GOVERNMENT POLYTECHNIC, PUNE

(AN AUTONOMOUS INSTITUTE OF GOVT. OF MAHARASHTRA)

180 OB CURRICULUM
(Since 2019-20)

DIPLOMA IN MECHANICAL ENGINEERING PROGRAMME

IN

DEPARTMENT OF MECHANICAL ENGINEERING

GOVERNMENT POLYTECHNIC, PUNE

METALLURGICAL ENGINEERING DEPARTMENT

INDEX

Government Polytechnic, Pune

(An Autonomous Institute of Government of Maharashtra)

Department of Mechanical 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 Mechanical Department

VISION

To develop skilled, adaptable, creative and quality conscious Mechanical Engineers to serve the society.

MISSION

- **M1:** Providing modern infrastructure and facilities so that students will gain hands on experience of using various equipment, machinery and software.
- **M2:** Developing strong interaction with industries, academic and research institutes to keep curricula updated.

- **M3:** Inculcating quality consciousness, self-learning attitude along with safety and environmental awareness in students.

- **M4:** Utilizing resources and expertise to organize training in emerging technologies for faculty, staff, students and industry employees.

- **M5:** Conducting various need based continuing education modular programmes in partnership with industries.

Program Educational Objectives (PEOs)

A Diploma Mechanical Engineer will be able to -

PEO1: Work effectively as a team leader in the industry or pursue higher education.

PEO2: Perform key role in quality improvement and solve real life problems in industry with social and environmental context.

PEO3: Adopt latest technologies.

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:** Use latest Mechanical Engineering related software for simple design drafting and manufacturing.
- **PSO2:** Use and operate machine, equipment and instruments related to mechanical engineering with more emphasis on automobile industry.

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 Mechanical 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 Mechanical Engineering Program, has brought this report to a stage of completion.

Dr. N. G. Kulkarni,
Head of Department and Chairman,
Mechanical Engineering Program

Introduction

Government Polytechnic Pune is offering three years Diploma Programme in Mechanical 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 Mechanical Engineering Programme. These domains are

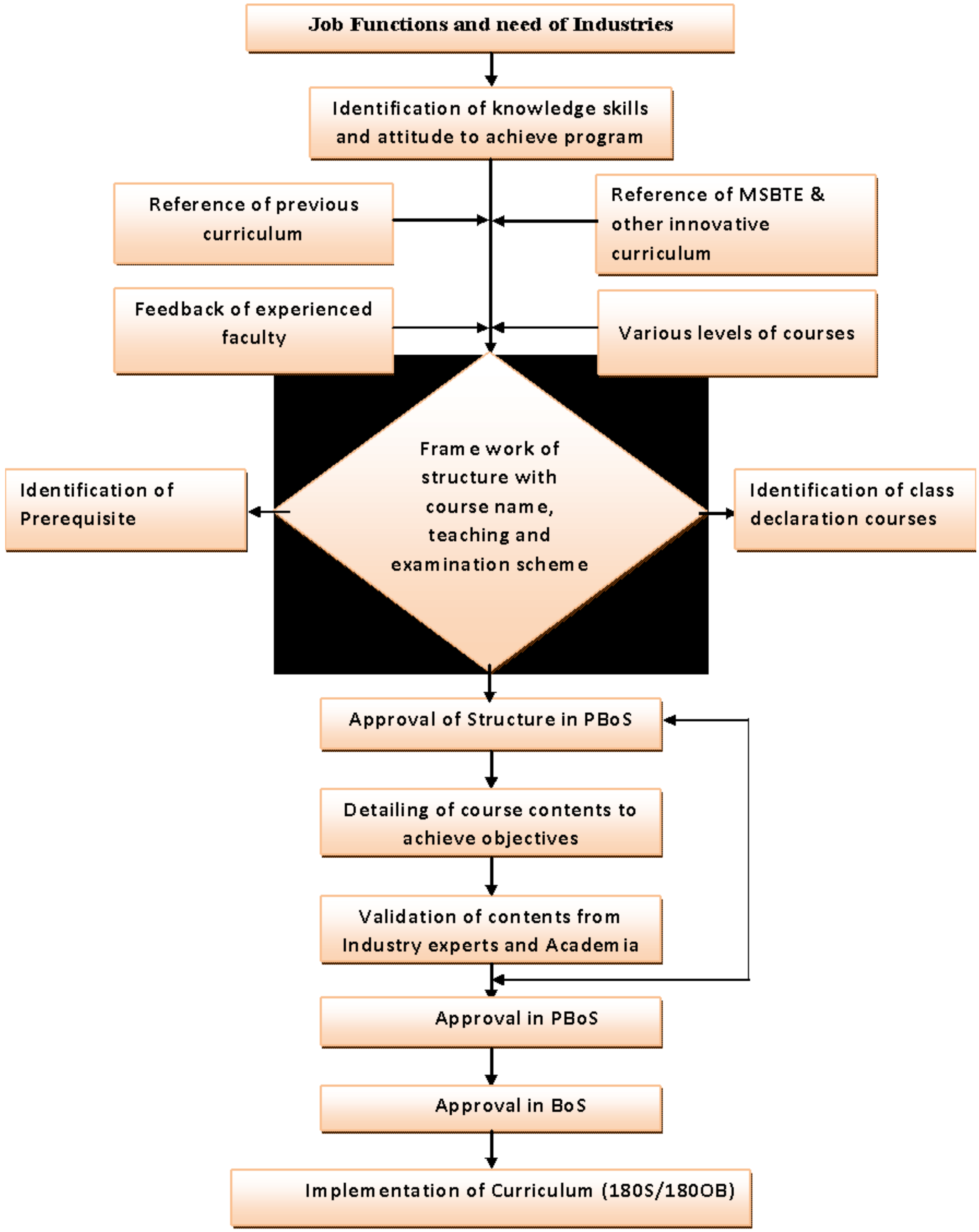
- Thermal and heat power,
- Manufacturing/Production Engineering and
- Engineering Drawing and Design.

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 and Fundamentals of Mechatronics are added at appropriate levels while few courses are improvised e.g. Engineering Graphics and Mechanical Engineering Drawing, Metrology and Measurement, Quality Techniques and one elective course from management level courses.
- 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 Mechanical 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. Kadar, 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. Gosh, 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

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Department of Mechanical 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	Member

	Polytechnic, Pune	
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 Mechanical 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 Mechanical Engineering

List of members of Program wise Board of Studies (PBoS)

Sr.No.	Name of Member	Designation
1.	Dr. Nitin G. Kulkarni, HOD. Mech. Engg. Dept.	Chairman
2.	Mr. Prashant B. Deshpande, Managing Director, Penta Designers, Pune	Member (Industry Expert)
3.	Mr. Sanjay Kandlikar, Technical Director, Sudarshan Saurshakti Pvt. Ltd. Aurangabad	Member (Industry Expert)
4.	Mr. Rajeev Apshankar, Managing Director, Energy Systech, Bhosari, Pune	Member (Industry Expert)
5.	Mr. Ajay Hantodkar, Deputy General Manager, Engineering, Thermax babcok Wilcox Energy Systems Pvt. Ltd. Chinchwad, Pune	Member (Industry Expert)
6.	Dr. Shivlingapa N. Sapali, Professor of Mech. Engg, College of Engg. Pune	Member (Academician)
7.	Dr. Ajay P. Bhattu, Asso. Prof. of Mech. Engg, College of Engg. Pune	Member (Academician)
8.	Mr. Dyaneshwar Amane, Senior Manager (Projects) Indo Schöttle Auto Parts Pvt. Ltd. Gat No. 1073/6, Mutha Urawade Road Village Pirangut Tal. Mulshi Dist. Pune	Member (Industry Expert)
9.	Mr. Suhas Shinde, Managing Director, Aquachill Systems India Pvt. Ltd., Pune	Member (Industry Expert)
10.	Mr. Amit S. Patwardhan, Director, Patson Machines Pvt. Ltd. Pune	Member (Industry Expert)
11.	Mr. M. W. Giridhar, Lecturer in Mech. Engg, Government Polytechnic Pune Mr. Vasudev B, Jaware, Head of Mech. Engg. Dept.(S-II) Govt. Poly., Pune (wef 13.01.2022)	Member (Teacher)
12.	Mrs. M. S. Deshmukh, Lecturer in Mech. Engg, Government Polytechnic Pune Mr. Sudin B. Kulkarni, Lecturer in Mech. Engg, Government Polytechnic Pune (wef 13.01.2022)	Member (Teacher)
13.	Dr. Shaheed Usmani, Deputy Secretary, RBTE, Pune	Nominee of MSBTE, Mumbai
14.	Mr. Anant Zanpure, I/C. C.D.C., Government Polytechnic, Pune Dr. Sachin S. Bharatkar, Head of Elect. Engg. Dept, Government Polytechnic Pune	Member Secretary

Government Polytechnic, Pune

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Department of Mechanical Engineering

Curriculum Development Cell committee of Institute

Institute Level CDC Team:

Sr. 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 :

Sr. No.	Name of Members	Name of Program
1	Smt. Sindhu R. Panapalli Smt. Jyotsna.S. Thorat	Civil Engineering
2	Smt Ujwala Tulangekar Shri. Sunil P. Date	Electrical Engineering
3	Smt. Pranita Mangesh 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. Shital A. Kakade	Science & Humanities
10	Smt. Dipti V. Saurkar	Science & Humanities
11	Shri. Sachin B. Yede	Science & Humanities
12	Smt. Saroj C. Patil	Science & Humanities

DIPLOMA IN MECHANICAL ENGINEERING

Programme Structure TO BE IMPLEMENTED FROM YEAR 2019-20 (180OB-OB1)

Course Code	Course Name	Compulsary/ Optional	Pre-Requ -isite	Teaching Scheme			Total Credits	Examination Scheme								Class Declaration
								Theory			Practical/Oral				Total Marks	
				L	P	T	C	ESE		PA	ESE		PA			
								Min	Max	Max	Min	Max	Min	Max		
LEVEL-1: Foundation Level Courses (All Compulsory)																
HU1101	COMMUNICATION SKILLS I	Compulsory		2	0	1	3	16	40	10	10	25 **$**	10	25	100	No
HU1102	COMMUNICATION SKILLS II	Compulsory	HU1101	2	0	1	3	16	40	10	NA	NA	20	50	100	No
SC1101	APPLIED MATHEMATICS I	Compulsory		3	0	2	5	32	80	20	NA	NA	10	25	125	No
SC1102	APPLIED MATHEMATICS II	Compulsory	SC1101	3	0	2	5	32	80	20	NA	NA	10	25	125	No
SC1103	APPLIED PHYSICS	Compulsory		3	2	0	5	32	#80	20	10	25 *	10	25	150	No
SC1106	APPLIED CHEMISTRY	Compulsory		3	2	0	5	32	#80	20	10	25 *	10	25	150	No
6			**Level Total**	**16**	**4**	**6**	**26**	**160**	**400**	**100**	**30**	**75**	**70**	**175**	**750**	
LEVEL-2: Core Technology Courses A(All Compulsory)																
AM2101	ENGINEERING MECHANICS	Compulsory		4	2	0	6	32	80	20	NA	NA	10	25	125	No
CM2102	FUNDAMENTALS OF ICT	Compulsory		1	2	0	3	NA	NA	NA	10	25 *	10	25	50	No
EE2102	ELECTRICAL TECHNOLOGY	Compulsory		3	2	0	5	32	80	20	NA	NA	10	25	125	No
ET2105	ELEMENTS OF ELECTRONICS ENGINEERING	Compulsory		3	2	0	5	32	80	20	NA	NA	10	25	125	No
ME2101	FUNDAMENTALS OF ENGINEERING GRAPHICS	Compulsory		2	2	0	4	32	80	20	NA	NA	10	25	125	No
ME2102	MECHANICAL ENGINEERING DRAWING	Compulsory	ME2101	2	2	0	4	32	80	20	NA	NA	10	25	125	No
WS2101	WORKSHOP PRACTICE	Compulsory		0	4	0	4	NA	NA	NA	NA	NA	20	50	50	No
7			**Sub Total**	**15**	**16**	**0**	**31**	**160**	**400**	**100**	**10**	**25**	**80**	**200**	**725**	
LEVEL-2: Core Technology Courses B(Any One)																
ME2105	PROGRAMMING IN C	Optional		0	4	0	4	NA	NA	NA	40	100 *	10	25	125	No
SC2101	APPLIED MATHEMATICS III	Optional	SC1102	3	0	1	4	32	80	20	NA	NA	10	25	125	No
1			**Sub Total**	**0**	**4**	**0**	**4**	**0**	**0**	**0**	**40**	**100**	**10**	**25**	**125**	
			Level Total	**15**	**20**	**0**	**35**	**160**	**400**		**50**	**125**	**90**	**225**	**850**	
LEVEL-3: Basic Technology Courses (All Compulsory)																
AM3104	STRENGTH OF MATERIALS	Compulsory	AM2101	4	2	0	6	32	80	20	NA	NA	10	25	125	No
ME3101	MACHINE DRAWING	Compulsory	ME2102	2	4	0	6	32	80	20	NA	NA	20	50	150	No
ME3102	THERMAL ENGINEERING	Compulsory		3	2	0	5	32	80	20	10	25 **$**	10	25	150	No

