal combustion engine) based vehicles. This has also encouraged automakers to jump on the electric mobility bandwagon in the country. After completion of this course students will get overview of electrical mobility system and will be helpful while performing duties of electrical maintenance supervisor etc. in this sector.

3. COMPETENCY

The aim of this course is to attend following industry identified competency through various teaching learning experiences:

Select and apply proper electric propulsion and energy storage system for the electric mobility system.

4. COURSE OUTCOMES (COs)

The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry oriented COs associated with the above mentioned competency**:**

1. Enumerate different types of vehicles and the implementation plans of Government of India for promoting the use of Electric Vehicles.
2. Describe the configurations of different types of Electric Vehicles.
3. Distinguish between different electric drives and Select appropriate drive for a given type of vehicle.
4. Classify the various energy storage systems and identify a suitable energy storage system for a given type of vehicle.
5. Enlist and describe various types of fuel technologies.
6. Know the concept of electric vehicular system used in Maglev trains, Monorails, Aircrafts, Space crafts and in under sea vehicles**..**

5. SUGGESTED PRACTICALS/ EXERCISES

Sr. No.	**Unit No.**	**Practical Exercises** (Outcomes in Psychomotor Domain)	**Relevant CO**	**Approx. Hours Required.**
1.	1	Prepare a report on various types of Electric Vehicles used in India and their manufacturing industries.	1	02
2.	1	Prepare a report on Global Market share of various countries and current Electric Vehicle market in India	1	02
3.	2	Draw a sheet (on half imperial) showing configuration of Battery operated Electric Vehicles, Plug-in Hybrid Vehicle and Fuel cell Electric Vehicles and prepare a report.	2	04
4.	2	Draw a sheet (on half imperial) showing Architectures of series and parallel Hybrid electric drive Trains and prepare a report.	2	02
5.	3	Draw a sheet (on half imperial) showing functional block diagram of a typical propulsion system used for Electric Vehicles and prepare a report.	3	02
6.	3	Draw a sheet (on half imperial) showing control strategies used for propulsion of Electric Vehicles for various drives used and prepare a report.	3	04

7.	4	Prepare a report on various types of batteries giving details regarding their basic component structures, advantages and disadvantages.	4	04
8.	5	Prepare a report on various fuel technologies adopted in Electric Vehicles	5	04
9.	5	Draw a sheet (on half imperial) showing configuration of Fuel Cell Hybrid Electric Train Drive and prepare a report.	2, 5	04
10.	6	Prepare a report on electrical vehicular system adopted in Maglev trains, Monorails, Aircrafts, Space crafts and in undersea vehicles.	6	04
11		Micro-project planning & Execution as written in suggested micro-project list.		02
12		Micro-project report writing.		02
13		Suggested student activity report.		02
Total Hrs				**38**

Sr.No.	Performance Indicators	Weightage in %
a.	Quality of information	20
b.	Quality of drawing sheets	20
c.	Interpretation of result and Conclusion	20
d.	Answer to sample questions	20
e.	Submission of report in time	20
Total		**100**

6. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

The major equipment with broad specification mentioned here will usher in uniformity in conduct of practical, as well as aid to procure equipment by authorities concerned**.**

Sr.No.	Major Equipment/ Instruments Required	Pr. No.
1	Computer having internet facility for data collection	1, 2, 7, 8, 10
2	Drawing sheet (half imperial size)	3, 4, 5, 6, 9

7. THEORY COMPONENTS

The following topics/sub topics should be taught and assessed in order to develop UOs for achieving the COs to attain the identified competency**.**

Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
SECTION-1	
UNIT-1: Environmental Impact and Electric Vehicles Scenario HRS -06, Marks-12	
1a. Compare the conventional vehicles with electric vehicles. 1b. Enumerate the types of electric vehicles.	1.1 Environment and Socio-economic Importance- Air pollution, Global warming, Petroleum resources. 1.2 Importance of different transportation development strategies. 1.3 Types and Applications of Electric Mobility systems in

Unit Outcomes (UOs) (in cognitive domain)	**Topics and Sub-topics**
1c. Know the implementation plans of Government of India for promoting the use of electric vehicles. 1d. Explain the future scenarios for electric vehicles	use today- Battery Electric Vehicles, Electric Hybrid Vehicle, Fuel cell Electric Vehicles, Electric Vehicles using supply lines, Solar powered Vehicles, Electric Vehicles using flywheels or Supercapacitors, Electric locomotives, Tramways, Elevators, Escalators etc.. 1.4 Implementation of Electric Vehicles in India- India's Goals for electrification in vehicles, Start ups and general awareness, Opportunities and challenges, Barriers to Electric Vehicles. 1.5 Future scenarios, Intelligent transportation system.
Unit 2:Configuration of different Electric vehicles	**HRS-06 Marks-12**
2a.Know the configurations of (Battery operated) Electric Vehicles, Hybrid Electric Vehicles, Plug-in Hybrid Electric Vehicles, Fuel cell Electric Vehicles, Electric scooter and three phase locomotive. . 2b. Know the terms related with tractive effort. .	2.1 Configuration and performance of a. Electric Vehicles (Battery operated). b. Hybrid electric drive trains c. Plug-in Hybrid Vehicle d. Fuel cell Electric Vehicles e. Three phase locomotive 2.2 Architectures of series and parallel Hybrid electric drive Trains 2.3 Tractive effort- Rolling resistance force, Aerodynamic drag, Hill climbing force, Acceleration force, Total tractive effort.
Unit 3:Electric Propulsion Systems for Road and Rail based Electric Vehicles	**HRS-12 Marks-16**
3a. Know the basic block diagram of electric propulsion system. 3b. Identify the factors affecting the choice of electric propulsion system 3c. State requirements of traction motors in an electric vehicle. 3d. Compare the different drives used for propulsion with respect to speed torque characteristics, control used, advantages and disadvantages. 3e. Know the PWM control Used for 3-phase Induction Motor of 3-phase locomotive 3f. Know the principle of LIM based traction system and its strengths and weaknesses.	3.1 Functional block diagram of typical electric propulsion system. 3.2 Factors affecting choice of electric propulsion system. 3.3 Requirements of Traction motors in an Electric Vehicles. 3.4 Comparative study of following drives used for propulsion with respect to Speed torque characteristics, advantages and disadvantages- a. DC Motor drives- Combined armature voltage and field control, Chopper control b. Induction motor drives- Constant volts/Hertz control, Power electronic control, c. Permanent magnet brushless DC motor drives- Torque control d. Switched reluctance motor drives-on Modes of operation. 3.5 PWM control of 3-phase Induction Motor of 3-phase locomotive 3.6 Linear Induction Motor Based Traction System a. Moving Primary Fixed Secondary Single Sided LIM b. Moving Secondary Fixed Primary Single Sided LIM c. Moving Primary Fixed Secondary Double Sided LIM 3.7 Strengths and Weaknesses of LIM Propelled Railway Traction.

Unit Outcomes (UOs) (in cognitive domain)	**Topics and Sub-topics**
SECTION-2	
Unit 4:Energy Storages and EV Charging Stations HRS-12 Marks-16	
4a. Know the various battery parameters. 4b. Enumerate the different energy storage devices used in electric vehicles and their principle of operation. 4c. Know the hybridization of energy storage devices. 4d. Classify the different the various charging systems and charging stations as per their application.	4.1 Battery parameters- Cell and battery voltages, Charge capacity, Energy stored, Specific energy, Energy density, Specific power, Amp-hour efficiency, Energy efficiency, Self discharge rates, Battery geometry, Battery temperature, heating and cooling needs, Battery life and number of deep cycles. 4.2 Battery technologies- Lead acid batteries, Nickel based batteries , Sodium based batteries, Lithium based batteries and Metal air batteries. (Basic construction components, battery parameters, advantages and disadvantages) 4.3 Ultra capacitors- Features, Basic principles, Performance and Technologies 4.4 Ultra high speed flywheels- Operation principles, Power capacities and Technologies 4.5 Hybridization of energy storages 4.6 Charging systems- AC, DC and Wireless charging 4.7 EV Charging Stations- Types, Different charging modes, Different charging levels, Charging time, Concept of public charging stations, Battery swapping.
Unit 5: Fuel Cell Vehicles HRS-06 Marks-12	
5a. Describe the operating principle of fuel cell and characteristics of fuel cell system. 5b. Enlist and describe various fuel cell technologies and sources of fuel supply. 5c. Know the configuration of fuel cell hybrid electric drive train	5.1 Operating principle of fuel cell 5.2 Fuel cell system characteristics 5.3 Fuel cell technologies 5.4 Fuel supply 5.5 Non hydrogen fuel cells 5.6 Configuration of typical Fuel Cell Hybrid Electric Drive Train
Unit 6: Additional Applications of Electrical Mobility HRS-06Marks-12	
6a. Know the working principle of Maglev trains, Mono rail and their types. 6b. Describe the features of Metro rail, Tramways, Trolley buses. 6c. Know the electrical vehicular system for Aircraft, Spacecraft, and for sea and undersea vehicles	6.1 Maglev trains- Basic working principle and introduction to Electromagnetic and Electrodynamic suspension types. 6.2 Mono rail- Concept of Mono rail and Features of Suspended and Straddle Mono rail systems. 6.3 Features of Metro rail, Tramways, Trolley buses. 6.4 Aircraft power generation and distribution system. 6.5 Spacecraft power system. 6.6 Electrical distribution in sea and undersea vehicles. (Introductory treatment to all the above applications)

8. SUGGESTED SPECIFICATION TABLE FORQUESTION PAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	**U Level**	**A Level**	**Total Marks**
1	Environmental Impact and Electric Vehicles Scenario	06	4	4	4	12
2	Configuration of different Electric vehicles	06	4	4	4	12
3	Electric Propulsion Systems for Road and Rail based Electric Vehicles	12	4	6	6	16
4	Energy Storages and EV Charging Stations	12	4	6	6	16
5	Fuel Cell Vehicles	06	4	4	4	12
6	Additional Applications of Electrical Mobility	06	4	4	4	12
Total		**48**	**24**	**28**	**28**	**80**

9. SUGGESTED STUDENT ACTIVITIES

Other than the classroom and laboratory learning, following are the suggested student-related ***co-curricular*** activities which can be undertaken to accelerate the attainment of the various outcomes in this course: Students should conduct following activities in group and prepare reports of about 5 pages for each activity, also collect/record physical evidences for their (student's) portfolio which will be useful for their placement interviews:

a. Prepare a chart of various types of Electric Vehicles.
b. Prepare a chart of current Electric Vehicles market in India
c. Prepare a chart of various factors affecting total tractive effort.
d. Prepare a chart of Linear Induction Motor based traction systems and write a report.
e. Seminar and its report on Ultra capacitors and Ultra high speed flywheels.
f. Prepare a chart of fuel cell system characteristics.
g. Seminar and its report on maglev trains and Mono rail.

10. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are sample strategies, which the teacher can use to accelerate the attainment of the various outcomes in this course:

a. Massive open online courses (***MOOCs***) may be used to teach various topics/sub topics.
b. About ***15-20% of the topics/sub-topics*** which is relatively simpler or descriptive in nature is to be given to the students for ***self-directed learning*** and assess the development of the COs through classroom presentations (see implementation guideline for details).
c. With respect to item No.8, teachers need to ensure to create opportunities and provisions for ***co-curricular activities***.
d. Guide student(s) in undertaking micro-projects.
e. Use proper equivalent analogy to explain different concepts.
f. Use Flash/Animations to explain working of different types of electric vehicles.
g. Teacher should ask the students to go through instruction and Technical manuals.
h.

11. SUGGESTED MICRO-PROJECTS

Only one micro-project is planned to be undertaken by a student that needs to be assigned to him/her.In the first four semesters, the micro-project are group-based. However, in the fifth and sixth semesters, it should be preferably be individually undertaken to build up the skill and confidence in every student to become problem solver so that s/he contributes to the projects of the industry. In special situations where groups have to be formed for micro-projects, the number of students in the group should not exceed three.