ME3103	FLUID MECHANICS AND FLUID MACHINERY	Compulsory		4	2	0	6	32	80	20	10	25 *****	10	25	150	No
ME3104	METROLOGY AND MEASUREMENT	Compulsory		4	2	0	6	32	80	20	10	25 *****	10	25	150	Yes
ME3105	THEORY OF MACHINES AND MECHANISMS	Compulsory		4	2	0	6	32	80	20	10	25 **$**	10	25	150	No
ME3106	FUNDAMENTALS OF MECHATRONICS	Compulsory		1	2	0	3	NA	NA	NA	10	25 **$**	10	25	50	No
ME3107	COMPUTER AIDED DRAFTING	Compulsory		0	4	0	4	NA	NA	NA	20	50 *****	20	50	100	No
MT3108	MECHANICAL ENGINEERING MATERIALS	Compulsory	SC1106	2	2	0	4	32	#80	20	NA	NA	10	25	125	No
WS3101	MANUFACTURING PROCESSES	Compulsory		2	4	0	6	32	80	20	10	25 *****	10	25	150	No
10			**Level Total**	**26**	**26**	**0**	**52**	**256**	**640**	**160**	**80**	**200**	**120**	**300**	**1300**	
LEVEL-4: Applied Technology Courses A(Auxiliary Courses - One Compulsory and Any One Optional)																
AU4101	ENVIRONMENTAL SCIENCE	Compulsory		0	2	0	2	NA	NA	NA	NA	NA	20	50	50	No
AU4102	RENEWABLE ENERGY TECHNOLOGIES	Optional		2	0	0	2	16	#40	10	NA	NA	NA	NA	50	No
AU4103	ENGINEERING ECONOMICS	Optional		2	0	0	2	16	#40	10	NA	NA	NA	NA	50	No
AU4104	ETHICAL SOURCES AND SUSTAINABILITY	Optional		2	0	0	2	16	#40	10	NA	NA	NA	NA	50	No
AU4105	DIGITAL MARKETING	Optional		0	2	0	2	NA	NA	NA	10	25 **$**	10	25	50	No
2			**Sub Total**	**2**	**2**	**0**	**4**	**16**	**40**	**10**	**0**	**0**	**20**	**50**	**100**	
LEVEL-4: Applied Technology Courses B(Management Level Courses - One Compulsory and Any One Optional)																
MA4101	ENTREPRENEURSHIP AND STARTUPS	Compulsory		2	0	0	2	16	#40	10	NA	NA	NA	NA	50	No
MA4102	INDUSTRIAL ORGANISATION AND MANAGEMENT	Optional		2	0	0	2	16	#40	10	NA	NA	NA	NA	50	No
MA4103	MATERIALS MANAGEMENT	Optional		2	0	0	2	16	#40	10	NA	NA	NA	NA	50	No
MA4104	DISASTER MANAGEMENT	Optional		2	0	0	2	16	#40	10	NA	NA	NA	NA	50	No
MA4105	INTRODUCTION TO E-COMMERCE	Optional		2	0	0	2	16	#40	10	NA	NA	NA	NA	50	No
MA4106	INFORMATION MANAGEMENT	Optional		2	0	0	2	16	#40	10	NA	NA	NA	NA	50	No
2			**Sub Total**	**4**	**0**	**0**	**4**	**32**	**80**	**20**	**0**	**0**	**0**	**0**	**100**	
LEVEL-4: Applied Technology Courses C(Programme Specific Courses (All Compulsory))																
ME4101	INDUSTRY INPLANT TRAINING	Compulsory	LEVEL 1 AND LEVEL 2 COURSES TERM GRANT	0	6	0	6	NA	NA	NA	20	50 **$**	20	50	100	No

ME4102	PROJECT	Compulsory	90 CREDITS AND LEVEL 1 PASSED	0	4	0	4	NA	NA	NA	20	50 **$**	20	50	100	Yes
ME4103	SEMINAR	Compulsory	90 CREDITS AND LEVEL 1 PASSED	0	2	0	2	NA	NA	NA	10	25 **$**	10	25	50	Yes
ME4104	QUALITY TECHNIQUES	Compulsory		3	0	0	3	32	80	20	NA	NA	NA	NA	100	No
ME4105	POWER ENGINEERING	Compulsory	ME3102	3	2	0	5	32	80	20	10	25 *****	10	25	150	Yes
ME4106	INDUSTRIAL HYDRAULICS AND PNEUMATICS	Compulsory		4	2	0	6	32	80	20	10	25 *****	10	25	150	Yes
ME4107	MACHINE DESIGN	Compulsory	AM3104	4	2	0	6	32	80	20	10	25 **$**	10	25	150	Yes
WS4101	PRODUCTION TECHNOLOGY	Compulsory		3	4	0	7	32	80	20	10	25 *****	10	25	150	Yes
8			**Sub Total**	**17**	**22**	**0**	**39**	**160**	**400**	**100**	**90**	**225**	**90**	**225**	**950**	
			Level Total	**23**	**24**	**0**	**47**	**208**	**520**		**90**	**225**	**110**	**275**	**1150**	
LEVEL-5: Diversified Courses (Total Four)																
ME5101	COMPUTER AIDED 3D MODELLING	Compulsory		1	4	0	5	NA	NA	50	20	50 *****	20	50	150	Yes
ME5102	REFRIGERATION AND AIR CONDITIONING	Optional	ME3102	3	2	0	5	32	80	20	10	25 *****	10	25	150	Yes
ME5103	AUTOMOBILE ENGINEERING	Optional		3	2	0	5	32	80	20	10	25 **$**	10	25	150	Yes
ME5104	CIM AND ROBOTICS	Optional		3	2	0	5	32	80	20	10	25 **$**	10	25	150	Yes
ME5105	TOOL ENGINEERING	Optional		3	2	0	5	32	80	20	10	25 **$**	10	25	150	Yes
ME5106	ADVANCED WELDING TECHNOLOGY	Optional		3	2	0	5	32	80	20	10	25 **$**	10	25	150	Yes
WS5101	ADVANCED MANUFACTURING AND CNC	Compulsory	WS3101	3	2	0	5	32	80	20	10	25 *****	10	25	150	Yes
4			**Level Total**	**10**	**10**	**0**	**20**	**96**	**240**	**110**	**50**	**125**	**50**	**125**	**600**	
			Total Credits	**90**	**84**	**6**	**180**	**880**	**2200**		**300**	**750**	**440**	**1100**	**4650**	

Note: Prerequisite condition for registration to each class declaration course is that all level 1 courses must be passed.

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

Details About 180OB-OB1 Structure

Note: **The figures at Sr. No. 3,4,5,9,10 may slightly vary depending upon optional courses offered by the programme.**

1.	**Total Credits**	**180**
2.	**Total No. Courses**	**40+0(Non Credit Courses)**
3.	**No of Courses with Theory Examination**	**30**
4.	**No. of Courses with Practical/Oral Examination**	**23**
5.	**No. of Courses without Theory Examination**	**11+0(Non Credit Courses)**
6.	**Total Marks**	**4650**
7.	**Marks For Class Declaration**	**1500**
8.	**Theory Paper Marks for Class Declaration**	**850**
9.	**Theory:Practical Ratio as per Credits**	**50:50**
10.	**Theory:Practical Ratio as per Marks**	**60:40**
11.	**Class Declaration Courses**	**11**

Department of Mechanical Engineering Government Polytechnic, Pune

D DIVISION: PATH CHART FOR 180 OB CURRICULUM (W.E.F Aug 2019)

I Odd Term	II Even Term	III Odd Term	IV Even Term	V Odd Term	VI Even Term
HU 1101 Communication Skills I 2 + 1= 3	HU 1102 Communication Skills II 2 + 1= 3	SC2101 Applied Maths-III 3+1=4 ME2105 Programming in C 0+4=4	ME 3102 Thermal Engineering 3 + 2 = 5	ME4101 Industry Inplant Training 0+6=6	MA 4101 Entrepreneurship and Start-ups 2+0=2
SC 1101 Applied maths-I 3 + 2 = 5	SC 1102 Applied maths-II 3 + 2 = 5	AM 3104 Strength of Materials 4+2=6	ME 3103 Fluid Mechanics & Fluid Machinery 4+2=6	* ME 4102 Project 0+2=2	* ME 4102 Project 0+2=2
SC 1106 Applied Chemistry 3+2=5	SC 1103 Applied Physics 3 + 2 = 5	ME 3101 Machine Drawing 2+4=6	ME 3104 Metrology and Measurements 4+2=6	ME 4103 Seminar. 0+2=2	MA 4102 Industrial Organization & Management 2+0=2
AM 2101 Engineering Mechanics 4+2=6	WS 2101 Work shop Practices 0+4=4	ME 3107 Computer Aided Drafting 0+4=4	ME 3105 Theory of Machines & Mechanisms 4+2=6	ME 4104 Quality Techniques 3 + 0 = 3	ME5101 Computer aided 3D Modelling 1 + 4 = 5
ME 2101 Fundamentals of Engineering Graphics 2 + 2 = 4	ME 2102 Mechanical Engineering Drawing 2 + 2 =4	MT 3108 Mechanical Engineering Materials 2+2=4	ME 3106 Fundamentals of Mechatronics 1+2=3	ME 4105 Power Engineering 3 + 2 = 5	WS 5101 Adv. Mfg. & CNC 3 + 2 = 5
ET 2105 Elements of ETX 3+2=5	EE 2102 Electrical Technology 3 + 2 = 5	WS 3101 Manufacturing Processes 2+4=6	WS 4101 Production Technology 3+4=7	ME 4106 Industrial Hydraulics & Pneumatics 4+2=6	ME 5102 Refrigeration & Air conditioning 3 + 2 = 5
	CM 2102 Fundamentals of ICT 1+2=3	AU4101 Environmental Science 0+2=2		ME 4107 Machine Design 4+2=6	ME 5103 Automobile Engineering 3 + 2 = 5
				AU 4102 Renewable Energy Technology 2+0=2	
			ELECTIVE COURSES	***credits distributed in 2 semesters**	**CD COURSES**
28	**29**	**32**	**33**	**32**	**26**
6	**7**	**7**	**6**	**8**	**7**

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Department of Mechanical Engineering Government Polytechnic, Pune

E DIVISION: PATH CHART FOR 180 OB CURRICULUM (W.E.F Aug 2019)

I Odd Term	II Even Term	III Odd Term	IV Even Term	V Odd Term	VI Even Term
HU 1101 Communication Skills I 2 + 1= 3	HU 1102 Communication Skills II 2 + 1= 3	SC2101 Applied Maths-III 3+1=4 ME2105 Programming in C 0+4=4	ME 3102 Thermal Engineering 3 + 2 = 5	ME4101 Industry Inplant Training 0+6=6	MA 4101 Entrepreneurship and Start-ups 2+0=2
SC 1101 Applied maths-1 3 + 2 = 5	SC 1102 Applied maths-II 3 + 2 = 5	AM 3104 Strength of Materials 4+2=6	ME 3103 Fluid Mechanics & Fluid Machinery 4+2=6	* ME 4102 Project 0+2=2	* ME 4102 Project 0+2=2
SC 1106 Applied Chemistry 3+2=5	SC 1103 Applied Physics 3 + 2 = 5	ME 3101 Machine Drawing 2+4=6	ME 3104 Metrology and Measurements 4+2=6	ME 4103 Seminar. 0+2=2	MA 4102 Industrial Organization & Management 2+0=2
ET 2105 Elements of ETX 3+2=5	EE 2102 Electrical Technology 3 + 2 = 5	ME 3107 Computer Aided Drafting 0+4=4	ME 3105 Theory of Machines & Mechanisms 4+2=6	ME 4104 Quality Techniques 3 + 0 = 3	ME5101 Computer aided 3D Modelling 1 + 4 = 5
ME 2101 Fundamentals of Engineering Graphics 2 + 2 = 4	ME 2102 Mechanical Engineering Drawing 2 + 2 =4	MT 3108 Mechanical Engineering Materials 2+2=4	ME 3106 Fundamentals of Mechatronics 1+2=3	ME 4105 Power Engineering 3 + 2 = 5	WS 5101 Adv. Mfg. & CNC 3 + 2 = 5
CM 2102 Fundamentals of ICT 1+2=3	AU4101 Environmental Science 0+2=2	WS 3101 Manufacturing Processes 2+4=6	WS 4101 Production Technology 3+4=7	ME 4106 Industrial Hydraulics & Pneumatics 4+2=6	ME 5102 Refrigeration & Air conditioning 3 + 2 = 5
WS 2101 Work shop Practices 0+4=4	AM 2101 Engineering Mechanics 4+2=6			ME 4107 Machine Design 4+2=6	ME 5103 Automobile Engineering 3 + 2 = 5
				AU 4102 Renewable Energy Technology 2+0=2	
			ELECTIVE COURSES	***credits distributed in 2 semesters**	**CD COURSES**
29	**30**	**30**	**33**	**32**	**26**
7	**7**	**6**	**6**	**8**	**7**

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M DIVISION: PATH CHART FOR 180 OB CURRICULUM (W.E.F Aug 2019)

I Odd Term	II Even Term	III Odd Term	IV Even Term	V Odd Term	VI Even Term
HU 1101 Communication Skills I 2 + 1= 3	HU 1102 Communication Skills II 2 + 1= 3	SC2101 Applied Maths-III 3+1=4 ME2105 Programming in C 0+4=4	ME 3102 Thermal Engineering 3 + 2 = 5	ME4101 Industry Inplant Training 0+6=6	MA 4101 Entrepreneurship and Start-ups 2+0=2
SC 1101 Applied maths-1 3 + 2 = 5	SC 1102 Applied maths-II 3 + 2 = 5	AM 3104 Strength of Materials 4+2=6	ME 3103 Fluid Mechanics & Fluid Machinery 4+2=6	* ME 4102 Project 0+2=2	* ME 4102 Project 0+2=2
SC 1106 Applied Chemistry 3+2=5	SC 1103 Applied Physics 3 + 2 = 5	ME 3101 Machine Drawing 2+4=6	ME 3104 Metrology and Measurements 4+2=6	ME 4103 Seminar. 0+2=2	MA 4102 Industrial Organization & Management 2+0=2
AM 2101 Engineering Mechanics 4+2=6	WS 2101 Work shop Practices 0+4=4	ME 3107 Computer Aided Drafting 0+4=4	ME 3105 Theory of Machines & Mechanisms 4+2=6	ME 4104 Quality Techniques 3 + 0 = 3	ME5101 Computer aided 3D Modelling 1 + 4 = 5
ME 2101 Fundamentals of Engineering Graphics 2 + 2 = 4	ME 2102 Mechanical Engineering Drawing 2 + 2 =4	MT 3108 Mechanical Engineering Materials 2+2=4	ME 3106 Fundamentals of Mechatronics 1+2=3	ME 4105 Power Engineering 3 + 2 = 5	WS 5101 Adv. Mfg. & CNC 3 + 2 = 5
CM 2102 Fundamentals of ICT 1+2=3	ET 2105 Elements of ETX 3+2=5	WS 3101 Manufacturing Processes 2+4=6	WS 4101 Production Technology 3+4=7	ME 4106 Industrial Hydraulics & Pneumatics 4+2=6	ME 5102 Refrigeration & Air conditioning 3 + 2 = 5
AU4101 Environmental Science 0+2=2	EE 2102 Electrical Technology 3 + 2 = 5			ME 4107 Machine Design 4+2=6	ME 5103 Automobile Engineering 3 + 2 = 5
				AU 4102 Renewable Energy Technology 2+0=2	
			ELECTIVE COURSES	***credits distributed in 2 semesters**	**CD COURSES**
28	**31**	**30**	**33**	**32**	**26**
7	**7**	**6**	**6**	**8**	**7**

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PTD: PATH CHART FOR 180 OB CURRICULUM (WEF 2019)

I ODD	II EVEN	III ODD	IV EVEN	V ODD	VI EVEN	VII ODD	VIII EVEN
HU 1101 Communication Skills I 2 + 1= 3	HU1102 Communication Skills-II 2+1=3	AM2101 Engineering Mechanics 4+2=6	AM3104 Strength of Materials 4+2=6	ME3104 Metrology.& Measurement 4+2=6	ME4105 Power Engineering 3+2=5	WS 4101 Production Technology 3+4=7	*ME4102 Project 0+2=2
SC1101 Applied Mathematics-I 3+2=5	SC1102 Applied Mathematics-II 3+2=5	ME2105 Programming in C 0+4=4	ME3101 Machine Drawing. 2+4=6	WS3101 Manufacturing. Processes 2+4=6	ME3103 Fluid Mechanics & Fluid Machinery 4+2=6	ME 4106 Industrial Hydraulics & Pneumatics 4+2=6	ME5103 Automobile Engineering 3+2=5
SC1106 Applied Chemistry 3+2=5	SC1103 Applied Physics 3+2=5	ET2105 Elements of ETX 3+2=5	ME3107 Computer Aided Drafting 0+4=4	MA4102 Industrial Organization & Management 2+0=2	ME3106 Fundamentals of Mechatronics 1+2=3	ME5102 Refrigeration & Air conditioning 3 + 2 = 5	ME4104 Quality Techniques 3+0=3
ME2101 Fundamentals of Engineering. Graphics 2+2=4	EE2102 Electrical Technology 3+2=5	ME3102 Thermal Engineering 3+2=5	MT3108 Mechanical Engineering Materials 2+2=4	ME3105 Theory of Machines & Mechanisms 4+2=6	ME4107 Machine Design 4+2=6	*ME4102 Project 0+2=2	WS5101 Adv.Mfg.&CNC 3+2=5
WS2101 Workshop Practice 0+4=4	ME2102 Mechanical Engineering Drawing 2+2=4	AU4101 Environmental Science 0+2=2	AU4102 Renewable Energy Technology 2+0=2		**ME4101 Industry Inplant Training(0+6=6) Exempted for PTD	ME4103 Seminar 0+2=2	MA4101 Entrepreneurship &Start ups 2+0=2
CM2102 Fundamentals of ICT 1+2=3							ME 5101 Comp Aided 3D Modelling 1 + 4 = 5
			ELECTIVE COURSES		***credits distributed in 2 semesters**		**CD COURSES**
24	22	22	22	20	26**	22	22
6	5	5	5	4	5	5	6

XX

Mr. V. J. Deshpande PTD In charge Government Polytechnic, Pune	Mr. A. S. Zanpure Institute CDC In charge Government Polytechnic, Pune	Dr. N. G. Kulkarni Head of Mechanical Engg. Deptt Government Polytechnic, Pune

Level 1 Curriculum

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 the Course	**Communication Skills -I**
Course Code	**HU1101**
Prerequisite course code and name	**NA**
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	1/2 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

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 nonverbal 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**

*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 I : Introduction and Principles of Communication (08 Hrs, 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	1.1 Introduction to communication 1.2 Definition and elements of communication 1.3 Process of communication 1.4 Barriers to communication and remedies to overcome it. 1.5 Principles of communication
Unit II : Nonverbal Skills (06 Hrs, 10 Marks)	
2a.Differentiate graphic communication 2b.Use different nonverbal codes 2c.Interpret various graphic forms.	2.1 Graphic communication 2.2 Nonverbal codes [Kinesics, Proxemics, Chronemics, Haptics 2.3 Vocalics Dress and Appearance] 2.4 Reading graphic forms[Bar graphPie chart]
Unit III : Learning Skills (06 Hrs, 04 Marks)	
3a.Recall listened information 3b.Apply oral skills 3c.Perceives various fonts & use it 3d.Compose sentences & paragraphs	3.1 Listening skills 3.2 Speaking skills 3.3 Reading skills 3.4 Writing Skills
Unit IV Comprehension (06 Hrs, 06 Marks)	
4a. Improve writing techniques 4b. Interpret information 4c. Summarize to extempore	4.1 Topic Writing (current issues) 4.2 Comprehend various information 4.3 Extempore some current Activities
Unit V Language Skills (06 Hrs, 08 Marks)	
5a. Use phonetic signs and symbols for pronunciation 5b. Practice Pronunciation using lingua-phone 5c. Utilize listening skills 5d. Classify jargon wise vocabulary for improvement	5.1 Phonetics(Practice of pronunciation) 5.2 Listening skills 5.3 Use of lingua-phone (language lab) 5.4 Vocabulary 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	Learning Skills	06	00	00	04	04
IV	Comprehension	06	00	02	04	06
V	Language skills	06	00	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 them. 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 and integrate PrOs, UOs and ADOs (Affective Domain Outcomes). Each student will have to maintain a dated work diary of individual contributions to the project work and give a seminar presentation before submission. The student should submit a 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. 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 and Year of publication, ISBN Number
1	Communication skills	Joyeeta Bhatacharya	Macmillan Co.
2	Written communication in English	Sarah Freeman	Orient Longman Ltd. ISBN- 13 : 978-8125004264
3	Developing Communication skills	Krishna Mohan and Meera Banerji	Macmillan India Ltd. 0333929195 9780333929193

13. SOFTWARE/LEARNING WEBSITES

1. www.talkenglish.com
2. Edutech.com
3. 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
CO1	1	1
CO2	2	1
CO3	1	1
CO4	1	1
CO5	1	1

Sign: Name: Mrs. S.C.Patil (Course Expert)	Sign: Name : Mrs.N.S.Kadam (Head of Department)
Sign: Name: Dr. N. G. Kulkarni. (Program Head) (Mechanical Engg Dept.)	Sign: Name: Shri. A. S. Zanpure. (CDC In charge)

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	**Communication Skills II**
Course Code	**HU1102**
Prerequisite course code and name	**HU1101 Communication Skills I**
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	01	00	03	Marks	40	10	--	50	100
				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

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:

1. Prepare various speeches for presentation
2. Write application for Business purposes.
3. Write various technical reports.
4. Write business letters.

5. SUGGESTED PRACTICALS/ EXERCISES

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.	1	2
2	1	Write job application, resume, leave application	3	2
3 *	2	Draft a project report to start a new industry (Or to write down the market survey report)	2	2
4	3	Prepare industrial visit report after visit	3	1
5	3	Write a placing an order letter, complaint letter	3	2
6	4	Write a joining letter	4	1
7 *	3	Draft a notice, circular and memorandum	3	2
8	3	Write a fall in production report	3	1
9	3	Work progress report	3	1
10	4	Description of devices	4	2
11	All	Complete a micro project based on guidelines provided in Sr. No. 11	All	2
		Total		16

*** Perform Pr.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/ INSTRUMENTS REQUIRED

NA

7. THEORY COMPONENTS

Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
Unit I Writing Speeches (08 Hrs, 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 the vote of thanks	1.1 Introduction of guest 1.2 Welcome speech 1.3 Farewell speech 1.4 Vote of thanks
Unit II Writing Applications (06 Hrs, 08 Marks)	
2a. Write official correspondence for Job 2b. Application with Resume 2c. Write application for leave. 2d. Write application for getting NOC from corporation. 2e. Students can write various applications	2.1 Job application with resume 2.2 Leave application 2.3 Miscellaneous applications
Unit III Writing Reports and Notices (10 Hrs, 10 Marks)	
3a. Students can write Industrial visit report after visit. 3b. Students can write survey report. 3c. Students can write Fall in production report. 3d. Students can draft circular and other notices. 3e. Students can draft Memos.	3.1 Visit report 3.2 Survey report (feasibility report) 3.3 Fall in production report 3.4 Circular/notice 3.5 Memos
Unit IV Drafting Business Letters (08 Hrs, 12 Marks)	
4a. Students can write Enquiry Letter. 4b. Students can write Placing an order letter. 4c. Student can write Complaint Letter. 4d. Students can write Appointment Letter. 4e. Students can draft Joining Letter.	4.1 Enquiry letter 4.2 Placing an order letter 4.3 Complaint letter 4.4 Appointment letter 4.5 Joining letter

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	Writing speeches	**08**	**2**	**2**	**6**	**10**
II	Writing applications	**06**	**2**	**2**	**4**	**08**
III	Writing Reports and Notices	**10**	**2**	**2**	**6**	**10**
IV	Drafting 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 in Lingua- 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 them. 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 and integrate PrOs, UOs and ADOs (Affective Domain Outcomes). Each student will have to maintain a dated work diary of individual contributions to the project work and give a seminar presentation before submission. The student should submit a 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:

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.	Title	Author	Publisher, Edition and Year of publication, ISBN Number
1	Communication skills	Joyeeta Bhatacharya	Macmillan Co.
2	Written communication in English	Sarah Freeman	Orient Longman Ltd. ISBN- 13 : 978-8125004264
3	Developing Communication skills	Krishna Mohan and Meera Banerji	Macmillan India Ltd. 0333929195 9780333929193
4	A Workbook Communication Skills	Sanjay Kumar and Push Lata	Oxford University Press. India. ISBN -9780199488803
5	Advanced skills for communication in English	Jeya Santhi.V., Dr. R.Selvam	New Century Book House. ISBN -978-81-2343-101-7

13. SOFTWARE/LEARNING WEBSITES

1. www.talkenglish.com
2. Edutech.com
3. www.makeuseof.com
4. 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
CO1	-	1
CO2	-	2
CO3	1	1
CO4	1	1

Sign: Name:Smt. S.C.Patil (Course Expert)	Sign: Name : Mrs.N.S.Kadam (Head of Department)
Sign: Name: Dr. N. G. Kulkarni. (Program Head) (Mechanical Engg Dept.)	Sign: Name: Shri. A. S. Zanpure. (CDC In charge)

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	**Applied Mathematics I**
Course Code	**SC1101**
Prerequisite course code and name	**NA**
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	02	00	05	Marks	80	20	00	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

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

Sr. No.	Unit No.	Practical Exercises (Learning Outcomes in Psychomotor Domain)	Relevant CO	Approx. Hrs. required
1	1	Solve simple problems of Logarithms based on definition and laws	1	2
2	1	Solve problems on determinant to find area of triangle, and solution of simultaneous equation by Cramer's Rules.	1	4
3	1	Resolve into partial fraction using linear non repeated, repeated, and irreducible factors	1	4
4	2	Solve problems on Compound, Allied, multiple and sub multiple angles.	2	4
5	2	Practice problems on factorization and de factorization.	2	2
6	2	Solve problems on inverse circular trigonometric ratios.	2	2
7	3	Practice problems on equation of straight lines using different forms.	3	4
8	3	Solve problems on perpendicular distance, distance between two parallel lines, and angle between two lines.	3	2
9	4	Solve problems on Area, such as rectangle, triangle, and circle.	4	2
10	4	Solve problems on surface and volume, sphere, cylinder and cone.	4	2
11	ALL	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

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

S. No.	Equipment Name with Broad Specifications	Experiment Sr. 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 I : Algebra (12 Hrs , 24 Marks)	
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 II : Trigonometry (18 Hrs , 24 Marks)	
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 III : Co ordinate geometry (09 Hrs , 16 Marks)	
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

Unit Outcomes (UOs) (in cognitive domain)	**Topics and Sub-topics**
	parallel lines
Unit IV : Mensuration (09 Hrs , 16 Marks)	
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

Sr. No.	Title of Book	Author	Publisher, Edition and Year of publication, ISBN Number
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

1. www.scilab.org/ -SCI Lab
2. www.mathworks.com/product/matlab/ -MATLAB
3. Spreadsheet Applications
4. www.dplot.com
5. https://www.khanacademy.org/math?gclid=CNqHuabCys4CFdOJaddHoPig

14. PO - COMPETENCY- CO MAPPING

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

	ME	
CO	PSO1	PSO2
1	-	2
2	-	2
3	-	2
4	-	2

Sign: Name: Mr.S. B. Yede Mr. V. B. Shinde Mrs. P. R. Nemade (Course Experts)	Sign: Name: (Head of Department)
Sign: Name: Dr. N. G. Kulkarni. (Program Head) (Mechanical Engg Dept.)	Sign: Name: Shri. A. S. Zanpure. (CDC In charge)

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	**Applied Mathematics II**
Course Code	**SC1102**
Prerequisite course code and name	**SC1101 – Applied Mathematics I**
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	02	00	05	**Marks**	80	20	00	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

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 and 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.