The micro-project could be industry application based, internet-based, workshop-based, laboratory-based or field-based. Each micro-project should encompass two or more COs which are in fact, an integration of PrOs, UOs and ADOs. Each student will have to maintain dated work diary consisting of individual contribution in the project work and give a seminar presentation of it before submission. The total duration of the micro-project should not be less than 16 (sixteen) student engagement hours during the course. The student ought to submit micro-project by the end of the semester to develop the industry oriented COs.

A suggestive list of micro-projects is given here. Similar micro-projects could be added by the concerned faculty:

a. **Environmental Impact and Electric Vehicles Scenario:**
   Prepare a power point presentation related to India's Goals for electrification in vehicles, Start ups and general awareness, Opportunities and challenges , Barriers to Electric Vehicles.
b. **Configuration of different Electric vehicles:**
   Prepare a power point presentation related to power circuit of three phase locomotive and PWM control of its motor circuit.
c. **Electric Propulsion Systems for Road and Rail based Electric Vehicles:**
   Prepare a power point presentation related to Permanent magnet brushless DC motor drives and Switched reluctance DC motor drives.
d. **Energy Storages and EV Charging Stations:**
   Prepare a power point presentation related to Charging systems and Charging Stations.
e. **Fuel Cell Vehicles:**
   Prepare a report on Fuel supply to Fuel cell vehicles.

12. SUGGESTED LEARNING RESOURCES

Sr. No.	Title	Author	Publication	ISBN No.
1	Modern Electric, Hybrid Electric and Fuel Cell Vehicles	Mehrdad Ehsani, YiminGao	CRC press	ISBN- 0-8493-3154-4
2	Electric Vehicle Technology Explained	James Larminie, John Lowry	John Wiley & Sons Ltd	ISBN- 0-470-85163-5
3	Vehicular Electric Power System	Ali Emadi, JohnM. Millar	Marcel Dekker, Inc. New York. Basel	ISBN- 0-8247-4751-8
4	ElectricTraction	J.Upadhyay, S.N.Mahendra	AlliedPublishersLtd.	ISBN- 81-7764-005-4,

13. SOFTWARE/LEARNING WEBSITES

1. www.nptel.com
2. www.wikipidia.org

14. PO - COMPETENCY- CO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	1	1	1	1	3	3	3
CO2	1	1	2	1	3	2	3
CO3	1	1	2	1	3	2	3
CO4	1	1	2	2	3	2	3
CO5	1	1	2	1	3	2	3
CO6	1	1	2	1	3	2	3

	PSO1	PSO2	PSO3	PSO4
CO1	3	2	2	3
CO2	1	1	2	3
CO3	2	1	1	3
CO4	1	1	2	3
CO5	2	1	1	3
CO6	2	1	1	3

Sign: Name: 1. Dr. S. S. Bharatkar 2. Mrs. S.P.Phadnaik 3. Mrs. M.H. Bilgi (Course Experts)	Sign: Name: Dr. S. S. Bharatkar/Shri.R. U. Shelke (Head of Department)
Sign: Name: Dr. S. S. Bharatkar/Shri.R. U. Shelke (Program Head) (Department of Electrical Engineering)	Sign: Name: Shri. A.S.Zanpure (CDC Incharge)

Government Polytechnic, Pune

'180 OB'– Scheme

Programme	Diploma in ET/CE/**EE**//ME/MT/CM/IT/DDGM
Programme code	01/**02**/03/04/05/06/07/08/15/**16**/17/18/19/21/**22**/23/24/26
Name of Course	**Building Maintenance System**
Course Code	**EE5108**
Prerequisite course code and name	No
Class Declaration	**Yes**

1. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P)		Examination Scheme				
					Theory		Practical		Total Marks
L	T	P	C		ESE	PA	$ESE	PA	150
3	1	2	6	Marks	80	20	25	25	
				Exam Duration	3 Hrs	1 Hr	--	--	--

Legends: L- lecture, T-Tutorial/teacher guided theory practice, P-practical, C-Credits, ESE-End semester examination, PA- Progressive Assessments(Test I, II/Term Work), * - Practical Exam, $ - Oral Exam. # - Online Exam., Each lecture/practical period is of one clock hour.

2. RATIONALE

Now a day, huge commercial buildings are constructed to utilize as Malls, Multiplex, Cinema Theatre, Residential Complex, IT Office etc. To operate various equipments and machinery, technicians are required. To know about various systems in huge buildings such as Elevator, Escalator, DG Set, Intercom System, Control Panels, CCTV system etc. is highly essential for diploma holders. To have knowledge & basic skills this course will be useful to final year Student as diversified course.

3. COMPETENCY

To Operate, Control & Maintain various systems such as Elevator, Escalator, DG Set, Control panel, CCTV System, Intercom system of huge buildings such as Malls,
Commercial Bank, I.T. Office, Residential Tower etc.

4. COURSE OUTCOMES (COs)

1: Draw layout of multi storied building and type of earthing used.
2: Operate Control and maintain elevator &escalator.
3: Operate Control and maintain DG Set and Water Pumps.
4 :Layout of Control Panel and operation of different systems.
5: Maintenance of Intercom System.
6: Performance, Control and maintenance of CCTV System.

5. SUGGESTED PRACTICALS/ EXERCISES

Pr. No.	**Practical Exercises** (Learning Outcomes in Psychomotor Domain)	Relevant CO	Approx. Hrs. required
1	Draw Single line diagram & wiring diagram of Hotels/Hospitals/Mall/Multistoried Buildings	**1**	**4**
2	Visit to installation site 1. Elevator 2. Escalator --- Report	**2**	**6**
3	Develop maintenance schedule and troubleshooting chart of DG Set.	**3**	**4**
4	Layout of Pump House	**3**	**2**
5	Develop maintenance schedule and troubleshooting chart of Submersible Pump.	**3**	**2**
6	Detail report on Control Panel of multistoried Building	**4**	**4**
7	Study of Intercom System – Case Study	**5**	**4**
8	Study of CCTV System – Case Study	**6**	**6**
9	Micro-project planning & Execution as written in suggested micro-project list		**2**
10	Micro-project report writing		**2**
11	Suggested student activity report		**2**
Total			**38**

S.No.	Performance Indicators	Weightage in %
a.	Arrangement of available equipment or model for testing	20
b.	Setting and operation	15
c.	Safety measures	20
d.	Observations and Recording	15
e.	Interpretation of result and Conclusion	15
f.	Submission of report in time	15
Total		**100**

6. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

The major equipment with broad specification mentioned here will usher in uniformity in conduct of practicals, as well as aid to procure equipment by authorities concerned.

S. No.	Equipment Name with Broad Specifications	Pr. No.
1	Measuring tape	1 to 8
2	Pumps	3, 4, 5
3	Control Panel	6
4	Intercom System	7
5	CCTV System	8

7. THEORY COMPONENTS:

Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
Section – I	
UNIT 1modern Electric Installation Of Multistoried Building HRS : 06 MARKS :10	
1a State IE Rules regarding electrical installation of multi storied building 1b Draw Electrical Layout of multi storied building 1 c Describe methods of Earthing used in multistoried buildings. 1 d Prepare Trouble Shooting and Maintenance of electric installation of multi storied building. 1 e Analysis of Load Calculation.	1.1 IE Rules regarding electrical installation of multi storied building 1.2. Electrical Layout of multi storied building 1:3. Earthing required as per need 1.4 Trouble Shooting and Maintenance of electric installation of multi storied building- Methodology. 1.5. Calculation of Total Load-Case Study
UNIT 2 Elevator & Escalator HRS : 12 MARKS : 20	
2 a Draw layout of elevator a Escalator. 2 b State Components of Elevator & Escalator system 2 c State Control Panel Components 2 d Select types of wires and cables used in lift an escalator. 2 e Select type of switches for Control an Power wiring 2 f Select types of sensors and limit switches used in elevator an escalator 2 g Explain the concept of counter weight buffer their functions. 2 h State difference between Geared and Gearless machine. 2 I Describe the procedure Maintenance of Elevator 2 j Describe protective Systems in elevator and escalator 2 k State Safety devices, interlocks, Braking systems.	2.1 General layout of elevator a Escalator. 2.2 Components of Elevator& Escalator system. 2.3 Control Panel Components 2.3.1 Types of wires and cables used in lift an escalator. 2.3.2 Type of switches for Control an Power wiring 2.3.3 Types of sensors and limit switches used in elevator an escalator 2.3.4 Concept of counter weight buffer their functions. 2.3.5 Difference between Geared and Gearless machine. 2.4 Maintenance of Elevator 2.4.1 Maintenance Concept 2.4.2 Types of Maintenance 2.4.3 Types of lubricants used in elevator/escalator 2.4.4 Maintenance schedule of elevator and escalator. 2.5 Protective Systems in elevator and escalator Safety devices, interlocks, Braking systems. 2.6 Troubleshooting of elevator

Unit Outcomes (UOs) (in cognitive domain)	**Topics and Sub-topics**
2 l Testing of of elevator and escalator 2 m State technical specification of elevator. Selection criteria for elevator.	2.6.1 Trouble shooting elevator in terms of electrical power and control system. 2.6.2 Logical sequence of testing trouble in electrical power and control circuit. 2.7 Technical specification of elevator. Selection criteria for elevator.
UNIT 3 Diesel Generator Set And Water Lifting Pump HRS : 06 MARKS : 10	
3 a Draw block diagram of DG Set. 3 b State factors to be Considered for selection and installation of DG set. 3 c Calculation of load assessment & determination size of DG set 3 d Prepare Maintenance, Schedule, Troubleshooting chart 3 e State classification of Pump, parts of centrifugal pumps & submersible pump. 3 f State factors to be considered to determine size of Pump and selection of Pump. 3 g Describe Maintenance schedule and Trouble Shooting chart of centrifugal & submersible pump.	3.1 Review of general block diagram of DG Set. 3.2 Factors to be Considered for selection and installation of DG set. 3.3 Load assessment & determination size of DG set (Numerical with particular example) 3.4 Installation, Maintenance Schedule, Troubleshooting chart 3.5 Classification of Pump, parts of centrifugal pumps & submersible pump. 3.6 Factors to be considered to determine size of Pump and selection of Pump. 3.7 Installation & Maintenance schedule and Trouble Shooting chart of centrifugal & submersible pump.
Section – II	
UNIT 4 Control Panel For Multistoried Building HRS : 06 MARKS : 12	
4 a Draw layout of control panel. 4 b Analytical method for size of busbar depending upon load current. 4 c Describe distribution of power in control panel. 4 d State components used in control panel such as MCB, MCCB, Relay, SMPS, Single Phase Preventer, Digital meters, limit switches. 4 e State specifications of components. 4 f Develop maintenance schedule& troubleshooting charts of control panels.	4.1 Layout of control panel. 4.2 Calculation for size of busbar depending upon load current. 4.3 Distribution of power in control panel. 4.4 Components used in control panel such as MCB, MCCB, Relay, SMPS, Single Phase Preventer, Digital meters, limit switches. 4.5 Specifications of components. 4.6 Maintenance schedule & troubleshooting charts of control panels. 4.7 Small Control Panel Case study.

Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
UNIT 5 Intercom System	**HRS : 06 MARKS : 12**
5 a Definition of intercom system and state different types of intercom Systems. 5 b Draw layout of Intercom system 5 c State components of intercom system and their functions. 5 d Draw basic building blocks of various systems.	5:1 Definition & different types of intercom Systems. 5.2 General Layout of Intercom system. 5.3 Components of intercom system and their functions. 5.4 Basic building blocks of various systems such as Party Line Systems, Matrix system, Wireless System. & their accessories.
UNIT 6 CCTV System	**HRS : 12 MARKS : 16**
6 State concept of Surveillance system. 6 b State Types of surveillance system 6cDraw block diagram of CCTV system and describe installation, configuration and troubleshooting. 6d. Describe monitoring of CCTV system.	6.1 Need of Surveillance system. 6. 2 Types of surveillance system 6.2.1 Types of cameras, Digital video recorder(DVR) & monitor 6.2.2 Types of application software 6.2.3 Types of topology- Caballing 6.3 Block diagram of CCTV system. 6.3.1 Installation, Configuration & trouble shooting of CCTV system. 6.3.2 Monitoring of CCTV System. a. Offline b. Remote monitoring

8. SUGGESTED SPECIFICATION TABLE FORQUESTION PAPER DESIGN :

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Modern electric Installation in multistoried building	06	04	02	04	10
II	Elevator and Escalator	12	04	08	08	20
III	DG Set and Water Lifting Pump	06	02	04	04	10
IV	Control Panel for multistoried building	06	04	04	04	12
V	Intercom System	06	04	04	04	12
VI	CCTV System	12	04	04	08	16
Total		48	**22**	**26**	**32**	**80**

9. SUGGESTED STUDENT ACTIVITIES

a. Visit to commercial buildings such as Hospital, Mall, Commercial Bank, Hostel, School, Big residential complex etc. for detail study of all systems. Write a detail report.

10. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are sample strategies, which the teacher can use to accelerate the attainment of the various outcomes in this course:

a. Massive open online courses (***MOOCs***) may be used to teach various topics/sub topics.
b. About ***15-20% of the topics/sub-topics*** which is relatively simpler or descriptive in nature is to be given to the students for ***self-directed learning*** and assess the development of the COs through classroom presentations (see implementation guideline for details).
c. Correlate subtopics with power plant system and equipment.
d. Use proper equivalent analogy to explain different concepts.
e. Use Flash/Animations to explain various components, operation.
f. Teacher should ask the students to go through instruction and Technical manuals
g.

11. SUGGESTED MICRO-PROJECTS –

Only one micro-project is planned to be undertaken by a student that needs to be assigned to him/her in the beginning of the semester. In the first four semesters, the micro-project are group-based. However, in the fifth and sixth semesters, it should be preferably be ***individually*** undertaken to build up the skill and confidence in every student to become problem solver so that s/he contributes to the projects of the industry. In special situations where groups have to be formed for micro-projects, the number of students in the group should ***not exceed three.***

The micro-project could be industry application based, internet-based, workshop-based, laboratory-based or field-based. Each micro-project should encompass two or more COs which are in fact, an integration of PrOs, UOs and ADOs. Each student will have to maintain dated work diary consisting of individual contribution in the project work and give a seminar presentation of it before submission. The total duration of the micro-project should not be less than ***16 (sixteen) student engagement hours*** during the course. The student ought to submit micro-project by the end of the semester to develop the industry oriented COs.

A suggestive list of micro-projects is given here. Similar micro-projects could be added by the concerned faculty:

a. Study of control panel in detail and its costing.
b. Detail study of CCTV system and its costing.
c. Detail study of Intercom system and its costing.
d. Visit to DG Set and write report.

12. SUGGESTED LEARNING RESOURCES

S.N.	Title	Author, Publisher, Edition and Year of publication	ISBN Number
1	Wells and Pump Engineering	S D Khepar and A M Michel	ISBN : 978-0074517857
2	Pump Theory and practices	Jain V K ,1st Edition2013	ISBN: 9788193296059
3	Handbook on Elevator	Make OTIS	
4	Handbook on D G Set	Make Kirloskar	
5	Handbook on Intercom system	Scientech Technologies Pvt. Ltd	
6	Handbook on CCTV	Sun Telecom Pvt.Ltd	

13. SOFTWARE/LEARNING WEBSITES

https://en.wikipedia.org/wiki/Pump
https://en.wikipedia.org/wiki/Elevator
https://en.wikipedia.org/wiki/Diesel_generator
https://realpars.com/electrical-control-panel/

14. PO - COMPETENCY- CO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	02	03	02	02	02	02	03
CO2	03	03	02	02	02	02	03
CO3	02	02	02	02	02	02	03
CO4	02	02	01	02	02	02	03
CO5	02	03	02	02	02	02	03
CO6	01	02	02	01	01	01	02

CO-PSO	PSO1	PSO2	PSO3	PSO4
CO1	03	03	03	03
CO2	03	03	03	03
CO3	02	02	03	03
CO4	02	02	02	03
CO5	02	02	01	02
CO6	02	02	01	02

Sign: Name: Shri. S. B. Kale (Course Expert)	Sign: Name:Dr. S. S. Bharatkar/Shri. R.U. Shelke (Head of Department)
Sign: Name:Dr. S. S. Bharatkar/Shri. R.U.Shelke (Program Head) (Department of Electrical Engineering)	Sign: Name: Shri A. S. Zanpure (CDC Incharge)

Other department Curriculum

Government Polytechnic, Pune

'180 OB' – Scheme

Programme	Diploma in ET/CE/EE/**ME**/**MT**/CM/IT/DDGM
Programme code	01/02/03/**04**/**05**/06/07/08/16/17/**18**/21/22/23/**24**/26
Name of Course	Electrical Technology
Course Code	EE2102
Prerequisite course code and name	No
Class Declaration	No

1. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P)		Examination Scheme				
					Theory		Practical		Total Marks
L	**T**	**P**	**C**		**ESE**	**PA**	**ESE**	**PA**	
03	00	02	05	**Marks**	80	20	-	25	125
				Exam Duration	3 Hrs	1 Hr	-	-	

Legends: L- lecture, T-Tutorial/teacher guided theory practice, P-practical, C-Credits, ESE-End semester examination, PA- Progressive Assessments(Test I, II/Term Work),* - Practical Exam, $ - Oral Exam. # - Online Exam., Each lecture/practical period is of one clock hour.

2. RATIONALE

Diploma holders in mechanical & metallurgy have to deal with electrical fundamentals & applications in various industrial processes. They have to handle various electrical drives, meters, & machines in industries. While working with electricity they must be conversant with safety rules & devices used in industry. Hence it is necessary for them to study the electrical principles and working characteristics of electrical Machines & electrical safety.

3. COMPETENCY

The aim of this course is to attend following industry identified competency through various teaching learning experiences:

- **Apply basic laws and principles of Electrical Engineering**.

4. COURSE OUTCOMES (COs)

The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry oriented COs associated with the above mentioned competency**:**

1. CO1: Evaluate the effect of resistance in electrical circuits.
2. CO2: Apply the principles of magnetic circuits & electromagnetic induction to DC & AC motors, Transformer& supervise their operation.
3. CO3: Select the appropriate drive for particular application
4. CO4: Use electric protective devices safely.
5. CO5: Measure electrical quantities like current, voltage, power in AC circuit.

5. SUGGESTED PRACTICALS/ EXERCISES

The practical in this section are Pros' (i.e. sub-components of the COs) to be developed and assessed in the student for the attainment of the competency**:**
Students should be able to

1. Identify the equipments, meters & machines related to electrical engineering.
2. Measure different parameters like current, voltage, power etc.
3. Connect various meters, equipments as per circuit diagram.
4. Verify various rules, relations, laws & use of safety devices used in practice.

Note: Perform any 8 experiments from sr. no. 1 to 11

Sr. No.	**Practical Exercises** (Learning Outcomes in Psychomotor Domain)	**Relevant CO**	**Approx. Hrs. required**
1	To determine temperature, rise of resistance of metal.	CO1	02
2	Verification of equivalent resistance of series & parallel resistive circuit.	CO1	04
3	Plot B-H curve of a magnetic material on D.C. generator.	CO2	02
4	Verification of Faradays laws of Electromagnetic Induction	CO2	02
5	To verify the relation between line & phase values of current and voltage in a balanced star & delta connected three phase circuit	CO1	04
6	To measure voltage, current & power in RL series circuit & calculate power factor.	CO5	02
7	To find the voltage ratio & current ratio of a single-phase transformer.	CO2	02
8	To reverse the direction of rotation of D.C. shunts motor.	CO2	02
9	Study of variable frequency drive.	CO3	02
10	Verify the use of MCB in a simple electric circuit.	CO4	02
11	Verify the use of ELCB in a simple electric circuit.	CO4	02
12	Micro project planning & Execution as written in suggested micro project list		02
13	Micro project report writing		02
14	Suggested student activity report		02
	Total Hrs		32

Sr. No.	Performance Indicators	Weightage in %
a.	Arrangement of available equipment / test rig or model	15
b.	Setting and operation	15
c.	Safety measures	10
d.	Observations and Recording	20
e.	Interpretation of result and Conclusion	20
f.	Answer to sample questions	10
g.	Submission of report in time	10
Total		**100**

6. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

The major equipment with broad specification mentioned here will usher in uniformity in conduct of practical, as well as aid to procure equipment by authorities concerned**.**

Sr. No.	Equipment Name with Broad Specifications	PrO. No.
1	Wire wound Rheostat	PrO1 , PrO2 , PrO3 ,
2	DC Ammeter, volt meter with probes, multimeter.	PrO2 , PrO3
3	Solenoid coil, dipole magnet, galvanometer	PrO4
4	Motor-Generator set	PrO3 ,
5	Three phase lamp bank	PrO5 , PrO10
6	Dimmerstat	PrO6
7	Single phase transformer	PrO7
8	D.C. Motor with starter, connecting wires.	PrO8
9	Variable frequency drive, connecting wires & three phase induction motor, multimeter, tachometer.	PrO9
10	MCB, ELCB	PrO10, PrO11
11	AC voltmeter, ammeter	PrO5, PrO6 , PrO7, PrO10,PrO11

7. THEORY COMPONENTS

The following topics/subtopics should be taught and assessed in order to develop UOs for achieving the COs to attain the identified competency**.**

Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
UNIT 1: Introduction to Electrical power supply system & Circuit (Hrs.-04 Marks-08)	
1a. Describe the details of Electrical power supply System & circuits.	**1.1** Introduction to electric power supply system, Single line diagram of electric power supply system. AC supply –single phase and three phase, DC supply- applications. Comparison between AC & DC supply.
1b. Explain the effect of temperature on the commonly used materials in electrical circuits.	**1.2** Definition of Resistance. Effect of temperature on resistance of pure metals, insulators, semiconductors &alloys, concept of resistance temperature coefficient. Simple numerical.
1c. Apply voltage division rule for series circuit, current division rule for parallel circuit.	**1.3** Resistances in series, Voltage division rule & practical examples of series connection. & simple numerical. Resistances in parallel, Current division rule & practical examples of parallel connection & simple numerical.
UNIT 2: Magnetic Circuit (Hrs.-04 Marks-08)	
2a. Describe the basic parameters of magnetic circuits.	**2.1** Introduction to magnetic circuit, Definitions of magnetic flux, magnetic flux density, magneto motive force (MMF),permeability, absolute permeability, relative permeability, reluctance, relation between M.M.F. and reluctance
2b. Give the comparison between magnetic & electric circuits.	**2.2** Compare between magnetic & electrical circuits. Simple series magnetic circuits.
2c. Explain the concept of useful flux, Leakage flux, total flux & fringing.	**2.3** concept of useful flux, leakage flux, total flux and fringing.
2d. Describe the significance of magnetization curves & hysteresis loop.	**2.4** Magnetization curves& their practical importance, concept of hysteresis, hysteresis loops. Practical importance of Hysteresis loop. No numerical.
2e. State & explain Fleming's left hand rule & applications of it.	**2.5** Force on current carrying conductor & correlate it with motor action. Fleming's left hand rule.
UNIT 3: Electromagnetic Induction (Hrs.- 04 Marks-06**)**	

Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
3a. State & explain Faradays laws of electromagnetic induction. **3b.** Describe the types of induced e.m.fs State & explain various laws related with electromagnetic induction.	**3.1** Faradays laws of Electromagnetic Induction. Types of induced e.m.f.- dynamically induced e.m.f. and statically induced e.m.f., Self and mutually induced e.m.f., applications. No numerical. **3.2** Lenz's law, Fleming's right hand rule.
UNIT 4: Single Phase & Three phase A.C. Circuits (Hrs.- 12 Marks- 16)	
4a. Explain the working of elementary alternator. **4b.** Describe the terms related with AC circuits. **4c.** Explain the concept of phasors **4d.** Draw the phasor diagram Waveforms of pure & simple series circuits. **4e.** State the voltage, current, power relations for above circuits. Solve numerical problems. **4f.** Describe the working of an elementary three phase alternator. **4g.** State the importance of three phase supply **4h.** Describe the concept of phase sequence & balanced load. **4i.** State the voltage, current & power relations for three phase star &delta connected load. **4j.** Solve simple numerical.	**4.1** Generation of single-phase alternating voltage and current, Graphical representation of sinusoidal E.M.F. and current. General Equation of alternating quantity. **4.2** Definitions of instantaneous value, cycle, period, frequency, amplitude, Peak value, average value, R.M.S. value of an alternating sinusoidal voltage and current, peak factor and form factor. **4.3** Concept of phase and phase difference, concept of lagging and leading **4.4** Representation of an alternating quantity by phasor. Waveforms and phasor diagram for a purely resistive AC circuit, purely inductive AC circuit, purely capacitive AC circuit. R-L, R-C & R-L-C Series circuits (Voltage, Current, Power, p.f. relations and phasor diagrams). **4.5** Simple numerical on above topics. **4.6** Generation of 3-phase voltages and its waveform. **4.7** Advantages of 3-phase supply over 1-phase supply. **4.8** Definition of phase sequence, balanced load **4.9** Definition of star & delta connected load, Voltage, current, power relations in star & delta connected system **4.10** Simple numerical.
UNIT 5: Transformer (Hrs.-04 Marks-10)	
5a. Define transformer; explain the functions of its various parts. **5b.** Classify transformer on various basis . **5c.** State E.M.F equation of single phase transformer. **5d.** Describe the concept of losses, efficiency and regulation of transformer.	**5.1** Definition, principle of operation, Construction. **5.2** Types of transformer on the basis of voltage, construction, & use. **5.3** E.M.F. equation (No derivation).Voltage, current ratio of a transformer. **5.4** Losses in transformer, efficiency & regulation of transformer.

Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
5e. State the specification of transformer. **5f.** State the applications of Transformer.	**5.5** Specifications & Rating (No numerical) **5.6** Concept of Three phases Transformer. Applications of transformers
UNIT 6: D.C. Motor (Hrs-04 Marks-08)	
6a. State the functions of different parts of DC Motors and explain its working principle. **6b.** State different types of DC motors with their applications. **6c.** Describe the concept of reversal of DC Motor with circuit diagrams.	**6.1** Construction and working principle of DC motor, significance of back E.M.F., Voltage equation & Torque equation. **6.2** Types of motors & their applications. **6.3** Reversal of rotation of DC shunt Motor.
UNIT 7: Three Phase & Single phase A.C. Motors (Hrs.- 10 Marks- 14)	
7a. State the functions of different parts of 3 Phase induction Motors and explain its working principle. **7b.** Draw schematic diagrams of different types of 3 Phase induction motors, speed-torque characteristics and state their applications. **7c.** Reverse the direction of rotation of 3 Phase induction motor. **7d.** Explain the need of starter for 3phase induction motor. **7e.** Describe the features of various starters for 3 phase induction motor and their advantages &limitations. **7f.** Draw schematic diagrams of different types of single phase induction motors, state their applications & state their specifications. **7g.** Draw the schematic diagrams & applications of special purpose motors.	**7.1** Three Phase induction motor: Construction and working principle, Definition of synchronous speed, slip. **7.2** Schematic diagrams of three phase squirrel cage and slipring induction motor, speed-torque characteristics, Applications. **7.3** Reversal of rotation of 3 Phase Induction motor . **7.4** Necessity of a starter, **7.5** Comparison between DOL, Star-Delta starter, variable frequency drive. **7.6** Single Phase Induction Motors- schematic diagrams, specifications, ratings and applications of following Motors: - a) Split Phase: - i) Resistance ii) Capacitance. b) Capacitor start capacitor run, capacitor start induction run, permanent capacitor c) Shaded pole **7.7** Schematic diagrams and applications of following Motors A.C. Servo Motor, ii) D.C. Servo Motor iii) Universal motor iv) stepper motor
UNIT 8: Electric Safety (Hrs.- 06 Marks- 10)	
8a. State the various reasons for electrical accidents and fire. **8b.** State safety rules to be followed while working on electrical installations. **8c.** State the need of earthing. **8d.** State the types of fire extinguishers with their applications. **8e.** State the use of various safety devices.	**8.1** Causes of electrical accidents & electric fire . **8.2** Safety rules to be followed while working with electrical appliances, installations. **8.3** Necessity of earthing **8.4** Types of fire extinguishers for A,B,C& D types of fire . **8.5** Use of safety devices viz fuse, MCB,& ELCB

8. SUGGESTED SPECIFICATION TABLE FORQUESTION PAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Electrical Circuits	04	02	02	04	08
II	Magnetic Circuits	04	04	04	00	08
III	Electromagnetic Induction	04	04	02	00	06
IV	Single Phase & Three Phase AC Circuits	12	06	06	04	16
V	Transformer	04	04	04	02	10
VI	D.C. Motor	04	04	02	02	08
VII	Three Phase & Single Phase A.C. Motor	10	04	04	06	14
VIII	Electric Safety	06	04	04	02	10
Total		**48**	**32**	**28**	**20**	**80**

9. SUGGESTED STUDENT ACTIVITIES

Other than the classroom and laboratory learning, following are the suggested student-related ***co-curricular*** activities which can be undertaken to accelerate the attainment of the various outcomes in this course: Students should conduct following activities in group and prepare reports of about 5 pages for each activity, also collect/record physical evidences for their (student's) portfolio which will be useful for their placement interviews:

a. Prepare journal based on practical performed in Electrical machines laboratory. Journal consists of drawing, observations, required equipment's, date of performance with teacher signature.
b. Read the name plate data on the available AC & DC motors in the laboratory & interpret the same.
c. Conduct market survey & collect the information of the manufacturers of various types of transformers, their specifications, applications and price range.
d. Prepare a chart showing special purpose motors with the following details. i) Photograph ii) Schematic diagram iii) Torque/Speed characteristics iv) Applications.
e. Conduct the market survey and collect the information of the manufacturers of single phase and three phase induction motors with specification and price range.

10. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are sample strategies, which the teacher can use to accelerate the attainment of the various outcomes in this course:

a. Massive open online courses (MOOCs) may be used to teach various topics/sub topics.
b. About 15-20% of the topics/sub-topics which is relatively simpler or descriptive in nature is to be given to the students for self-directed learning and assess the

development of the COs through classroom presentations (see implementation guideline for details).

c. With respect to item No.8, teachers need to ensure to create opportunities and provisions for co-curricular activities.
d. Guide student(s) in undertaking micro-projects.
e. Correlate subtopics with power plant system and equipments.
f. Use proper equivalent analogy to explain different concepts.
g. Use Flash/Animations to explain various components, operation and
h. Teacher should ask the students to go through instruction and Technical manuals

11. SUGGESTED MICRO-PROJECTS

Only one micro-project is planned to be undertaken by a student that needs to be assigned to him/her. In the first four semesters, the micro-projects are group-based. However, in the fifth and sixth semesters, it should be preferably be **individually** undertaken to build up the skill and confidence in every student to become problem solver so that s/he contributes to the projects of the industry. In special situations where groups have to be formed for micro-projects, the number of students in the group should **not exceed three.**

The micro-project could be industry application based, internet-based, workshop-based, laboratory-based or field-based. Each micro-project should encompass two or more COs which are in fact, an integration of PrOs, UOs and ADOs. Each student will have to maintain dated work diary consisting of individual contribution in the project work and give a seminar presentation of it before submission. The total duration of the micro-project should not be less than **16 (sixteen) student engagement hours** during the course. The student ought to submit micro-project by the end of the semester to develop the industry oriented COs.

A suggestive list of micro-projects is given here. Similar micro-projects could be added by the concerned faculty:

a) Conduct the market survey for collecting information of MCB and write a report based on 1) Manufacturers 2) Constructional Details 3) Types 4) Selection of right type of MCB by i) Ampere rating ii) Breaking capacity iii) Brands
b) Search on website to collect the information of ELCB and write a report based on 1) Manufacturers 2) Constructional Details 3) Types 4) Advantages and disadvantages.
c) Search on website to collect the information of variable frequency drives and write a report based on 1) Manufacturers 2) Constructional Details 3) Specifications 4) Cost.
d) Prepare a power point presentation on safety in electrical engineering.
e) Search on website to collect the information of various adjustable speed drives in respect of their applications. Compare electrical variable frequency drives and mechanical adjustable speed drives and write a report, based on advantages of variable frequency drives, and limitations of adjustable speed drives. Also collect the information of variable voltage, variable frequency (VVFD) drives.

12. SUGGESTED LEARNING RESOURCES

S. No.	Title	Author, Publisher, Edition and Year of publication	ISBN Number
1	Electrical Technology Vol. I & II	B.L. Theraja, S. Chand & Co. , 2006	Vol. I- ISBN 10- 8121924405 ISBN 13: 9788121924405 Vol. II - ISBN 10: 8121924375 / ISBN 13: 9788121924375
2	ABC of Electrical Engineering	Jain & Jain, Dhanpat Rai Publishing Company ,1 January 2013	ISBN-10 9384378011
3	Electrical Technology	Edward Hughes, Longman, 1972	ISBN 10: 0582411440 / ISBN 13: 9780582411449
4	Electrical Technology	H. Cotton, CBS, Delhi ,2005	ISBN-8123909284, 9788123909288
5	Basic Electrical Engineering	V.N. Mittle, Tata Mc-Graw Hill, 1989	ISBN- 0074516329, 9780074516324

13. SOFTWARE/LEARNING WEBSITES

http://sdeuoc.ac.in/sites/default/files/sde_videos/Electrical%20Drives%20and%20Controls_0.pdf
http://www.ene.ttu.ee/elektriajamid/oppeinfo/materjal/AAV0020/4Drives_Lehtla.pdf
https://beeindia.gov.in/sites/default/files/3Ch2.pdf

14. PO - COMPETENCY- CO MAPPING (For mechanical engineering only)

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	1	1	1	2	1	3
CO2	1	2	1	2	2	1	2
CO3	1	1	1	2	1	1	3
CO4	2	1	1	2	2	1	3
CO5	1	3	3	2	2	1	3

	PSO1	PSO2
CO1	-	2
CO2	-	2
CO3	-	2
CO4	-	2
CO5	-	2

15. PO - COMPETENCY- CO MAPPING (For metallurgical engineering only)

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	1	1	1	2	1	3
CO2	1	2	1	2	2	1	2
CO3	1	1	1	2	1	1	3
CO4	2	1	1	2	2	1	3
CO5	1	3	3	2	2	1	3

	PSO1	PSO2	PSO3	PSO4
CO1	3	1	2	1
CO2	2	1	2	1
CO3	2	1	2	1
CO4	1	1	2	1
CO5	3	1	2	1

Sign: Name: Mrs. A. N. Duraphe (Course Expert)	Sign: Name:Dr. S. S. Bharatkar/Shri. R.U.Shelke (Head of Electrical Engineering)
Sign: Name:Dr. S. S. Bharatkar/Shri. R.U.Shelke (Program Head) (Department of Electrical Engineering)	Sign: Name: Shri A. S. Zanpure (CDC Incharge)

Government Polytechnic, Pune

'180OB' – Scheme

Programme	Diploma in **ET**/CE/EE//ME/MT/CM/IT/DDGM
Programme code	01/02/**03**/04/05/06/07/08/16/**17**/21/22/**23**/24/26
Name of Course	**Fundamentals Electrical Engineering**
Course Code	**EE 2103**
Prerequisite	No
Class Declaration	No

1. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			**Total Credits (L+T+P)**		**Examination Scheme**				
					Theory		**Practical**		**Total Marks**
L	**T**	**P**	**C**		**ESE**	**PA**	**ESE**	**PA**	
03	00	02	05	**Marks**	80	20	25	25	150
				Exam Duration	3 Hrs	1 Hr	2 Hr		

Legends: L- lecture, T-Tutorial/teacher guided theory practice, P-practical, C-Credits, ESE-End semester examination, PA- Progressive Assessments(Test I, II/Term Work), * - Practical Exam, $ - Oral Exam. # - Online Exam., Each lecture/practical period is of one clock hour.