5. 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.	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

***Perform experiment 2 or 3 and experiment 10 or 11.**

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

Sr.No.	Performance Indicators	Weightage in %
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 practicals, as well as aid to procure equipment by authorities concerned**.**

Sr. No.	Equipment Name with Broad Specifications	Experiment Sr. No
1	LCD Projector	1-15
2	Interactive Classroom	1-15

7. THEORY COMPONENTS

Unit Outcomes (UOs) (in cognitive domain)	**Topics and Sub-topics**
Unit I : Differential Calculus (24 Hrs, 40 Marks)	
1a. Solve the given simple problems 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. 1e. 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 II : Integration (06 Hrs, 10 Marks)	
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 III : Statistics (06 Hrs, 10 Marks)	
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. 3c. Determine the variance and coefficient	3.1 Range, coefficient of range of discrete and grouped data. 3.2 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**
of variance of given grouped and ungrouped data. 3d. Justify the consistency of given simple sets of data.	
Unit IV : Numerical Methods (06 Hrs, 10 Marks)	
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 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 V : Matrices (06 Hrs, 10 Marks)	
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

Sr. No.	Title of Book	Author	Publisher, Edition and Year of publication, ISBN Number
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

1. www.scilab.org/ -SCI Lab
2. www.mathworks.com/product/matlab/ -MATLAB
3. Spreadsheet Applications
4. www.dplot.com
5. https://www.khanacademy.org/math?gclid=CNqHuabCys4CFdOJaddHoPig

14. PO - COMPETENCY- CO MAPPING

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

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

1)Sign: Name: Mr. S. B. Yede Mr. V.B.Shinde Mrs. P. R. Nemade (Course Experts)	Sign: Name: (Head of Department)
Sign: Name: Dr. N. G. Kulkarni. (Program Head) (Mechanical Engg Dept.)	Sign: Name: Shri. A. S. Zanpure. (CDC In charge)

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	**Applied Physics**
Course Code	**SC1103**
Prerequisite course code and name	**NA**
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	2 Hrs	--	--

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 designed with some fundamental information to help the diploma engineers to apply the basic concepts and principles of physics to solve broad-based engineering problems. The study of basic principles and the concepts of motion, elasticity, viscosity, surface tension, sound, heat, optics, photo electricity and X-rays will help in understanding the technology courses where emphasis is laid on the 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 the measurement of physical quantities.
2. Apply laws of motion in various applications.
3. Apply the concepts of elasticity, viscosity and surface tension to solve engineering problems.
4. Use basic principles heat, light and optics in related engineering problems.

5. SUGGESTED PRACTICALS/ EXERCISES

S. No.	**Unit No.**	**Practical Exercises** (Outcomes in Psychomotor Domain)	**Relevant COs**	**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. i) 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.	1,2	02*
5	2	Determine surface tension by capillary rise method.	1,3	02
6	2	Measure coefficient of viscosity of given liquid using Stoke's method (Stokes law).	1,3	02*
7	2	Calculate spring constant using Hooke's law.	3	02
8	3	Use resonance tube to determine velocity of sound. (Concept of resonance).	1,3	04*
9	4	Verify of Boyle's law and establish relation between pressure and volume for given gas.	4	04*
10	5	Determine refractive index of glass slab using principle	4	02

		of total internal reflection.		
11	5	Study the properties and working of laser using He-Ne laser beam.	4	02*
12	6	Use photoelectric cell to study effect of : i) Intensity of light on photoelectric current. ii) Applied potential on photoelectric current.	4	04*
13	All	Complete a Micro- project based on guidelines provided in Sr.No.11	1 to 4	04*
		Total		**32**

Note: A suggestive list of Practical is given in the above table. Minimum 10 practical need to be performed out of which practical marked as * are compulsory. Any one practical out of Sr. No. 1,5,7 & 10 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 Sr. No
1	Voltmeter (0-10 V), ammeter (0-5 A),	1
2	Vernier Calliper : Range: 0-15 cm, Resolution 0.01 cm.	1,2,8
3	Micrometer screw gauge: Range 0-25 mm, Resolution 0.01 mm.	1,3,6
4	Simple pendulum, Stop Watch.	4
5	Travelling microscope: Range: 0.05-22 cm, Resolution 0.001 cm, Capillary tube.	5
6	Stoke’s apparatus, Wooden scale, small metal sphere.	6
7	Hooke’s law apparatus	7
8	Resonance tube, tuning fork set, rubber pad.	8
9	Boyles law apparatus.	9

10	Glass Slab 75x50x12mm.	10
11	He-Ne laser kit.	11
12	Photoelectric cell.	12

7. THEORY COMPONENTS

Unit Outcomes (UOs) (in cognitive domain)	**Topics and Sub-topics**
Unit I General Physics (8 Hrs,14 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 Measurements:** Introduction, Definition of unit, Fundamental and derived units, Different System of units, Errors in measurements **1.2 Circular Motion**: Definition, Uniform circular motion(UCM), radius vector, angular 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, equation of SHM starting from mean position.
Unit II Properties of Matter (12 Hrs,18 Marks)	
2a. Compare cohesive and adhesive force. 2b. Explain phenomenon of ST with the help of molecular theory. 2c. Calculate surface tension of given liquid. 2d. State Newton's law of viscosity. 2e. Calculate coefficient of viscosity of given liquid. 2f. Distinguish between streamline flow and turbulent flow 2g. Describe concept of elasticity and	**2.1 Surface Tension :** Definition and unit, molecular theory of surface tension, Cohesive and adhesive forces, angle of contact and its significance, shape of liquid surface in capillary tube, capillary action and examples, surface tension by capillary rise method (no derivation), analytical treatment, effect of impurity and temperature on surface tension. **2.2 Viscosity:** Definition, velocity gradient and its unit, Newton's law of viscosity, terminal velocity, Stokes law, Stokes formula,

plasticity. 2h. State Hooke's law of elasticity. 2i. Establish relation between given types of modulii of elasticity. 2j. Predict the behavior of the given wire.	coefficient of viscosity by stokes method (no derivation), type of flow of liquid - stream line flow, turbulent flow, Reynolds's number (significance), applications and analytical treatment. **2.3 Elasticity:** Elastic, plastic and rigid bodies, stress, strain and its types, Hook's law, types of elastic modulii with its relation, analytical treatment, behavior of wire under continuously increasing load (stress-strain diagram).
Unit III Sound (6 Hrs,10 Marks)	
3a. Distinguish between Transverse and Longitudinal wave. 3b. Describe phenomenon of resonance with example and applications. 3c. Describe properties and applications of ultrasonic wave in engineering.	**3.1 Sound:** Wave motion, Transverse and longitudinal waves, free and forced vibrations, Resonance – explanation, example and applications, absorption, reflection and transmission of sound. **3.2 Ultrasonic:** Definition, properties of ultrasonic waves, applications of ultrasonic in engineering.
Unit IV Heat (6 Hrs,12 Marks)	
4a. State Boyle's law, Charles's law and Gay lussac's law. 4b. Verify Boyle's law. 4c. Derive general gas equation 4d. Convert given temperature in different scale. 4e. Explain different modes of heat transfer with example.	**4.1 Gas Laws:** Explanation of Gas laws, Boyle's law, Charles's law, Gay Lussac's law, General Gas Equation, analytical treatment, units of temperature ^{0}C, ^{0}K with their conversion, absolute scale of temperature. **4.2 Heat:** modes of heat transfer, conduction, convection and radiation.
Unit V Optics and Laser (8 Hrs,14 Marks)	
5a. State laws of reflection and refraction. 5b. Describe phenomenon of total internal reflection. 5c. Calculate acceptance angle and numerical aperture for given optical fiber. 5d. Distinguish between optical fiber communication system and ordinary system. 5e. Differentiate between properties of ordinary light and laser light. 5f. Explain spontaneous and stimulated emission.	**5.1 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. **5.2 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, analytical treatment. **5.3 LASER:** Definition, properties of LASER,

5g. Describe working of He-Ne laser with energy level diagram. 5h. State applications of laser in different field.	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 VI Modern Physics (8 Hrs,12 Marks)	
6a. Describe properties of photon 6b. Derive Einstein's photoelectric equation. 6c. Explain working of given photoelectric device. 6d. Explain production of X-rays. 6e. Describe properties and applications of X-ray in different field.	**6.1 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. **6.2 X- ray:** principle, production of X-rays using Coolidge tube, origin of X-rays, types of X-rays, properties of X-rays, engineering applications.

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	General Physics	**8**	4	4	6	14
II	Properties of matter	**12**	8	6	4	18
III	Sound	**6**	4	4	2	10
IV	Heat	**6**	4	4	4	12
V	Optics and Laser	**8**	6	6	2	14
VI	Modern Physics	**8**	6	4	2	12
	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 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-PROJECT

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. **Gas Laws :** Prepare report on Boyles law, Charles law and Guy Lussacs law .
c. **Optics :**Prepare chart to study Total Internal Reflection/LASER.
d. **X-Ray** :Prepare chart showing properties of X-rays/Photoelectric cell.
e. Collect different **Viscous Liquids** and List their applications.

12. SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	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 Edition John Wily (2004) ISBN :9781118230718,111823071X
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,ISBN :9780071426114
9	Engineering Physics	Avadhanulu, Kshirsagar	S Chand ISBN: 9788121908177

13. SOFTWARE/LEARNING WEBSITES

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

14. PO - COMPETENCY- CO MAPPING

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

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

Sign: Name: Smt. D. V. Saurkar Dr. R. B. Birajadar (Course Expert)	Sign: Name : Mrs.N.S.Kadam (Head of Department)
Sign: Name: Dr. N. G. Kulkarni. (Program Head) (Mechanical Engg Dept.)	Sign: Name: Shri. A. S. Zanpure. (CDC In charge)

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	**Applied Chemistry**
Course Code	**SC1106**
Prerequisite course code and name	**NA**
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">150</th></tr>
<tr><td rowspan="2">03</td><td rowspan="2">00</td><td rowspan="2">02</td><td rowspan="2">05</td><td>Marks</td><td>80</td><td>20</td><td>25</td><td>25</td></tr>
<tr><td>Exam Duration</td><td>2 Hrs</td><td>1 Hr</td><td>2 Hrs</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/ TermWork), *- Practical Exam, $- Oral Exam, #- Online Examination. 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. Steels, alloys, plastic and elastomers are included considering their present extensive use in automobiles, chemicals and heavy engineering industries.

Corrosion and methods of prevention will make students realize the importance of care and maintenance of machines and equipment. Study of impurities and hardness in water and methods for water softening will help the students to make proper use of water.

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. Select metals and non metals for given applications.
3. Use corrosion preventive measures in industry.
4. Use relevant water treatment processes to solve industrial problems.
5. Select relevant fuel and lubricant in relevant applications.

5. SUGGESTED PRACTICALS/ EXERCISES

Expt. Sr. No.	Unit No.	Practical Exercises (Learning Outcomes in Psychomotor Domain)	Relevant COs	Approx. Hrs. required
1	1	Write the electronic configuration of atoms from Z=1 to Z=30	1	2
2	1	Write the formation of compounds NaCl, $AlCl_3$, H_2O, CO_2, N_2	1	4
3	1	*Determine acidic and basic radical from unknown solution (solution 1)	1	4
4	1	*Determine acidic and basic radical from unknown solution (solution 2)	1	4
5	2	Determine the percentage of iron in a given steel sample by redox titration.	2	4
6	3	Preparation of phenol formaldehyde resin.	1	2
7	4	Determine the rate of corrosion of Aluminium in acidic medium.	3	2
8	5	Determination of hardness of given water sample by EDTA method.	4	2
9	6	Determine the coefficient of viscosity using Ostwald's viscometer.	5	2
10	7	Determine moisture content from a given coal sample.	5	2
11	8	Determine thinner content in oil paint.	5	4
12	1 to 8	Complete a Micro- project as per the guidelines in point no. 11	1 to 5	4
			Total	32

***Perform Expt.Sr. No 3 or 4**

Scheme of Practical Evaluation

Sr.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 to 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 practical, as well as aid to procure equipment by authorities concerned.

S. No.	Equipment Name with Broad Specifications	Experiment Sr. No
1	Digital Hot Air Oven GR Lab temperature range 100 to 250 ^{0} c	7, 8
2	Electronic balance with the scale range of 0.001 gm to 500 gm	All

7 THEORY COMPONENTS

Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
UNIT I: Atomic Structure (06 hrs, 10 marks)	
1a. Explain the characteristics of fundamental particles 1b. Distinguish between atomic number and atomic mass number 1c. Distinguish between orbit and orbital. 1d. Describe significance of quantum numbers. 1e. Explain the formation of molecules. 1f. Draw orbital electronic configurations (s, p, d, f) of elements. 1g. Define metallic bond with example.	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'srule,orbital electronic configurations (s, p, d, f) of elements having atomic number 1 to 30. 1.4 Definitions of valence electrons, valency, types of valencies, definition of metallic bond. 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 II: METAL AND ALLOYS (08 hrs, 12 marks)	
2a. Draw the flow chart showing different processes in metallurgy. 2b. Classify carbon steel giving properties and application of each type. 2c. Define heat treatment and state the purposes of the hardening method. 2d. Describe purposes of making alloys. 2e. Explain effects of alloying elements on the properties of steel. 2f. State the composition, properties and uses of given alloy.	2.1 Occurrence of metals, definitions of mineral, ore, flux, matrix, slag and metallurgy, mechanical properties of metal. 2.2 Flow chart showing different processes in metallurgy, classification, properties and application of carbon steel, heat treatment (definition, purposes and methods) 2.3 Definition of alloy, purposes of making alloys with examples, classification of alloys (ferrous and non-ferrous), effects of alloying elements on the properties of steel (Ni, Co, Si, Mn, V, W) 2.4 Composition, properties and uses of Heat resisting steel, Magnetic steel, Shock resistance steel, Stainless steel, High speed steel, Spring steel, Tool steel, Duralumin, Woods metal, Brass and Monel metal.
UNIT III: PLASTIC AND RUBBER (06 hrs, 10 marks)	
3a. Describe the formation of a given polymer. 3b. Distinguish between thermosoftening and thermosetting plastics. 3c. List the applications of Plastic based on its properties. 3d. Explain the vulcanization process of natural rubber. 3e. Distinguish between synthetic and natural rubber. 3f. Describe preparation reaction of given synthetic rubber.	3.1 Definition of monomer and polymer, polymerization, classification of plastic on the basis of monomer, on basis of thermal behavior, on basis of monomer structure, 3.2 Types of polymerization (Addition, and Condensation) applications of Plastic based on its properties. 3.3 Synthesis, properties and applications of- Polythene, PVC, Teflon, Bakelite, Polystyrene. 3.4 Types of rubber, processing of natural rubber, properties of rubber, drawbacks of natural rubber, vulcanization of rubber. 3.5 Synthetic rubber – preparation, properties and application of BUNA-S, BUNA-N, Neoprene, Thiokol.
UNIT IV: CORROSION (06 hrs, 08 marks)	
4a. Explain different types of oxide films. 4b. Explain the mechanism of electrochemical corrosion. 4c. Explain the factors affecting rate of atmospheric corrosion and electrochemical corrosion. 4d. Describe the galvanization process of protection of metal from corrosion.	4.1 Definition, causes of corrosion types of corrosion-definition (atmospheric and electrochemical) Types of oxide films 4.2 Mechanism of atmospheric and electrochemical corrosion (evolution of hydrogen, absorption of oxygen). 4.3 Factors affecting rate of atmospheric corrosion and electrochemical corrosion. 4.4 Protection Methods- Galvanization and Tinning processes, Sherardizing, Metal spraying, Metal cladding.

4e. Distinguish between galvanization and tinning.	
UNIT V: WATER (06 hrs, 10 marks)	
5a. Explain the bad effects of hard water in paper and textile industries. 5b. Describe the method of removal of hardness by zeolite process. 5c. Explain reverse osmosis process of water. 5d. Explain sewage treatment of water. 5e. Calculate the pH and pOHfor a given solution.	5.1 Definition of hard water and soft water causes of hardness, types of hardness. 5.2 Bad effect of hard water in industries (paper, textile, dye, sugar) 5.3 Removal of hardness by lime soda method, zeolite, ion exchange method, reverse osmosis. 5.4 reverse osmosis, sewage treatment- 5.5 pH scale, applications of pH in engineering. Numerical based on pH.
UNIT VI: LUBRICANT (04 hrs, 08 marks)	
6a. Explain the mechanism of fluid film lubrication. 6b. Classify lubricant and list the examples of each type. 6c. Describe given physical and chemical properties of lubricant. 6d. Select the proper lubricant for given machines, (I.C.E., gears, cutting tools, high pressure.)	6.1 Definition and functions of lubricant, mechanism of lubrication (fluid film, boundary, extreme pressure lubrication) 6.2 Classification of lubricant, properties of lubricating oils (physical and chemical) 6.3 Selection of lubricant for light machines, I.C.E., gears, cutting tools, high pressure and low speed machines, transformers, spindles in textile industry, for refrigeration system.
UNIT VII: FUELS (06 hrs, 10 marks)	
7a. Describe the characteristics of good fuel. 7b. Compare solid, liquid and gaseous fuel on the basis of ignition point, calorific value, ash content and mode of supply. 7c. Explain proximate analysis of coal. 7d. Draw the diagram of refining of crude petroleum.	7.1 Definition, classification of fuels, characteristics of good fuel. 7.2 Comparison between solid, liquid and gaseous fuel, types of coal, analysis of coal by proximate and ultimate analysis 7.3 Refining of crude petroleum. 7.4 Fractions obtained by distillation of crude oil, gasoline, kerosene, diesel as a fuel (properties and uses)

UNIT VIII: MATERIALS (06 hrs, 12 marks)	
8a. Describe the different constituents of paint. 8b. Distinguish between varnish and paint. 8c. Describe the preparation and properties of a given insulator. 8d. Explain the function of different constituents of cement.	8.1 Paints: Definition, purpose of applying paints, characteristics of paint, constituents of paint, function and examples of each constituent. 8.2 Varnish: Definition, types, difference between varnish and paint. 8.3 Insulators: Definition, characteristics, preparation, properties and application of Glass wool and Thermocole. 8.4 Cement: Definition, classification of cement, chemical composition of Portland cement, function of constituent in cement.

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	Atomic structure	06	02	08	00	10
II	Metals and alloys	08	02	04	06	12
III	Polymer and elastomer	06	02	02	06	10
IV	Corrosion	06	00	02	06	08
V	Water	06	02	02	06	10
VI	Lubricant	04	02	00	06	08
VII	Fuel	06	02	04	04	10
VIII	Materials	06	02	04	06	12
Total		**48**	**14**	**26**	**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 a journal based on practical performed in a 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, operations.
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:

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

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

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

d.Lubricants: Prepare a chart includingSelection of lubricant for different machines.

e. Water: Collect & Analyse different water samples from different sources.

12 SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publisher, Edition and Year of publication, ISBN Number
1	Engineering Chemistry	Dara S.S. Umare S.S.	S. Chand and Co publication, New Delhi, 201, ISBN: 8121997658
2	Engineering Chemistry	Jain and Jain	DhanpatRai and Sons, New Delhi,2015, ISBN: 9352160002
3	Engineering Chemistry	Vairam. S	Wiley Indian Pvt. Ltd, New Delhi, 2013 ISBN: 9788126543342
4	Chemistry for Engineers	Agnihotri, Rajesh	Wiley Indian Ptd. Ltd, New Delhi, 2014, ISBN: 9788126550784
5	Engineering Chemistry	Agrawal Shikha	Cambridge University press, New Delhi, 2015 ISBN: 97811074764

13 SOFTWARE/LEARNING WEBSITES

1. www.chemistrytesching.com
2. www.visionlearning.com
3. www.chem1.com
4. www.onlinelibrary.wiley.com
5. www.rsc.org
6. www.chemcollective.org
7. www.wqa.org

14 PO - COMPETENCY- CO MAPPING

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

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

Sign: Name: Smt.S. A. Kakade Smt. G.M.Patel, (Course Expert)	Sign: Name: (Head of Department)
Sign: Name: Dr. N. G. Kulkarni. (Program Head) (Mechanical Engg Dept.)	Sign: Name: Shri. A. S. Zanpure. (CDC In charge)

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	**NA**
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></th></tr>
<tr><td rowspan="2">04</td><td rowspan="2">00</td><td rowspan="2">02</td><td rowspan="2">06</td><td>Marks</td><td>80</td><td>20</td><td>NA</td><td>25</td><td>125</td></tr>
<tr><td>Exam Duration</td><td>3Hrs</td><td>1 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/TermWork, *- Practical Exam, $- Oral Exam, #- Online Examination 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. 2.2 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

Sr. 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
CO1	-	1
CO2	-	2
CO3	-	1
CO4	-	2
CO5	-	2
CO6	-	2

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. N. G. Kulkarni (Program Head) (Mechanical Engg. Dept.)	Sign: Name: Shri A.S.Zanpure (CDC)

Government Polytechnic, Pune

'180OB' – Scheme

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

1. TEACHING AND EXAMINATION SCHEME

<table>
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<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">01</td><td rowspan="2">00</td><td rowspan="2">02</td><td rowspan="2">03</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>
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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

In any typical business setup, to carry out routine tasks related to creating business documents, performing data analysis and its graphical representations, and making electronic slide show presentations, the student needs to learn various software such as office automation tools like word processing applications and spreadsheets and presentation tools. They also need to use these tools for making their project reports and presentations. The objective of the 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

This course aims 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 competency mentioned above**:**

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 the 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 the motherboard. Mounting and Unmounting 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 the 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 files and folders, Creating shortcuts.	1	1
7	1	Various operations on Window based operating system	1	2

		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		
8	2	i) Create, edit and save the 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 a 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 the 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 fthe or 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 the primary key. iii) Modify the table structure-add column, change the column's data type, and delete the column from the 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 -I Introduction to Computer System (04 Hrs)	
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 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 - II Word Processing (03 Hrs)	

Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
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 -III Spreadsheets and Database (04 Hrs)	
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	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

Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
given dataset	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 – IV Presentation Tool (03 Hrs)	
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 charts in the given presentation	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 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 transitions, , Add Speaker Notes, Print a Presentation. 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 - V Basics of Internet (02 Hrs)	

Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
5a. Explain the 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.

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, the following are the suggested student-related ***co-curricular*** activities that can be undertaken to accelerate the attainment of the various outcomes in this course:
Students should conduct the following activities in groups and prepare reports of about five pages for each activity, also collect/record physical evidence for their (student's) portfolio, which will be helpful in their placement interviews:

a. Prepare a journal of practicals.
b. Prepare a sample document with all word processing features. (Course teacher shall allot appropriate document type to each student)
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 teach various topics/subtopics.
b. About ***15-20% of the topics/sub-topics,*** which is relatively simpler or descriptive, 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. For item No.8, teachers need to create opportunities and provisions for ***co-curricular activities***.
d. Guide student(s) in undertaking micro-projects.
e. Correlate subtopics with power plant systems and equipments.
f. Use proper equivalent analogy to explain different concepts.
g. Use Flash/Animations to explain various components, operation and
h. Teachers 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 them. 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-baddd, internet-based, workshop-based, laboratory-based, or field-based. Each micro-project should encompass two or more COs that are the integration of PrOs, UOs and ADOs. (Affective Domain Outcomes). Each student will have to maintain an activity chart consisting of individual contributions in 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. Word documents: Prepare Time Table, Application Notes, Reports (Subject teacher shall assign a document to be prepared by each student)
b. Slide Presentations: Prepare slides with all Presentations of reports (Subject teacher shall assign a presentation to be prepared by each student.
c. Spreadsheets: Prepare pay bills, tax statements, student's assessment records using spreadsheets (Teacher shall assign a spreadsheet to be prepared by each student
d. Web Browser/E-mail: Create an E-mail ID using any web browser and E-mail service and explore all the options available in e-mail, 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

1. http://www.nptel.ac.in
2. https://www.microsoft.com/en-in/learning/office-training.aspx
3. http://www.tutorialsforopenoffice.org
4. 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
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 Expert /s)	Sign: Name: Shri. U. V. Kokate Dr. S. B. Nikam (Head of Department) (Department of Computer Engineering)
Sign: Name: Dr. N. G. Kulkarni. (Program Head) (Mechanical Engg Dept.)	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**/06/07/08/16/17/**18**/**19**/21/22/23/**24**/26
Name of Course	**Electrical Technology**
Course Code	**EE2102**
Prerequisite course code and name	**NA**
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	00	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

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 they must study the electrical principles and working characteristics of electrical Machines & electrical safety.