2. RATIONALE

Technicians from Electronics discipline are required to operate and maintain the electrical machines, electrical installations and control panels. So, it is highly essential to know basic principles of Electrical Engg.

3. COMPETENCY

The aim of this course is to attend following industry identified competency through various teaching learning experiences:

- **To operate and control various parameters of electrical machines.**
- **To maintain various electrical installations in industry.**

4. COURSE OUTCOMES (COs)

The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry oriented COs associated with the above mentioned competency**:**

1: To understand the principals related with magnetic circuits and electromagnetic induction.

2: To understand terms related to ac supply also able to analyze ac circuits and 3 ph Circuits.

3: To know the construction, working principal, characteristics and application of ac and dc machines.

4: To select and use appropriate L.T. Switch gears for electrical distribution system and also able to select proper type of earthing.

5. SUGGESTED PRACTICALS/ EXERCISES

The practicals in this section are PrOs (i.e. sub-components of the COs) to be developed and assessed in the student for the attainment of the competency**:**

Sr. No.	**Unit No.**	**Practical Exercises** (Outcomes in Psychomotor Domain)	**Approximate Hours Required.**
1.	1	Verification of Faradays laws of Electromagnetic induction	2
2.	1	To plot B-H curve of a magnetic material	2
3.	2	To verify the relation between line & phase value of current & voltage in balanced star circuit.	4
4.	2	To verify the relation between line & phase value of current & voltage in balanced delta circuit	4
5.	2	To determine voltage & current ratio of single phase transformer and determine efficiency and voltage regulation of single phase.	4
6.	3	Verification of reversal of rotation of following motor i) DC motor ii) 3PH Induction motor	2
7.	6	Demonstration of use & tripping of MCB against overload	2
8.	2	Study of R-L series circuit	2
9.	2	Study of R-C series circuit	2
10.	3	Study of 3 point starter.	2
11.	6	Indian Electricity Rulesfor electrical safety	4
		Total Hrs	**30**

***marked are compulsory.**

S.No.	Performance Indicators	Weightage in %
a.	Arrangement of available equipment / test rig or model	20
b.	Setting and operation	20
c.	Safety measures	10
d.	Observations and Recording	10
e.	Interpretation of result and Conclusion	20
f.	Answer to sample questions	10
g.	Submission of report in time	10
Total		**100**

6. MAJOR EQUIPMENT/ INSTRUMENTSREQUIRED

The major equipment with broad specification mentioned here will usher in uniformity in conduct of practical, as well as aid to procure equipment by authorities concerned**.**

Sr.No.	Major Equipment/ Instruments Required	Experiment Sr. No.
1	Single phase Transformer ,50Hz,1KVA, 1phase,230/115 Volts	Expt no 5
2	Dc shunt Motor,110 V DC, 1HP	Expt no 6
3	3 phase Induction Motor 440 V	Expt no 6
4	A.C./D.C. Ammeters	Expt no 2,3,4,5,8,9
5	A.C./D.C. Voltmeters	Expt no 2, 3,4,5,8,9
6.	3 Phase RAM Bank	Expt no 3,4
7	Galvanometer(30-0-30)	Expt no 1
8	MCB 44V,4pole,3phase,16A,50 Hz	Expt no 7

7. THEORY COMPONENTS :

The following topics/subtopics should be taught and assessed in order to develop UOs for achieving the COs to attain the identified competency**.**

Unit Outcomes (UOs) (in cognitive domain)	**Topics and Sub-topics**
UNIT 1 : Magnetic & Electromagnetic Circuits (Weightage- 16, Hrs- 12)	
1a.Describe the various parameters of magnetic circuits 1b.Describe the significance of magnetization curve and hysteresis loop 1c. State and explain faraday's laws. Lenz law, Fleming's right and left hand rule. 1d. Differentiate between self and mutual inductance. 1e. Differentiate between	1.1 Definition-M.M. F,Permeability,Magnetic Flux,Reluctance,Flux Density,Magnetising force 1.2 Relation between Magnetizing Force & Flux density. 1.3Magnetising Curve of Different magnetic Material. (B-H Curve). 1.4.Concept of Hysteresis & Hysteresis loop 1.5. Comparison between Magnetic circuit & Electrical Circuit. 1.6 Definitions & Explanation of a. Faraday's first & second Law b.Lenz's Law

Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
statically &Dynamically Induced emf	c. Fleming's Left- and Right-hand rule. 1.7 Concept of self & Mutual Inductance. 1.8 Concept of self & Mutual induced emf. 1.9 Concept of statically &Dynamically Induced emf, simple numerical(1.7 to 1.9)
UNIT 2 :A.C.Fundamentals & Series Circuits (Weightage- 16, Hrs- 08)	
2a.Explain generation of alternating emf. 2b.Define the various terms related to ac supply 2c. Explain the behavior of ac voltage and ac currents for different circuits.	2.1Graphical Representation of one phase Supply.(Sinusoidal) 2.2 Definition-Instantaneous Value,Cycle,Frequency,Amplitude,Time Period, Peak value ,Average Value,RMS Value, Peak factor& Form factor 2.3Concept of Phaser and phasor difference-leggings and leading 2.4 Study of following circuits w.r.to circuit diagram,waveform,phasor diagram & mathematical expression for a.Purely resistive b.Purely Inductive c.Purely Capacitive d.R-L Series. e.R-C Series 2.5 simple numerical from 2.1 to 2.4
UNIT 3 : Three Phase Circuits (Weightage- 10 , Hrs- 06**)**	
3a. Explain the generation of three phase supply. &States its advantages 3b.Explain types of connections of load for 3 ph system. 3c.state relation between line voltage & phase current.and line current & phase current for delta and star conetion load	3.1Generation of 3 phase voltage and its waveforms. 3.2 Advantages of 3 ph system over 1ph system. 3.3 Phase sequence, star & delta connection. 3.4 Concept of balanced load & balanced supply 3.5 Voltage ,current, power relation in star & delta connected system, simple numerical on 3.5
UNIT 4:Transformer and D.C motors (Weightage- 14, Hrs- 08)	
4a. Explain the function of various part and working principal of single-phase transformer. 4b.Derive emf equation of transformer. And understand voltage ratio and current ratio of transformer. 4c.Describe the construction and working of dc motor 4d.State the types of dc motor 4e.Select the dc motor depending upon application f selection of necessary starter.	4.1Definition and working principal, construction of transformer 4.2 EMF Equation, voltage and current ratio. Concept of F.L.KVA of transformer. 4.3 losses of transformer and regulation of transformer (no numerical) 4.4construction and working principal of D.C.motor 4.5 Types of D.C. motor 4.6 Characteristics and application of dc motor 4.7 study of 3-point starter 4.8 simple numerical on 4.2
UNIT 5 : Induction Motor (Weightage- 14 , Hrs- 08)	

Unit Outcomes (UOs) (in cognitive domain)	**Topics and Sub-topics**
5a. Describe the construction and working of 3ph & 1 ph Induction motor. 5b.State the types of Inductions motor. 5c.Select the Induction motor depending upon application.	5.1 Construction and working principal of three phase induction motor. Types of 3 ph Induction motor. 5.2 synchronous speed, slip 5.3 D.O.L. Starter 5.4 construction,working principal, application of i.split phase ii. capacitor start, capacitor run iii. shaded pole
UNIT 6: L.T. Switchgear & earthing (Weightage- 10 , Hrs- 06)	
6a. Select proper L.T.switchgear as per requirement. 6b.Understand the importance of earthing 6c.Select type of earthing asper requirement.	6.1 Fuse: operation and types 6.2switch fuse unit and fuse switch unit difference 6.3MCB,MCCB,ELCB; operation, General specifications 6.4 import ants of earthing and factors affecting on earthing 6.5 Explain pipe earthing and Plate earthing with suitable diagram

8. SUGGESTED SPECIFICATION TABLE FORQUESTION PAPER DESIGN

Unit No.	**Unit Title**	**Teaching Hours**	**Distribution of Theory Marks**			
			R Level	**U Level**	**A Level**	**Total Marks**
I	**Magnetic & Electromagnetic Circuits**	12	**8**	**4**	**4**	16
II	**A.C.Fundamentals & Series Circuits**	8	**8**	**4**	**4**	16
III	**Three Phase Circuits**	6	**4**	**2**	**4**	10
IV	**Transformer and D.C motors**	8	**4**	**4**	**6**	14
V	**Induction motor**	8	**4**	**4**	**6**	14
VI	**L.T Sweachgear & earthing**	6	**2**	**4**	**4**	10
Total		48	**34**	**20**	**26**	**80**

9. SUGGESTED STUDENT ACTIVITIES

Other than the classroom and laboratory learning, following are the suggested student-related ***co-curricular*** activities which can be undertaken to accelerate the attainment of the various outcomes in this course: Students should conduct following activities in group and prepare reports of about 5 pages for each activity, also collect/record physical evidences for their (student's) portfolio which will be useful for their placement interviews:

a. Market survey regarding commonly used electrical equipment which are not covered in the curriculum.
b. Undertake microprojects.(Under PP1)
c. Search information about Ratings and specifications of voltage Regulator ICs, power amplifier ICs and electronic components.
d. Undertake market survey of different domestic electrical appliances based on the following points:

i. Manufacturing
ii. Specifications /Ratings
iii. Salient Features
iv. Apllications

e. Prepare power point presentation showing working 1 phase transfprmer.
f. Prepare power point presentation showing working of AC and DC motors.

10. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are sample strategies, which the teacher can use to accelerate the attainment of the various outcomes in this course:

a. Massive open online courses (***MOOCs***) may be used to teach various topics/sub topics.
b. About ***15-20% of the topics/sub-topics*** which is relatively simpler or descriptive in nature is to be given to the students for ***self-directed learning*** and assess the development of the COs through classroom presentations (see implementation guideline for details).
c. With respect to item No.9, teachers need to ensure to create opportunities and provisions for ***co-curricular activities***.
d. Guide student(s) in undertaking micro-projects.
e. Guide student(s) for using data sheets/manuals.
f. Use proper equivalent analogy to explain different concepts.
g. Use Flash/Animations to explain operation and working of various instruments, transformer, motors,
h. Use PPTs to explain different circuits.

11. SUGGESTED MICRO-PROJECTS

Only one micro-project is planned to be undertaken by a student that needs to be assigned to him/her. In the first four semesters, the micro-projects are group-based. However, in the fifth and sixth semesters, it should be preferably be **individually** undertaken to build up the skill and confidence in every student to become problem solver so that s/he contributes to the projects of the industry. In special situations where groups have to be formed for micro-projects, the number of students in the group should **not exceed three.**

The micro-project could be industry application based, internet-based, workshop-based, laboratory-based or field-based. Each micro-project should encompass two or more COs which are in fact, an integration of PrOs, UOs and ADOs. Each student will have to maintain dated work diary consisting of individual contribution in the project work and give a seminar presentation of it before submission. The total duration of the micro-project should not be less than **16 (sixteen) student engagement hours** during the course. The student ought to submit micro-project by the end of the semester to develop the industry oriented COs.