3. COMPETENCY

This course aims to attend the 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 competency mentioned above**:**

1. Evaluate the effect of resistance in electrical circuits.
2. Apply the principles of magnetic circuits & electromagnetic induction to DC & AC motors, transformers & supervise their operation.
3. Select the appropriate drivers for a particular application
4. Use electric protective devices safely.
5. Measure electrical quantities like current, voltage, power in AC circuit.

5. SUGGESTED PRACTICALS/ EXERCISES

Sr. No.	Unit No.	Practical Exercises (Learning Outcomes in Psychomotor Domain)	Relevant CO	Approx. Hrs. required
1	1	Determine temperature rise of resistance of the metal.	1	02
2		Verify equivalent resistance of series & parallel resistive circuits.	1	04
3	2	Plot B-H curve of magnetic material on D.C. generator.	2	02
4	3	Verify Faraday's laws of Electromagnetic Induction	2	02
5	4	Verify the relation between line & phase values of current and voltage in a balanced star & delta connected three phase circuit	1	04
6		Measure voltage, current & power in RL series circuit & calculate power factor.	5	02
7	5	Find the voltage ratio & current ratio of a single-phase transformer.	2	02
8	6	Operate D.C. shunts motor in the reverse direction of rotation.	2	02
9	7	Study variable frequency drive.	3	02
10	8	Verify the use of MCB in a simple electric circuit.	4	02
11		Verify the use of ELCB in a simple electric circuit.	4	02
12		Complete any one suggested student activity from Sr. No. 10		02
13		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	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 the broad specification mentioned here will usher in uniformity in the conduct of practical and aid to procure equipment by authorities concerned.

Sr. No.	Equipment Name with Broad Specifications	Experiment Sr. No
1	Wire wound Rheostat	1, 2, 3,
2	DC Ammeter, voltmeter with probes, multimeter.	2, 3
3	Solenoid coil, dipole magnet, galvanometer	4
4	Motor-Generator set	3,
5	Three phase lamp bank	5, 10
6	Dimmerstat	6
7	Single phase transformer	7
8	D.C. Motor with starter, connecting wires.	8
9	Variable frequency drive, connecting wires & three phase induction motor, multimeter, tachometer.	9
10	MCB, ELCB	10, 11
11	AC voltmeter, ammeter	5, 6, 7, 10,11

7. THEORY COMPONENTS

Unit Outcomes (UOs) (in the cognitive domain)	Topics and Sub-topics
Unit I: Introduction to Electrical power supply system & Circuit (04 Hrs, 08 Marks)	
1a. Describe the details of the Electrical power supply System & circuits. **1b.** Explain the effect of temperature on the commonly used materials in electrical circuits. **1c.** Apply voltage division rule for series circuit, current division rule for parallel circuit.	**1.1** Introduction to the 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. **1.2** Definition of Resistance. Effect of temperature on resistance of pure metals, insulators, semiconductors &alloys, the concept of resistance temperature coefficient. Simple numerical. **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 II: Magnetic Circuit (04 Hrs, 08 Marks)	
2a. Describe the basic parameters of magnetic circuits. **2b.** Give the comparison between magnetic & electric circuits. **2c.** Explain the concept of useful flux, Leakage flux, total flux & fringing.	**2.1** Introduction to magnetic circuit, Definitions of magnetic flux, magnetic flux density, magnetomotive force (MMF),permeability, absolute permeability, relative permeability, reluctance, relation between M.M.F. and reluctance

Unit Outcomes (UOs) (in the cognitive domain)	**Topics and Sub-topics**
2d. Describe the significance of magnetization curves & hysteresis loop. **2e.** State & explain Fleming's left hand rule & applications of it.	**2.2** Compare between magnetic & electrical circuits. Simple series magnetic circuits. **2.3** concept of useful flux, leakage flux, total flux and fringing. **2.4** Magnetization curves& their practical importance, concept of hysteresis, hysteresis loops. Practical importance of Hysteresis loop. No numerical. **2.5** Force on current carrying conductor & correlate it with motor action—Fleming's left hand rule.
Unit III: Electromagnetic Induction (04 Hrs, 06 Marks)	
3a. State & explain Faraday's 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 IV: Single Phase & Three phase A.C. Circuits (14 Hrs, 16 Marks)	
4a. Explain the working of the elementary alternator. **4b.** Describe the terms related to 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 Outcomes (UOs) (in the cognitive domain)	Topics and Sub-topics
Unit IV: Transformer (04 Hrs, 10 Marks)	
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. **5e.** State the specification of transformer. **5f.** State the applications of Transformer.	**5.1** Definition, principle of operation, Construction. **5.2** Types of transformer based on 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. **5.5** Specifications & Rating (No numerical) **5.6** Concept of Three phases Transformer. Applications of transformers
Unit VI: D.C. Motor (04 Hrs, 08 Marks)	
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 VII: Three Phase & Single phase A.C. Motors (10 Hrs, 14 Marks)	
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 Outcomes (UOs) (in the cognitive domain)	Topics and Sub-topics
Unit VIII: Electric Safety (06 Hrs, 10 Marks)	
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, the following are the suggested student-related ***co-curricular*** activities that can be undertaken to accelerate the attainment of the various outcomes in this course:
Students should conduct the following activities in groups and prepare reports of about five pages for each activity, also collect/record physical evidence for their (student's) portfolio which will be helpful in their placement interviews:

a. Prepare journal based on practical performed in Electrical machines laboratory. Journal consists of drawing, observations, required equipment, date of performance with teacher signature.
b. Read the nameplate data on the available AC & DC motors in the laboratory & interpret the same.
c. Conduct a market survey & collect the manufacturers' information 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 manufacturers' information 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 teach various topics/subtopics.
b. About 15-20% of the topics/sub-topics that are relatively simpler or descriptive in nature are 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. For item No.8, teachers need to create opportunities and provisions for co-curricular activities.
d. Guide student(s) in undertaking micro-projects.
e. Correlate subtopics with power plant systems and equipments.
f. Use proper equivalent analogy to explain different concepts.
g. Use Flash/Animations to explain various components, operation and
h. A 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 them. 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 that are 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) 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 the right type of MCB by i) Ampere rating ii) Breaking capacity iii) Brands
b) Search on a 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 the 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 PowerPoint presentation on safety in electrical engineering.
e) Search on the website to collect the information of various adjustable speed drives regarding their applications. Compare electrical variable frequency drives and mechanical adjustable speed drives and write a report based on the 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

Sr. 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

1. http://sdeuoc.ac.in/sites/default/files/sde_videos/Electrical%20Drives%20and%20Controls_0.pdf
2. http://www.ene.ttu.ee/elektriajamid/oppeinfo/materjal/AAV0020/4Drives_Lehtla.pdf
3. 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

Sign: Name: Mrs. A. N. Duraphe (Course Expert)	Sign: Name: (Head of Electrical Department)
Sign: Name: Dr. N. G. Kulkarni. (Program Head) (Mechanical Engg. Dept.)	Sign: Name: Shri. A. S. Zanpure. (CDC In charge)

Government Polytechnic, Pune

'180 OB' – Scheme

Programme	**Diploma in Mechanical Engineering**
Programme code	01/02/03/**04**/05/06/07/08/16/17/**18**/21/22/23/**24**/26
Name of Course	**Elements of Electronics Engineering**
Course Code	**ET2105**
Prerequisite course code and name	**NA**
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	--	02	05	**Marks**	80	20	00	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

Most consumer appliances are based on electronic circuits and devices in today's world. The foundation for working a computer or any of its peripherals is based on electronics. This course has been designed to develop skills to understand and test simple electronic components and circuits. After studying this course, students will develop an insight to identify, build and troubleshoot simple electronic circuits.

3. COMPETENCY

This course aims to attend the 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 competency mentioned above**:**

1. Plot the characteristics of semiconductor devices.
2. Interpret the working of oscillators.
3. Verification of logic gates and relevant applications.
4. Use OP-AMP IC in circuits.
5. Operate CRO and Function generator.
6. Select appropriate transducers for relevant applications

5. SUGGESTED PRACTICALS/ EXERCISES

Sr. No.	Unit No.	Practical Exercises (Outcomes in Psychomotor Domain)	Relevant CO	Approximate Hours Required.
1.	1	Calculate the values of different resistors by colour coding method	1	02
2.		Plot V-I characteristics of P-N junction diode.	1	02
3.		Test performance of diode as Half wave and Full wave rectifier with and without filter.	1	04
4.		Plot the input and output characteristics in CE configuration.	1	04
5.	2	Calculate frequency of oscillations for Hartley and Colpitts oscillator.	2	02
6.	3	Verification of truth table for logic gates.	3	02
7.	4	Observe input-output waveforms of Inverting Amplifier.	4	02
8.		Observe input-output waveforms of Non Inverting Amplifier.	4	02
9.		Observe input/output waveforms of Integrator.	4	02
10.		Observe input/output waveforms of Differentiator	4	02
11.	5	Measure amplitude, Time period of sine, triangular and square wave with the help of CRO.	5	02
12.	6	Test performance of inductive transducer LVDT.	6	02
13.	All	Complete a Micro- project as per the guidelines in point no. 11 towards the fulfillment of the COs of the course.	All	04
		Total Hrs.		**32**

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/ 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	Variable DC Power supply 0-30V with display for voltage and current	2,3,4,5,7,8,9,10
2	Digital Multimeter	1,2,4,14
3	CRO	3,5,7,8,9,10,11,12,13
4	Function Generator	3,5,7,8,9,10,12,13
5	Different types of cables and connectors	All

7. THEORY COMPONENTS

Unit Outcomes (UOs) (in the cognitive domain)	Topics and Sub-topics
Unit -I Semiconductor Devices (15 Hrs., 20 Marks)	
1a. Plot V-I characteristics of PN Diode 1b. Define and Measure parameters of diode 1c. Implement Zener diode as a voltage regulator. 1d. Compare salient features of the given type of rectifiers. 1e. Explain with sketches the working principle of the given transistor configuration. 1f. Analyze and differentiate between CE, CB, CC configurations	1.1 Introduction to basic components Resistors- Colour coding, values and types Capacitor- Colour coding values and types Inductors- Colour coding values and types 1.2 Semiconductor Theory Types: 1] intrinsic Semiconductor 2] Extrinsic semiconductor- P-type and N-type semiconductor. P-N junction diode: Diode symbol, Working, Barrier voltage, depletion region, Junction Capacitance, Forward & reverse Characteristics 1.3 Zener diode: Diode symbol, Working, Forward & reverse Characteristics Avalanche & Zener breakdown. Introduction to LED: symbol, working 1.4 Rectifier: Definition, Classification Half wave and Full wave Rectifier: circuit diagram, working, comparison, merits and demerits. Filters, necessity, types, comparison, merits, demerits. 1.5 Transistor: construction, symbol, operating principle, characteristics, configurations, comparison between CB, C, E, CC, applications as switch and amplifier.

Unit Outcomes (UOs) (in the cognitive domain)	Topics and Sub-topics
Unit - II Oscillators (7 Hrs., 12 Marks)	
2a. State Barkhausen criteria for an oscillator. 2b. Classify oscillators. 2c. Draw circuits and explain the working of Different types of oscillators.	2.1 Block diagram, Barkhausan Criteria for sustained oscillations, Oscillations in LC tank circuit; 2.2 Classification: LC and RC. Classification of RC Oscillator: Working of RC Phase shift and Wein Bridge Oscillator. 2.3 Classification of LC Oscillator: Working of Hartley, Colpitts 2.4 Crystal Oscillator
Unit -III Digital Fundamentals (7 Hrs., 12 Marks)	
3a. Understand different numbering system with numerical examples 3b. Draw symbols for different logic gates with truth tables. 3c. Implement different Boolean laws using different gates. 3d. Verify De Morgan's theorem	3.1 Number systems: Decimal, Binary, Hexadecimal, Octal. 3.2 Basic logic gates: AND, OR, NOT, NAND, NOR, EXOR symbols, IC numbers and Truth Table. 3.3 Boolean Algebra: Fundamentals of Boolean algebra, Basic laws 3.4 De Morgan's theorem,
Unit -IV Linear ICS (7 Hrs., 12 Marks)	
4a. Draw symbol and pin diagram of IC 741. 4b. Define various parameters related to OP-AMP. 4c. Derive an expression for various mathematical operation of OP-AMP.	4.1 OP AMP. IC 741, symbol, pin diagram, ideal and typical characteristics, 4.2 Applications such as Inverting, Non-Inverting amplifier, Difference amplifier, adder, subtractor, integrator, differentiator. (using closed-loop system)
Unit -V Instrumentation (5 Hrs., 12 Marks)	
5a. Draw and explain blocks of CRT, CRO and Function generator. 5b. State applications & specifications of CRO and Function generator.	5.1 CRO: Cathode Ray Tube, Oscilloscope Block diagram, operation, oscilloscope specifications, Applications. 5.2 Function generator, Block diagram, operation, specifications,

Unit Outcomes (UOs) (in the cognitive domain)	**Topics and Sub-topics**
Unit -VI Sensors and Transducers (7 Hrs., 12 Marks)	
6a. Differentiate between sensor and transducer. 6b. Define and classify transducers. 6c. State selection criteria of the transducer. 6d. Differentiate between Active- Passive, Primary-Secondary, and analogue-digital transducers. 6e. Interpret working principle and application of Resistive, Capacitive, Inductive, Transducers (LVDT), photodiode, phototransistor, Piezoelectric Transducers	6.1 Definition, classification: Active, Passive, Primary, Secondary, Analog, Digital 6.2 Selection criteria for transducer 6.3 Classification: Active, Passive, Primary, Secondary, Mechanical, Electronic, Analog, Digital, Resistive, Capacitive, Inductive Transducers. 6.4 Construction, Operation, Applications: LVDT, RTD, Thermocouple, Photoelectric, Piezoelectric Transducers,

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	Semiconductor Devices	15	08	08	04	20
II	Oscillators	07	04	06	02	12
III	Digital Fundamentals	07	04	04	04	12
IV	Linear ICs	07	04	04	04	12
V	Instrumentation	05	02	04	06	12
VI	Sensors and Transducers	07	04	06	02	12
Total		**48**	**24**	**32**	**24**	**80**

9. SUGGESTED STUDENT ACTIVITIES

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

Students should conduct the following activities in groups and prepare reports of about five pages for each activity, also collect/record physical evidence for their (student's) portfolio, which will be helpful in their placement interviews:

a. Prepare journals based on practicals performed in the laboratory.
b. Study of the datasheet of electronic components.

c. Prepare charts of symbols of Electronic components.
d. Search information about Ratings and specifications of Regulator, diodes, transistors, CRO, function generator.
e. Collect information of passive transducers and prepare charts of the same.
f. Prepare posters to illustrate the use of photoelectric sensors in remote controls.

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. About ***15-20% of the topics/sub-topics,*** which is relatively simpler or descriptive, 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. For item No.8, teachers need to create opportunities and provisions for ***co-curricular activities***.
d. Guide student(s) in undertaking micro-projects.
e. Correlate subtopics with power plant systems and equipments.
f. Use proper equivalent analogy to explain different concepts.
g. Use Flash/Animations to explain various components, operations and
h. A 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 them at the beginning of the semester. They ought to submit it by the end of the semester to develop industry-oriented COs. Each micro-project should encompass two or more COs that are 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 the micro-project is to be done under Practical (PA) Assessment.

The Micro Project is preferably assigned to the group of (4-6) students or an individual, taking into consideration the capabilities and circumstances at that time

A suggested list is given here. The concerned faculty could add a similar micro-project.

a. Prepare a chart of different types of Resistors showing their specifications and applications.
b. Prepare a chart of different types of Capacitors showing their specifications and applications.
c. Prepare a chart of different types of Inductors showing their specifications and applications.
d. Prepare a chart of different types of Diodes showing their specifications and applications.
e. Prepare a chart of different types of Inductors showing their specifications and applications.
f. Prepare a chart of different types of Rectifiers showing their specifications and applications.
g. Prepare a chart of different types of Logic Gates and their truth tables.

h. Prepare a chart of different types of Sensors & Transducers showing their specifications and applications
i. Prepare a chart of functions of front panel control of C.R.O.
j. Prepare a chart of functions of the front panel of the Function generator.

12. SUGGESTED LEARNING RESOURCES

S.N.	Title	Author	Publisher, Edition and Year of publication, ISBN Number
1	Basic Electronics.	Albert Malvino	8th Edition,Tata McGraw Hill,2015 ISBN10:1259200116ISBN13:9781259200113
2	Basic Electronics.	J.S.Katre	Edition 2017, Techmax Publishers ISBN-10: 9350779641 ISBN-13: 978-9350779644
3	Basic Electronics.	B.L.Theraja	S Chand Publishing, 2007 ISBN 10: 8121925568 ISBN 13: 9788121925563
4	Linear Integrated Circuits	Ramakant Gaikwad	4TH EDITION, PHI Publication ISBN 10: 8120320581 ISBN 13: 9788120320581
5	Modern Digital Electronics	R P Jain,	McGraw Hill Education Pvt. Ltd, 4th Edition,2012 ISBN 10: 0070669112 ISBN 13: 9780070669116
6	Instrumentation	A K Sawheny,	Nineteenth Edition, 2017, DhanpatRai publication ISBN 8177001006

13. SOFTWARE/LEARNING WEBSITES

1. www.nptel.com
2. http://www.electronics-tutorials
3. https://en.wikipedia.org/wiki/P%E2%80%93n_junction
4. https://learn.sparkfun.com/tutorials/transistors
5. http://www.pitt.edu/~qiw4/Academic/ME2082/Transistor%20Basics.pdf
6. http://faculty.cord.edu/luther/physics225/Handouts/transistors_handout.pdf
7. http://www.technologystudent.com/elec1

14. PO - COMPETENCY- CO MAPPING

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

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

Sign: Name: Shri. M. J. Deshpande (Course Experts)	Sign: Name: (Head of Department)
Sign: Name: Dr. N. G. Kulkarni. (Program Head) (Mechanical Engg Dept.)	Sign: Name: Shri. 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**/05/06/07/08/16/17/**18**/19/21/22/23/**24**/26
Name of Course	**Fundamentals of Engineering Graphics**
Course Code	**ME2101**
Prerequisite course code and name	**NA**
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	02	04	**Marks**	80	20	00	25	125
				Exam Duration	4 Hrs	1.5 Hrs	--	--	--

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

3. COMPETENCY

This course aims to help the student to attain the following industry identified competency through various teaching-learning experiences:

- Interpret ,understand and prepare orthographic and isometric drawings of a given component.

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

5. SUGGESTED PRACTICALS/ EXERCISES

Sr. No.	Practical Exercises (Learning Outcomes in Psychomotor Domain)	Unit No.	Relevant CO	Approx. Hrs. required
1	Draw horizontal, vertical, 30 degrees, 45 degree, 60 and 75 degrees lines, different types of lines, dimensioning styles using Set squares/ drafter. (do this exercise in sketchbook)	01	--	02
2	Line letters and numbers. Dimensioning technique. One problem on Redraw the figure (Sheet No.1).	01	--	02
3	Engineering curves Any four problems (Sheet No.2)	02	1	06
4	Draw a problem on orthographic projections using First angle method of projection having plain surfaces. (Sheet No.3-Problem-1)	03	2	02
5	Draw a problem on orthographic projections using Third angle method of projection having plain surfaces. (Sheet No.3-Problem-2)	03	2	02
6	Draw a problem on orthographic projections using first angle method of projection having slanting surfaces, cylindrical surfaces, ribs.(Sheet No-4-Problem-1)	03	2	03
7	Draw a problem on orthographic projections using Third angle method of projection having slanting surfaces, cylindrical surfaces, ribs.(Sheet No-4-Problem-2)	03	2	03
8	Draw one problem on the Isometric view of simple objects with plain, slanting, and cylindrical surfaces using a natural scale.(Sheet No.5-Problem-1)	04	3	03
9	Draw one problem on Isometric projection of simple objects with plain, slanting, and cylindrical surfaces using an isometric scale. (Sheet No.5-Problem-2)	04	3	03
10	Draw neat and proportionate free hand sketches. Any six elements (Sheet No.6)	05	4	02
11	Complete a micro project based on guidelines provided in Sr. no. 11	All	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	10
5	Answer to sample questions	10
6	Submission of drawing in time	20
Total		**100**

6. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

The major equipment with the broad specification mentioned here will usher in uniformity in the conduct of practicals and aid in procuring equipment by authorities concerned.

Sr. No.	Equipment Name with Broad Specifications	Experiment Sr.No
1	Drawing Table with Drawing Board of Full Imperial/ A1 size.	All
2	Models of objects for orthographic / isometric projections	3,4,5,6,7,8,9,10
3	Models/ Charts of objects mentioned in unit no. 3,4,5	-
4	Set of various industrial drawings being used by industries.	All
5	Drawing equipments and instruments for classroom teaching- large size: a. T-square or drafter (Drafting Machine) b. Set squares (450 and 300- 600) c. Protractor d. Drawing instrument box (containing a 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 constructions.	**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. 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).

Unit Outcomes (UOs) (in cognitive domain)	**Topics and Sub-topics**
Unit II: Engineering Curve and Tangential Exercises (06 Hrs, 16 Marks)	
2a. Explain different engineering curves with areas of application. **2b.** Draw different conic sections based on given situation. **2c.** Draw involute and cycloidal curves based on given data. **2d.** Draw helix and spiral curves from given data	**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. **2.5** To draw involute of circle, Regular polygon such as pentagon **2.6** To draw a cylindrical helix (limited to two turns). **2.7** To draw cycloid, epicycloids and hypocycloid.
Unit III: Orthographic Projections (10 Hrs, 24 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** Orthographic projection, First angle and Third angle method, their symbols. **3.2** 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: Isometric Projections (08 Hrs, 24 Marks)	
4a. Prepare an isometric scale. **4b.** Draw isometric views of given simple 2D entities containing lines, circles and arcs only. **4c.** Interpret the given orthographic views. **4d.** Draw Isometric views from given orthographic views.	**4.1** Isometric view **4.2** Isometric projection. **4.3** Isometric scale and Natural Scale. **4.4** Illustrative problems related to simple objects having plain, slanting, cylindrical surfaces and slots on slanting surfaces. **4.5** Conversion of orthographic views into Isometric view/Projection.
Unit V: Free Hand Sketches (04 Hrs, 16 Marks)	
5a. Sketch proportionate freehand sketches of given machine elements. **5b.** Select proper fasteners and locking arrangement for given situation.	**5.1** 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	--	16	--	16
III	Orthographic Projection	10	--	--	24	24
IV	Isometric Views	08	--	--	24	24
V	Free hand sketches	04	16	--	--	16
Total		32	**16**	**16**	**48**	**80**

9. SUGGESTED STUDENT ACTIVITIES

Following is the list of proposed student activities like:

a. Students should maintain a separate A3 size sketchbook which will be 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
   1. types of lines used
   2. lettering styles used
   3. dimension styles used
   4. IS code referred
c. List the shapes and curves you observe around you in real life with the 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:

a. Guide student(s) to fix the sheet and mini drafter on the 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 the first and third angle method using a model.
e. Use charts and industrial drawings to teach standard symbols 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 them. 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 that integrate 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. Helical springs: Each batch will collect five open coils and closed coil helical springs of various sizes. Each student will measure the significant parameters of one spring and draw the corresponding helix curve in their sketchbook.
b. Flat coil or spiral springs: Each batch will collect ten spiral springs of various sizes. Each student will measure the significant parameters of one spring and draw the corresponding helix curve in their sketchbook.
c. Isometric views: Each batch student will collect at least one production drawings/ construction drawing/plumbing drawings from local workshops/builders /electrical and mechanical contractors and generate isometric views from the orthographic views given in the drawings.
d. Isometric views: Each batch student will select a household/industrial real item and draw its isometric view in the sketchbook.
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. Each batch will try to make a wooden model from these views in the carpentry shop.
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. Involute curves: Each batch will develop cardboard/thermocol working models that can generate an involute curve of any regular geometrical shape.
h. Cycloidal curves: Each batch will collect three different sizes of bicycle tyres and compare the locus of tube air valve by rolling them on a flat road.
i. Conic curves: Each batch will go to the institute's playground. 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.
j. Involute and Cycloidal curves: Each batch will collect one Involute and one cycloidal tooth profile spur gear and find out the Involute function.

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	K. Venugopal	New Age International Publishers.

Sr. No.	Title of Book	Author	Publisher, Edition and Year of publication, ISBN Number
	and Graphics + AutoCAD		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

1. https://www.youtube.com/watch?v=TJ4jGyD-WCw
2. https://www.youtube.com/watch?v=dmt6_n7Sgcg
3. https://www.youtube.com/watch?v=_MQScnLXL0M
4. https://www.youtube.com/watch?v=3WXPanCq9LI
5. https://www.youtube.com/watch?v=fvjk7PlxAuo
6. http://www.me.umn.edu/courses/me2011/handouts/engg%20graphics.pdf

14. PO - COMPETENCY- CO MAPPING

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

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

Sign: Name: M. R. Mundhe. M. W. Giridhar (Course Experts)	Sign: Name: Dr. N. G. Kulkarni. (Head of Department)
Sign: Name: Dr. N. G. Kulkarni. (Program Head) (Mechanical Engg Dept.)	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	**Mechanical Engineering Drawing**
Course Code	**ME2102**
Prerequisite course code and name	**ME2101 Fundamentals of Engineering Graphics.**
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	02	04	**Marks**	80	20	00	25	125
				Exam Duration	4 Hrs	1.5 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

Engineering drawing is the graphical language. It is used by engineers, designers, planners, supervisors, and workers to express their thoughts, ideas, and concepts. The expression by drawing is very accurate, precise, and brief. At a glance, one can understand a detailed description of any part to be manufactured or a dam to be built or an electric circuit to be used. For all technicians thorough understanding of the principles of engineering drawing is essential. The curriculum aims to develop the ability to draw and read orthographic projections, projection of solids, and intersection of solids with skills in drawing sections.