A suggestive list of micro-projects is given here. Similar micro-projects could be added by the concerned faculty:

1) Collect the photographs of different types fuses
2) Collect the coloured photographs of various types of electric motors
3) Prepare a chart of Plate Earting
4) Prepare a chart of Pipe Earthing
5) Prepare a chart of MCB and ELCB
6) Prepare a chart of different types transformers

12. SUGGESTED LEARNING RESOURCES

S.N.	Title	Author, Publisher, Edition and Year of publication	ISBN Number
1	Electrical Technology-Vol.1	B.L.Therja, S.Chand & co., New Delhi	ISBN: 9788121927833
2	Electrical Technology-Vol.2	B.L.Therja, S.Chand & co., New Delhi	ISBN10:1259200116 ISBN13:9781259200113
3	Basic Electrical Engg.	Mittal and Mittal, Tata Mcgraw Hill ,New Delhi	ISBN 10: 8121925568 ISBN 13: 9788121925563

13. SOFTWARE/LEARNING WEBSITES

1. www.nptel.com
2. SCILAB
3. SIMULINK
4. PSIM
5. PSPICE
6. ELECTRONIC WORKBENCH
7. www.nptel.iitm.ac.in
8. www.onlinelibrary.willy.com

14. PO - COMPETENCY- CO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	1	1	3	-	-	3
CO2	3	2	-	1	-	-	3
CO3	3	2	1	3	--		3
CO4	3	-	1	3	3	-	3

	PSO1	PSO2	PSO3
CO1	**3**	**2**	-
CO2	3	2	-
CO3	3	2	**3**
CO4	3	2	-

Sign: Name: Shri. S.B. Kale (Course Experts)	Sign: Name:Dr. S. S. Bharatkar/Shri. R.U.Shelke (Head of Electrical Engineering)
Sign: Name:Dr. S. S. Bharatkar/Shri. R.U.Shelke (Program Head) (Department of Electrical Engineering)	Sign: Name: Shri A. S. Zanpure (CDC Incharge)

Government Polytechnic, Pune

'180OB' – **Scheme**

Programme	Diploma in ET/CE/EE/ME/MT/**CM/IT**/DDGM/
Programme code	01/02/03/04/05/06/07/08/21/22/23/24/26
Name of Course	**Electrical Engineering**
Course Code	**EE2107**
Prerequisite course code and name	**NO**

1. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P)		Examination Scheme				
					Theory		Practical		Total Marks
L	T	P	C		ESE	PA	$ ESE	PA	
03	00	02	05	Marks	80	20	25	25	150
				Exam Duration	3Hrs	1Hrs	2 Hrs		

Legends: **L**- lecture, **T**-Tutorial, **P**-practical, **C**- Credits, **ESE**-End semester examination, **PA**- Progressive Assessment (Test I, II/Term Work), *****- Practical Exam**,** **$**-Oral Exam, **#**-Online Examination, Each Lecture/Practical period is of one clock hour;

2. RATIONALE

The basic concepts of electrical engineering in this course will be very useful for understanding the utilization of electrical circuits, equipment, and machines. Hence, it is necessary to able to grasp the basic electric and magnetic circuits, AC fundamentals, polyphase circuits, different types of AC and DC motors , their principles, working characteristics and application. It is also useful for trouble shooting of basic electrical wiring and knows the electrical safety; this course will be very useful for understanding of higher level courses.

3. COMPETENCY

The aim of this course is to help the student to attain the following competency through various teaching learning experience

a. **Use electrical equipment in computer.**

b. **Do trouble shooting and rectification of basic electrical wiring.**

c. **Understand the electrical safety.**

4. COURSE OUTCOMES (COs)

The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so the student are able to demonstrates the following COs associated with the above mentioned competency.

a. **CO1- Appreciate the basic principles of electric and magnetic circuits**
b. **CO2- Use single phase and three phase AC supply.**
c. **CO3- Utilization of transformer and AC , DC and special purpose motors for specific applications**
d. **CO4- Use electrical protective switchgear for electrical wiring and system as per requirement**
e. **CO5- Recognize the electrical safety**

5. SUGGESTED PRACTICALS/ EXERCISES

The practical's in this section are PrOs (i.e. sub-components of the COs) to be developed and assessed in the student for the attainment of the competency**:**

Sr. No.	Unit No.	Practical Exercises (Outcomes in Psychomotor Domain)	**Relevant CO**	Approximate Hours Required
1	1	To verify properties of series and parallel connection of resistances	CO1	2
2	1	Verification of Kirchhoff‟ s Voltage Law and Kirchhoff‟ s Current Law	CO1	2
3	1	Verification of Faradays laws of Electromagnetic Induction.	CO1	2
4	1	To perform statically and dynamically induced EMF	CO1	2
5	2	To determine frequency, time period, peak value, rms value, peak factor and form factor of a sinusoidal A. C. waveform on C. R. O.	CO2	2
6	2	Find the phase difference between voltage and current on C. R. O. for resistive, inductive and capacitive circuits.	CO2	2
7	2	To verify the relation between line & phase values of current and voltage in a balanced star & delta connected circuit	CO2	2
8	2	Measurement of power by two wattmeter method	CO2	2
9	3	To determine voltage & current ratio of single-phase transformer and determine efficiency and voltage regulation of single phase transformer	CO3	2
10	3	Reversal the direction of following motors 1 Three phase Induction motor 2. Single phase induction motor	CO3	4
11	4	Reversal the direction of any one of the following motor 1. D.C. motor	CO3	2
12	5	To connect and perform two lamps control by two switches with MCB.	CO4	2
13	5	To prepare switch board of one lamp and one socket control by using two switches.	CO4	2
14	5	Test circuit using series lamp and multimeter	CO4	2
15	5	Prepare chart of procedure for rescuing a person who has received an electrical shock.	CO5	2
		Total Hrs		32

S.No.	Performance Indicators	Weightage in %
1	Arrangement of available equipment / test rig or model	20
2	Setting and operation	20
3	Safety measures	10
4	Observations and Recording	10
5	Interpretation of result and Conclusion	20
6	Answer to sample questions	10
7	Submission of report in time	10
Total		**100**

6. MAJOR EQUIPMENT/ INSTRUMENTSREQUIRED

The major equipment with broad specification mentioned here will user in uniformity in conduct of practical, as well as aid to procure equipment by authorities concerned**.**

Sr.No.	Major Equipment/ Instruments Required	Experiment no.
1	Voltage /Current/Power measuring meter AC & DC	1 to 11
2	Passive electrical elements ,Rheostat, Capacitor and inductor & CRO	5 & 6
3	Three phase lamp load	7 & 8
4	Single phase transformer	9
5	Three phase induction motor & Single phase motor	10
6	Stepper motor , servo motor , BLDC motor	10
7	Tachometer	10 & 11
8	DC Motor	11
9	Electrical tools	1 to 15

7. THEORY COMPONENTS

The following topics/subtopic should be taught and assessed in order to develop UOs for achieving the COs to attain the identified competency**.**

Unit Outcomes (UOs) (in cognitive domain)	**Topics and Sub-topics**
UNIT 1. Electrical Circuit and Electromagnetism (**Marks-12, Hrs-07**)	
1a.Define Ohms Law and Kirchhoff's Laws 1b. Analyze series and parallel circuits 1c. Define Power and Energy. 1d. Define laws and rules of electromagnetism.	1.1 Ohms Law and Kirchhoff's laws 1.2 Analysis of series, parallel and series –parallel circuits excited by independent voltage sources. Power and Energy. 1.3 Faradays Laws, Lenz's Law, Fleming's Rules. Statically and dynamically induced EMF. Concepts of self-inductance, mutual inductance and coefficient of

Unit Outcomes (UOs) (in cognitive domain)	**Topics and Sub-topics**
1e. Explain Statically and dynamically induced EMF.. 1f. Explain concepts of self-inductance, mutual inductance and coefficient of coupling. 1g. Explain Energy stored in magnetic fields.	coupling. Energy stored in magnetic fields
Unit 2 Single Phase and Three phase A.C. Circuits (Marks-13, Hrs-22)	
2a. Describe the method of generation of single phase voltage by an elementary alternator, define basic terms of sinusoidal waveform 2b. Represent the given AC quantities by phasors, waveform and mathematical equations. 2c. With the help of waveforms and phasor diagrams, show the phase relationship between voltage and current in R, L, C, RL, RC, and RLC ac circuit. 2d. Calculate the parameters of the given circuit, and also calculate current, power factor and power of the given AC circuit 2e Explain the concept of symmetrical system and phase sequence of the given AC supply. 2f Calculate the current and power of the given three phase star / delta connection.	2.1 Generation of sinusoidal voltage. Definition of average value, root mean square value, form factor and peak factor of sinusoidal voltage and current and phasor representation of alternating quantities. 2.2 Analysis with phasor diagrams of R, L, C, RL, RC and RLC circuits. Real power, reactive power, apparent power and power factor, series, parallel and series -parallel circuits. Series and parallel resonance. 2.3 Necessity and Advantages of three phase systems. 2.4 Generation of three phase power, definition of Phase sequence. 2.5 Relationship between line and phase values of balanced star and delta connections. Power in balanced three phase circuits. 2.6 Measurement of power by two wattmeter method
UNIT 3 Induction motor and Transformer (Marks- 16 , Hrs- 10)	
3a. Explain the construction & working principal of induction motor 3b.Select relevant induction motor for given application with justification. 3c. Describe the construction and working of transformer. 3d. Derive emf equation and explain losses, efficiency and voltage regulation.	3.1 Concept of rotating magnetic field; Principle of operation, types and constructional features of induction motor.; Slip and its significance. 3.2 Necessity of a starter, star-delta starter: 3.3 Applications of squirrel cage and slip ring motors. 3.4 Single Phase Induction Motors- Working principle, construction and applications of following Motors. I) Split phase a)Resistance b)Capacitance II) Capacitor start capacitor run III) Shaded pole. Reversal of rotation of above motors. 3.5 Principle of operation and construction of single phase transformers (Core and shell types). 3.6 EMF equation, losses, efficiency and voltage regulation

Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
UNIT 4 Special Purpose Electrical Motors (Marks-16 , Hrs-10)	
4a. Explain the construction and working principle of DC motor and its applications. 4b. Explain the construction and working principle of stepper motor, servo motor and BLDC motor and its applications	4.1 DC Motor: DC motor working principle; Back EMF and its significance, torque equation; Types of D.C. motors, characteristics and applications; Necessity of a starter for DC motor. 4.2. Stepper Motor: Working principal and construction of stepper motor and application. 4.3 Servo motor: Servo motor working principal, construction and application. 4.5 BLDC Motor: Brush less D. C. Motor construction, working principal and application
UNIT 5 Electrical wiring ,Protective Devices and Electrical safety (Marks-14, Hrs-08)	
5a. Select the relevant protective device and suitable switchgear for the given application with justification. 5b Describe the features of the given type of protective device. 5c State the I.E. rule related to be applied for the safety with justification. 5d. Explain how to take the precautions against shocks and understand the procedure for rescuing a person, who has received an electrical shock.	5.1 Introduction to domestic wiring, service mains, meter board and distribution board; 5.2 Introduction to circuit protective devices: Concept of overload, O.C., S.C., leakage current, H.R.C. Fuses, MCB, use of ELCB. Necessity of Earthing 5.3. One lamp control by one switch. Two lamp control by two switches. Electrical wiring diagram of 5 PC labs. 5.4 I.E. rules for safety of person & equipment followed when working with electrical installation. Electrical shocks and precautions against shocks. Procedure for rescuing a person who has received an electrical shock.

8. SUGGESTED SPECIFICATION TABLE FORQUESTION PAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Practical Marks			
			R Level	U Level	A Level	Total Marks
I	**Electrical Circuit and Electromagnetism**	07	02	06	04	12
II	**Single Phase and Three phase A.C. Circuits**	13	06	10	06	22
III	**Induction motor and Transformer**	10	04	06	06	16
IV	**Special Purpose Electrical Motors**	10	04	06	06	16
V	**Electrical wiring ,Protective Devices and Electrical safety**	08	04	06	04	14
VI						
VII						
Total		48	**20**	**34**	**26**	**80**

9. SUGGESTED STUDENT ACTIVITIES

Other than the classroom and laboratory learning, following are the suggested student-related ***co-curricular*** activities which can be undertaken to accelerate the attainment of the various outcomes in this course: Students should conduct following activities in group and prepare reports of about 5 pages for each activity, also collect/record physical evidences for their (student's) portfolio which will be useful for their placement interviews:

a. Prepare journals based on practical performed in laboratory.
b. Market survey regarding commonly used electrical equipment which are not covered in the curriculum.
c. Prepare charts of different electrical wiring diagram
d. Search information about Ratings and specifications of AC, DC and special purpose electrical motors.
e. Prepare power point presentation or animation for showing working of DC or AC or special purpose electrical motors.
f. Prepare posters to illustrate the use of procedure for rescuing a person who has received an electrical shock.

10. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are sample strategies, which the teacher can use to accelerate the attainment of the various outcomes in this course:

a. Massive open online courses (***MOOCs***) may be used to teach various topics/sub topics.
b. About ***15-20% of the topics/sub-topics*** which is relatively simpler or descriptive in nature is to be given to the students for ***self-directed learning*** and assess the development of the COs through practically implementation.
c. With respect to item No.8, teachers need to ensure to create opportunities and provisions for ***co-curricular activities***.
d. Guide student(s) in undertaking micro-projects.
e. Teacher should ask the students to go through instruction and Technical manuals

11. SUGGESTED MICRO-PROJECTS

Only one micro-project is planned to be undertaken by a student that needs to be assigned to him/her in the beginning of the semester. The micro project should be preferably being ***individually*** undertaken to build up the skill and confidence in every student to become problem solver so that she/he contributes to the projects of the industry. In special situations where groups have to be formed for micro projects, the number of students in the group should ***not exceed three.***

The micro-project could be application based, internet-based, and field based. Each micro-project should encompass two or more COs. Each student will have to maintain dated work diary consisting of individual contribution in the project work and give a seminar presentation of it before submission. The student ought to submit micro-project report by the end of the semester.

A suggestive list of micro-projects is given here. Similar micro-projects could be added by the concerned faculty:

a) Visit nearby pole mounted sub-station and prepare a report based on the following points
   i. Rating :kVA rating, primary & secondary voltage and connections
   ii. Different parts and their functions
   iii. Earthing arrangement
   iv. Protective devices
b) Visit Institute workshop and prepare a report which includes the following points:
   i. Electrical Control panel
   ii. Switch gears
   iii. Different types of motors
c) Each batch will select any one electrical device/equipment which is not included in the curriculum and prepare a short power point presentation for the class based on the following points: construction, working salient feature ,cost merits, demerits, applications manufacturers etc
d) Write a report of electrical specification of various electrical parts/motors are used in printer, monitor ,CPU, UPS & SMPS in terms of voltage, power and frequency.
e) To build electrical switch board of three sockets and three switches.
f) Prepare a report of electrical specification of accessories such as wire, MCB, switches etc., (minimum 25 items)

12. SUGGESTED LEARNING RESOURCES

S.N.	Title	Author, Publisher, Edition and Year of publication	ISBN Number
1	Electrical Technology – Vol-I	B. L. Theraja, A. K. Theraja , S. Chand & Company Pvt. Ltd. New Delhi	ISBN: 978-81-219-2440-5
2	Electrical Technology- Vol-II	B. L. Theraja, A. K. Theraja , Revised by S. G. Tarnekar , S. Chand & Company Pvt. Ltd., New Delhi	ISBN: 978-81-219-2437-5
3	A Textbook of Electrical Machines	K. R. Siddhapura, D. B. Raval, Vikas Publishing House Pvt. Ltd.	ISBN: 978-93259-7562-0

13. SOFTWARE/LEARNING WEBSITES

1. www.nptel.com
2. www.electrical-technologies.com
3. www.youtube.com/electrical

14. PO - COMPETENCY- CO MAPPING

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	*3*	-	-	-	*1*	-	-
CO2	*3*	*1*	*1*	*1*	*1*	-	*1*
CO3	*3*	*2*	*1*	*2*	-	-	*2*
CO4	-	*1*	*1*	*1*	*2*	-	*2*
CO5	-	*1*	-	-	*3*	-	*1*

For Information Technology Program

CO\PO	PSO1	PSO2	PSO3
CO1	1	-	-
CO2	*2*	-	*1*
CO3	*3*	-	*1*
CO4	2	-	-
CO5	2	-	-

For Computer Engineering program

CO\PO	PSO1	PSO2
CO1	1	-
CO2	*2*	-
CO3	*3*	-
CO4	2	-
CO5	2	-

Sign: Name: Dr. V. K. Jadhav (Course Expert)	Sign: Name: S. S. Bharatkar/Shri. R.U. Shelke (Head of Department)
Sign: Name: Dr. S. S. Bharatkar/Shri. R. U. Shelke (Program Head)	Sign: Name: Shri A.S. Zanpure (CDC)

GOVERNMENT POLYTECHNIC, PUNE

Programwise Equivalence for 180 (S) Curriculum with 180 (OB) Curriculum of all Courses for Level 1 to 4 Electrical Engineering Department.

Date : 08-01-2021

Sr. No.	Existing 180 (S) Curriculum												Proposed 180 (OB) Curriculum									Remarks Equivalent/Not Equivalent	PROGRAM
	Course code	Course Name	CREDITS			EXAM SCHEME						Course code	Course Name	CREDITS			EXAM SCHEME					
			TH	PR	TU	TH	PA	PR	OR	TW				TH	PR	TU	TH	PA	PR	PR		
1	HU181	English	2	2	0	80	20	-	-	25		HU1101	Communication Skill-I	2	0	1	40	10	25	25	Equivalent	
2	HU 182	Communication Skills	2	2	0	80	20	-	25			HU1102	Communication Skill-II	2	0	1	40	10		50	Not Equivalen	
3	SC 181	Applied Mathmatics -I	3	0	1	80	20	-	-			SC1101	Applied Mathamatics -I	3	0	2	80	20		25	Equivalent	
4	SC182	Applied Mathamatics-II	3	0	1	80	20	-	-			SC1102	Applied Mathamatics-II	3	0	2	80	20		25	Not Equivalent	
5	SC183	Engg Physics	3	2	0	80	20	50				SC1104	Engg Physics	3	2	0	80	20	25	25	Equivalent	EE,ET,CM,IT
6	SC184	Engg Chemistry	3	2	0	80	20	50				SC1105	Engg Chemistry	3	2	0	80	20	25	25	Equivalent	
7	AM281	Engg.Mechanics	4	2	0	80	20	-	--	25		AM2101	Engg.Mechanics	4	2	0	80	20	0	25	Equivalent	EE
8	CM286	Computer Fundamentals	1	2	0	--	--	50	0	25		CM2102	Fundamentals of ICT	1	2	0	0	0	25	25	Not Equivalent	EE
9	CM 287	C Programming	2	2	0	0	0	50	0	0		CM2105	Computational Laboratory	1	2	0	0	0	25	25	Not Equivalent	EE
10	EE281	Basic Electrical Engg	3	2	1	80	20	50	0	0		EE2101	Basic Electrical Engg	3	2	0	80	20	25	25	Equivalent	EE
11	EE390	Electrical Materials and Workshop	1	2	0	40	10	0	25	25		EE2104	Electrical Wiring and Domestic Appliances	0	2	0	0	0	0	25	Equivalent	EE
12	ET281	Basic Electronics	4	2	0	80	20	50	-	25		ET2108	Electronic components and circuits	2	2	0	10	40	25	25	Not Equivalent	EE
12	ME 287	Fundamentals of Mechanical Engg	2	2	0	80	20	0	0	0		ME2107	Fundamentals of Mechanical Engg	**2**	**2**	**0**	**80**	**20**	0	25	Equivalent	EE
13	WS281	Workshop Practice	0	4	0	0	0	0	0	50		WS2102	Workshop Practice (Electrical)	0	2	0	0	0	25	25	Equivalent	EE
14	ME 284	Engineering Drawing	2	2	0	-	-	-	-	50		ME 2104	Engineering Graphics	2	2	0	-	-	-	50	Equivalent	EE
15	EE282	Elements of Electrical Engg	3	2	0	80	20			25		EE2102	Electrical Technology	3	2	0	80	20	-	25	Equivalent	ME/MT
16	EE283	Fundamentals of Electrical Engg	3	2	-	80	20		25	25	EE2103	EE2103	Fundamentals of Electrical Engg	3	2	-	80	20	25	25	Equivalent	ET
17	EE283	Fundamentals of Electrical Engg	3	2	-	80	20		25	25		EE2107	Electrical Engineering	3	2	-	80	20	25	25	Not Equivalent	CO/IT
18	AU481	Environmental Science	0	2	0	-	-	-	-	50		AU4101	Environmental Science	-	2	-	-	-	-	50	Equivalent	EE
19	SC282	Engineering Mathematics	2	0	1	80	20	0	0	0		SC2103	Mathematics III	3	**0**	**0**	**80**	20	0	0	Equivalent	EE
20	EE381	MINI PROJECT	0	2	0	0	0	0	25	25		-	-	-	-	-	-	-	-	-	-	-
21	EE382	ELECTRICAL CIRCUITS AND NETWORKS	3	2	1	80	20	50	0	0		EE3102	ELECTRICAL CIRCUIT ANALYSIS	3	2	1	80	20	25	25	Equivalent	EE
22	EE383	ELECTRICAL MEASUREMENTS	3	2	0	80	20	50	0	0		EE3103	ELECTRICAL MEASUREMENTS & INSTRUMENTS	3	2	0	80	20	25	25	Equivalent	EE
23	EE384	ELECTRICAL POWER GENERATION	3	1	0	80	20	0	25	0		EE3104	GENERATION OF ELECTRICAL POWER	3	2	0	80	20	25	25	Equivalent	EE
24	EE386	COMPUTER AIDED ELECTICAL DRAWING	0	2	0	0	0	50	0	0		EE3101	ELECTRICAL CAD	0	2	0			25	25	Equivalent	EE
25	EE387	ELECTRICAL MACHINES - I	3	2	1	80	20	50	0	0		EE3105	DC MACHINES & TRANSFORMERS	3	2	1	80	20	25	25	Equivalent	EE

26	EE388	Transmission & Distribution of electrical power	3	2	0	80	20	0	25	0		EE3106	TRANSMISSION & DISTRIBUTION OF ELECTRICAL POWER	3	0	1	80	20	0	25	Equivalent	EE
27	EE389	INSTRUMENTATION AND CONTROL	3	2	0	80	20	25	0	0		EE3107	INSTRUMENTATION & CONTROL	3	2	0	80	20	25	25	Equivalent	EE
28	ET390	DIGITAL ELECTRONICS AND MICROPROCESSOR	3	2	0	80	20	50	0	0		ET3101	DIGITAL TECHNIQUES & APPLICATIONS	3	2	0	80	20	25	25	Equivalent	EE
29	EE481	PROJECT AND SEMINAR	0	8	0	0	50	0	50	50		EE4102	PROJECT	0	4	0	0	0	50	50	Equivalent	EE
												EE 4103	SEMINAR	0	2	0	0	0	25	25	Equivalent	EE
30	EE482	POWER ELECTRONICS AND DRIVES	3	2	0	80	20	0	25	0		EE4104	POWER ELECTRONICS & APPLICATIONS	3	2	0	80	20	25	25	Equivalent	EE
31	EE483	A.C. MACHINES	3	2	1	80	20	50	0	0		EE4105	A.C. MACHINES	3	2	1	80	20	25	25	Equivalent	EE
32	EE484	TESTING AND MAINTENANCE OF ELECTRICAL EQUIPMENTS	4	2	0	80	20	0	25	0		EE4106	INSTALLATION, TESTING AND MAINTENANCE OF ELECTRICAL EQUIPMENT	4	2	0	80	20	25	25	Equivalent	EE
33	EE485	SWITCHGEAR & PROTECTION	4	2	0	80	20	0	25	0		EE4107	SWITCHGEAR & PROTECTION	4	2	0	80	20	25	25	Equivalent	EE
34	EE486	ELECTRICAL ESTIMATION AND COSTING	2	2	1	80	20	0	25	0		EE4108	ELECTRICAL ESTIMATION & COSTING	3	2	0	80	20	25	25	Equivalent	EE
35	EE487	UTILISATION OF ELECTRICAL	3	2	0	80	20	0	25	0		EE4109	UTILISATION OF ELECTRICAL ENERGY	3	1	0	80	20	25	25	Equivalent	EE
36	EE488	ELECTRICAL AUDIT & CONSERVATION	3	2	0	80	20	0	25	0		EE4110	ELECTRICAL CONSERVATION & AUDIT	3	2	0	80	20	25	25	Equivalent	EE

Head of Electrical Engineering Depatment
Government Polytechnic, Pune

CDC Incharge.
Government Polytechnic, Pune

Annexure I

Government Polytechnic, Pune

(An autonomous Institute of Government of Maharashtra)

University Road, Pune 16

(www.gppune.ac.in)

Department of Electrical Engineering

INDUSTRY QUESTIONNAIRE

Dear Sir/Madam,

Government Polytechnic Pune , is an autonomous institute of Government of Maharashtra, imparting Engineering Diploma Program such as, Civil, Electrical, Mechanical, Electronics and telecommunication, Computer Engineering, Information Technology, Metallurgy and Dress Design & Garment Manufacturing. Being academically autonomous institute, each department has to design and implement curriculum of respective program after every 5 years. Now it is time to revise existing curriculum, which will be implemented from academic year 2019-20. In this regard, a survey is being conducted to identify needs of the industry in changing technical scenario.

Your experience in the industry and your valuable time of 10-15 minutes to respond to this short survey will greatly help to develop an outcome-based Electrical Engineering diploma curriculum to enhance their employability and match the industry need for the next couple of years.

General Information

S.No.	Particulars	Information
1	Name of Industry	
2	Type of Industry	Small / Medium / Large
3	Product(s) /Service(s) of the Industry	
4	Postal Address	
5	Telephone Numbers	
6	Website	
7	Contact Person: (Name, Designation, E-mail, Mobile/Contact No.) (Attached your visiting card)	

S.No.	Particulars	Please tick (√) in any one column			
		To a great extent	To a considerable extent	To some extent	Very rarely
8	In your industry, Diploma engineers in electrical engineering are involved to what extent in the following activities?				
	a) Maintenance and Servicing				
	b) Production				
	c) Installation				
	d) Marketing				
	e) Materials Management				
	f) Research/Design/Development				
	g) Testing				
	h) Quality Control/Energy Audit				
	i) Any Other 1...				
	2...				

Competencies expected from Diploma in Electrical Engineering

S. No.	Skills (i.e. What diploma holders will do in the industry at entry level) Legends: Most essential (**ME**), Essential (**E**), Desirable (**D**), Not Required (**NR**)	Tick (√) in one column			
		ME	**E**	**D**	**NR**
	Behavioral Skills				
1	Use relevant soft skills such as team work, leadership, time management, decision making, planning, conflict resolutions, counseling and others, effectively in different situations.				
2	Develop life-long learning skills through learning-to-learn strategies.				
3	Follow safe practices in production, operation and maintenance.				
4	Communicate to higher authorities and subordinate				
5	Respond positively in all circumstances				
6	Demonstrate ideas ,innovative thoughts and experiences				
7	Negotiate a fruitful outcome in an interaction				
8	Acknowledge mistake ,misunderstanding, errors etc				
9	Motivate others for achieving desired goal				
	Generic Skills (GS)				
1	Communicate in English in oral and written form.				
2	Use relevant management principles in industry.				
3	Plan to establish 'start-up small Electrical engineering related unit'				
4	Apply quality principles for assuring quality of products and services.				
5	Use computers for word processing, data analysis and presentations.				
	Technical Skills (TS)				
1	Apply basic principles of physics and chemistry for solving electrical engineering related problems.				
2	Apply the basic mathematical principle to solve basic electrical engineering calculations.				
3	Apply mathematical tools to analyse electrical system.				
4	Apply principles of applied mechanics in relevant situations.				
5	Prepare engineering drawings manually using prevailing drawing instruments.				
6	Prepare electrical circuit drawings using CAD software.				
7	Use basic principles of electronics engineering in relevant situations.				
8	Prepare simple jobs in the shop floor of the electrical engineering workshop.				
9	Select electrical engineering material as per requirement in electrical system.				
10	Measure electrical parameters with suitable meters and instruments.				

S. No.	Skills (i.e. What diploma holders will do in the industry at entry level) Legends: Most essential (**ME**), Essential (**E**), Desirable (**D**), Not Required (**NR**)	Tick (√) in one column			
		ME	E	D	NR
11	Calibrate, use and maintain different types of instrumentation system in industry and power system.				
12	Operate, test and maintain electrical equipment's, machineries and switchgears.				
13	Develop and implement the electrical related code with the help of software programming.				
14	Select appropriate electrical drive and its rating.				
15	Draw and interpret electrical power and control circuits used for various electrical installation systems.				
16	Use relevant power electronics devices and microcontroller for controlling electrical parameters in electrical machines, power system and utilization system.				
17	Implement energy conservation techniques in electrical system.				
18	Design and execute illumination schemes efficiently for residential, commercial and industrial				
19	Design of electrical machines and equipment's.				
20	Select tools and meters for repairing work of electrical system.				
21	Update and apply the advanced technique of allied disciplines through self-learning.				
22	Install and maintain the heating ventilation and air conditioner system.				
23	Apply Industrial Engineering techniques to improve productivity and quality.				
24	Estimate the cost for electrical installation of residential, commercial and industrial.				
25	Perform the jobs of store operations, materials management and purchase				
26	Use automation techniques for process control.				
27	Implement pollution reduction techniques for sustainable environment in industries.				
28	***Please mention any other***				
29					
30					
31					
	(Use separate sheet for more)				

Date: *Seal* *Signature*

Annexure II

Government Polytechnic, Pune

ELECTRICAL ENGINEERING DEPARTMENT

Validation of 180 OB curriculum by Industry / Engineering Institute/ Research Institute

<u>Course Details</u>

Name of Program: **Diploma in Electrical Engineering**

Name of the Course: ____

Course code : ____

Course offered to: - First year/Second year/Third year

<u>Validator information</u>

Name of the Validator/Expert:- ____

Designation of the Validator/Expert:____

Name of the Organisation:____

Please mention the Field/s of Expertise:- ____

Email :-___________________________ Mobile No: ______________________________

<u>Validator report</u>

Following parameters may please be commented upon in view of present/ current technology in the industry and employability

S.No.	Parameters	Excellent (5)	Very Good (4)	Good (3)	Satisfactory (2)	Needs Improvement(1)
1	The design and relevance of the competency expected from the student.					
2	The design of course outcomes					
3	Inclusion of Technological Skills					
4	The extent of relevance of the list of practical (practical outcomes) with the competency and course outcomes.					

Any other suggestion for improvement:

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____

Date Seal of Organization Signature of Validator

Annexure III

List of Industries contacted for 180 OB curriculum

Sr. No.	Name of Industry	Address
1	Central Water & Power Research Station	Khadakwasla, Pune-24
2	Ammunition Factory Khadaki, Pune	Khadaki, Pune 03
3	Maharashtra State Electricity Distribution Co. Ltd.	Shivaji Housing Soc. Plot No 14, MSEDCL Office, Pune
4	Ammunition Factory Khadaki, Pune	Khadaki, Pune 411003
5	Medical Equipment Manufacturing	Plot no B79, Chakan, MIDC Phase 2, Sawardari. Chakan, Pune
6	Jones Lang Lasalle	Amar Avinash Plaza, Bund Gardenroad, Pune
7	Star Electrical Company	J403, MIDC, Bhosari, Pune 411026
8	Cubix Automation	26/6, Vitthalwadi, Sinhgad, Pune, 411051
9	Pratham Technologies Pvt. Ltd	S No 14, Dhadge Ind. Estate, Nanded Phata, Pune
10	Unique Controls Pvt. Ltd.	S No 25/5A/1/1A, Estate, Nanded Phata, Pune 411041
11	Anaka Schalttafel	Shop No 71, Aditya Shagun Mall, NDA Pashan Road, Bavdhan, Pune 411021
12	Maharashtra State Electricity Distribution Co. Ltd.	Small Training Centre, Prakash Bhavan, S B Road, Pune 411016
13	Maharashtra State Electricity Transmission Co. Ltd.	182 KV, Mohol Substation, Tal Mohol, Dist Solapur
14	Supreme Pvt Ltd	Plot No E-87, Ranjangaon Industrial Area, Koregaon, 412220
15	Kerin Transformers	F-11, Behind Navjeevan Tyres, MIDC, Latur
16	Electronica Make Systems (I) Pvt. Ltd.	37/44, Electronic Estate, Satara Road, Pune.
17	Alfa One Systems Pvt. Ltd	Pune Satara Road, Electronic Estate, 44
18	Enrich Consultant	Yashshri, 26, Nirmal Bag Society, Parvati, Pune, 411009
19	ELECTROBS Enterprises	Shop No. 4, Vishwakarma Building, Narhe Gaon, Pune, 411041
20	Geometrics Automation And Robotics Pvt. Ltd.	Gat No 53/1, near Talwade Circle, Nigadi Chakan Road, Talawade, Pune, 411062
21	Horizon Automation Pvt. Ltd	2-Shashivihar, Shridhar nagar, Chinchwad Gaon Pune, 411033
22	Accurate Power Solutions	No 76, First Floor, 9th Cross, Rajgopal Nagar, Pinya, 2nd Stage, banglore , 560058
23	Pune Municipal Corporation (B.W.)	Bibwewadi ward office, Satara Road, Pune
24	Vertiv Energy Pvt. Ltd.	118/119-45/Lane No 7/ Ramtekadi

		Industrial Area, Hadapsar, Pune, 411013
25	Railway	Electrical Locoshed, Lonawala
26	GPP Engineering Services	Shop No. 5, Kunal Complex, Behind Shailaja Hotel, JM Road, Pune.
27	Maharashtra State Electricity Transmission Co. Ltd.	132 KV Ganeshkhind Substation, Ganeshkhind Pune.
28	3M ECI Pvt. Ltd.	145, Mumbai- Pune Road, Pimpri, Pune 411018
29	M/s Chaitanya Enterprises	Sector no 10, Plot no 23, Swastik Industrial Complex, Gala No. 29, Near Times of India, MIDC, Bhosari, 411026
30	Tele Electric Enterprises	23, Milap Society, Near Vakil Nagar, erandwane, Pune, 411004
31	Mahindra CIE Automative Ltd	General Block, Bhosari MIDC, Pune, 411026
32	San Techno Mentors Pvt Ltd	Office No. 4, GA Kulkarni Path, Kothrud, Pune, 411038
33	Reliance Industries Ltd	Navi Mumbai, Ghansoli, 400761

Annexure IV

List of Industries used for curriculum validation

Sr. No.	Name of Industry
1.	Empirical Industry Solutions, Pune
2.	Thermax India Ltd., Pune
3.	MSEDCL, Pune
4.	Greenovative Energy Pvt. Ltd. Pune