3. COMPETENCY

This course aims to help the student to attain the following industry identified competency through various teaching-learning experiences:

- Interpret and prepare sectional mechanical working drawing /production drawing of a 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. Use principles of orthographic projection to draw sectional views of a given object.
2. Use principles of orthographic projection to draw missing lines and view of a given object.
3. Solve given problems on projections of Lines, Planes, right and regular solids and draw solid in sectional view.
4. Draw free hand sketches of given engineering elements

5. SUGGESTED PRACTICALS/ EXERCISES

Sr. No	Unit No	Sheet No.	Practical Exercises (Outcomes in Psychomotor Domain)	Relevant CO	Approx. Hours
1	1	01	Sectional orthographic views (Two Problems)	1	05
2	2	02	Missing views (Two Problems)	2	05
3	3	03	Projection of Lines (Two Problems)	3	02
4	4	03	Projection of Planes (Two Problems)	3	02
5	5	04	Projection of Solids (Two Problems)	3	05
6	6	05	Sections of solids (Two Problems)	3	05
7	7	06	Free hand sketches. (Any Six elements)	4	04
8	All	--	Complete a micro project based on guidelines provided in Sr. no. 11	1 to 4	04
		Total			**32**

S.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	10
5	Answer to sample questions	10
6	Submission of drawing in time	20
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.	Equipment Name with Broad Specifications	Experiment Sr.No
1	Drawing Table with Drawing Board of Full Imperial/ A1 size.	All
2	Models/ Charts of objects mentioned in unit no. 1,2,3,4,5,6,7	1,2,3,4,5,6,7
3	Set of various industrial drawings being used by industries.	All

Sr. No.	Equipment Name with Broad Specifications	Experiment Sr.No
4	Drawing equipments and instruments for classroom teaching-large size: a. T-square or drafter (Drafting Machine) b. Set squares (450 and 300- 600) c. Protractor d. Drawing instrument box (containing a set of compasses and dividers)	All
5	Interactive board with LCD overhead projector	All

7. THEORY COMPONENTS

Unit Outcomes (UOs) (In cognitive domain)	Topics and Sub-topics
UNIT I: Sectional orthographic views (05 Hrs, 16 Marks)	
1a. Classify various types of sectional views. **1b.** Explain sectioning and hatching conventions. **1c.** Convert pictorial views of a given object into sectional orthographic views. **1d.** Interpret the given Drawing	**1.1** Cutting plane line, Types of sectional views: Full section, half section, Partial or broken section, revolved section, removed section, offset section, Aligned section. Sectioning conventions Hatching or section lines. Conversion of pictorial views into sectional orthographic views (Use First Angle and Third Angle Projection Method.)
UNIT II: Missing views (05 Hrs, 12 Marks)	
2a. Interpret the given views **2b.** Draw the missing view	**2.1** Draw Missing lines and views from the given orthographic views.(Use First Angle and Third Angle Projection Method.)
UNIT III: Projection of Lines (04 Hrs, 06 Marks)	
3a. Classify various positions of lines with respect to projection planes. **3b.** Draw projection of lines in different positions.	**3.1** Projection of straight lines with following positions(Use First Angle only) a) Parallel to both the planes. b) Perpendicular to one plane. c) Inclined to one plane and parallel to the other. d) Inclined to both the planes, Traces of Line. (Concept purpose only,No problems)
UNIT IV: Projection of Planes (04 Hrs, 06 Marks)	
4a. Classify various types of planes according to orientations. **4b.** Draw projection of planes with different orientations.	**4.1** Projection of Planes with following orientations:(Use First Angle only) a) Plane parallel to one principal plane and perpendicular to the other. b) Plane inclined to one principal plane and perpendicular to the other

<table>
<tr><th>Unit Outcomes (UOs)
(In cognitive domain)</th><th>Topics and Sub-topics</th></tr>
<tr><td colspan="2">UNIT V: Projection of Solids (05 Hrs, 12 Marks)</td></tr>
<tr><td>5a. Classify various types of solids.
5b. Explain orientation of axis with respect to projection planes.
5c. Draw projection of standard regular solids like a polyhedron, prisms, pyramids, solids of revolution</td><td>5.1 Types of Solids Projection of the following solids: (Use First Angle only)
a) Regular Polyhedron – Tetrahedron, Hexahedron (cube)
b) Regular prisms and Pyramids – Triangular, Square, Pentagonal, Hexagonal
c) Regular solids of Revolution – Cylinder, Cone, Sphere with Axis:
i. Perpendicular to one of the principal projection plane.
ii. Inclined to one of the principal plane and parallel to the other.
iii. Parallel to both principal planes.</td></tr>
<tr><td colspan="2">Unit VI: Sections of solids (05 Hrs, 12 Marks)</td></tr>
<tr><td>6a. Describe cutting planes and their orientation with respect to given solid and projection planes.
6b. Explain the significance of sectional view and true shape.
6c. Draw sectional view of given solid.
6d. Draw true shape of the section of given solid with a mentioned axis</td><td>6.1 Sectional Views and True shape of the section for the solids with section plane in following positions:(Use First Angle only)
i) parallel to one of the principal projection plane
ii) inclined to one and perpendicular to the other principal projection plane
Note: Position of solid is restricted to the following:
i) Axis parallel to both principal projection planes
ii) Axis perpendicular to one and parallel to the other principal projection plane</td></tr>
<tr><td colspan="2">UNIT VII. Free Hand sketches/conventional representation (04 Hrs, 16 Marks)</td></tr>
<tr><td>7a. Identify various engineering components and their materials in the given sectional view.
7b. Draw Free hand sketches/conventional representation of commonly used engineering components.</td><td>7.1 Draw Free hand sketches/conventional representation of:
Rivet heads
Riveted joints:
Lap Joint – Single and Double Riveted
Butt Joint – Single strap, Double Strap
Foundation bolts: Eye , Lewis and Rag
Types of keys –Sunk ,Saddle, Taper, Gib headed, feather Keys, wood ruff Key, Cone Key, splined Shaft
Couplings: Muff, Flange, Protected Flange and Pin type Flexible Flange
Pulleys: Rope and V-Belt.</td></tr>
</table>

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	Sectional orthographic views	5	--	--	16	16
II	Missing views	5	--	--	12	12
III	Projection of Lines	4	--	--	6	06
IV	Projection of Planes	4	--	--	6	06
V	Projection of Solids	5	--	--	12	12
VI	Sections of solids	5	--	--	12	12
VII	Free Hand sketches/ conventional representation	4	8	8	--	16
Total		32	**8**	**8**	**64**	**80**

9. SUGGESTED STUDENT ACTIVITIES

Other than the classroom and laboratory learning, the 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. Students should maintain a separate A3 size sketchbook which will be part of term work, and submit it along with drawing sheets.
b. Students should collect Production drawings, Layouts from nearby workshops/industries and study the drawings.

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/sub topics.
b. Show video/animation films to explain orthographic and sectional orthographic projection.
c. 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 them. 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 that 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. Wood/Thermocol Related Jobs: Students should use the wooden/thermocol models and verify the correctness of views drawn in the problems solved in the sketch book.
b. Production drawings: Each student of the batch should collect at least one production drawings from local workshops or industry and list various types of sections used in the drawings
c. Production drawings: Each student should be given ten problems in which two views of the objects are given with missing lines. Student should identify the missing lines and complete the views.
d. Thermocol Models: The teacher will assign one set of orthographic views and ask the student to develop 3D thermocol models of the same.
e. Students should collect samples/catalogues of the standard mechanical components available in the market.

12. SUGGESTED LEARNING RESOURCES

S. 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	A Workbook in Engineering Drawing	Curriculum Development Centre, TTTI, Bhopal	Somaiyya Publication Pvt. Ltd., Mumbai
3	Geometrical and Machine Drawing	N.D. Bhatt	Charotar Publication, Anand. ISBN- 978-93-80358-17-8
4	Machine Drawing	G. R. Nagpal	ISBN- 9387394077
5	Engineering Drawing and Graphics + AutoCAD	K. Venugopal	New Age International Publishers. ISBN : 9788122415452

13. SOFTWARE/LEARNING WEBSITES

1. https://www.youtube.com/watch?v=TJ4jGyD-WCw
2. https://www.youtube.com/watch?v=dmt6_n7Sgcg
3. https://www.youtube.com/watch?v=_MQScnLXL0M
4. https://www.youtube.com/watch?v=3WXPanCq9LI
5. https://www.youtube.com/watch?v=fvjk7PlxAuo
6. http://www.me.umn.edu/courses/me2011/handouts/engg%20graphics.pdf

14. PO - COMPETENCY- CO MAPPING

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

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

Sign: Name: Shri. M. R. Mundhe. (Course Expert) Shri. M. W. Giridhar (Course Experts)	Sign: Name: Dr. N. G. Kulkarni. (Head of Department)
Sign: Name: Dr. N. G. Kulkarni. (Program Head) (Mechanical Engg Dept.)	Sign: Name: Shri 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	**Workshop Practice**
Course Code	**WS2101**
Prerequisite course code and name	**NA**
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	04	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

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 their duties in industries. Students can perform various operations using hand tool equipment and machineries in various shops. Working in a workshop develops the attitude of group working and safety awareness. This course provides a miniature industrial environment in the educational institute.

3. COMPETENCY

The course should be taught and implemented to develop the course outcomes (COs) so that students demonstrate 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 competency mentioned above:
After studying this course, the student will be able to

1 Select tools and machinery according to a job.
2 Use hand tools in different shops for performing the different operations.
3 Operate equipment and machinery in different shops.
4 Prepare job according to drawing.

5. SUGGESTED PRACTICALS/ EXERCISES

Sr. No.	Unit No.	Practical Exercises (Outcomes in Psychomotor Domain)	Relevant CO	Approx. Hours Required
1	1	Demonstration of a smithy and forging equipment and process.	1,2,3,4	4
2	2	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	16
3	3	Prepare job with following operations a. Prepare Socket joint pipe fitting job as per given drawing (individually) b. Prepare elbow joint pipe fitting job as per given drawing c. Prepare bill of material for given pipeline layout	1,2,3,4	8
4	4	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	12
5	5	Prepare utility job (like stool, benches, tables or similar jobs) involving arc welding and artificial wood as per given drawing a. Fabrication operation involves measuring, marking, cutting, edge preparation, welding b. Carpentry operations involve measuring, marking, cutting, and assembly with fabrication parts.	1,2,3,4	16
6	6	Prepare sheet metal utility job using following operations a. Cutting and Bending b. Edging c. End Curling d. Lancing e. Spot Welding f. Riveting	1,2,3,4	8
Total Hrs				**64**

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

Sr. No.	Major Equipment/ Instruments Required	Experiment Sr. No.
1	Fire buckets of standard size.	1 to 6
2	Fire extinguisher A,B and C types	1 to 6
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	5
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	5
5	Wood working tools- marking and measuring tools, saws, claw hammer, II mallet, chisels, plans, squares,	5
6	Carpentry Vice 200 mm	5
7	Work Benches- size:1800 x 900 x 750 mm	2
8	Bench Drilling machine (upto 13 mm drill cap.) with ½ H.P. Motor 1000 III mm. Height	2
9	Power Saw machine 350 mm mechanical with 1 HP Motor & all III Accessories.	2
10	Bench Grinder 200 mm Grinding Disc diameter 200 mm. with 25 mm. bore III 32 mm. with ½ HP/1HP Motor.	2
11	Vernier height Guage 450 mm	2
12	Surface Plate 600 x 900 mm Grade I	2
13	Angle Plate 450 x 450 mm	2
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	4
15	Oxygen and acetylene gas welding and cutting kit with cylinders and IV regulators	4
16	Pipe Bending Machine	3
17	Pipe Vice – 100 mm	3
18	Pipe Cutter- 50 mm	3
19	Bench Vice 100 mm	3

Sr. No.	Major Equipment/ Instruments Required	Experiment Sr. No.
20	Portable Hammer Drill Machine 0-13 mm II, III, A.C. 230 V, 2.5Amp, Pistol type, having different types of bits	6
21	Sheet Bending Machine	6
22	Sheet Cutting Machine	6
23	Brazing Equipment	6
24	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.	2
25	Plumbing tools- pipe vice, pipe bending equipment, pipe wrenches, dies.	3
26	Gas welding hand tools- welding torch, welding tip, pressure regulator, V oxygen and acetylene cylinders, spark lighter	4
27	Arc welding hand tools- electrode holder, cable connector, cable lugs, V chipping hammer, earthing clamp, wire brush.	4
28	Sheet metal hand tools- snip, shears sheet gauge, straight edge, L square, VI scriber, divider, trammel, punches, pliers, stakes, groovers, limit set	4

7. THEORY COMPONENTS

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

8. SUGGESTED SPECIFICATION TABLE FORQUESTION PAPER DESIGN

NA

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 to consist of freehand sketches of tools and equipments in each shop, detailed specifications and precautions to be observed while using tools and equipment.
c. Prepare/Download the following specifications: 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 to procure workshop tools, equipment machineries and raw material. i.e. Visit any fabrication/woodworking/sheet metal 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 teach various topics/subtopics.
b. Guide student(s) in undertaking micro-projects.
c. Arrange a visit to nearby industries and workshops for understanding various manufacturing processes.
d. Show video/animation films to explain 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 them. 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 that 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. Prepare a utility job using various wood working shop operations as per given drawing.
b. Prepare a utility job using various plumbing operations as per the given drawing.
c. Prepare a utility job using various sheet metal operations as per the given drawing. Note: i. The teacher will assign utility job. ii. Utility Job will be completed in a group of 4 to 5 students. Students have to maintain a work diary consisting of job drawing, operations details, required raw materials, tools, equipments, and date-wise performance records.

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

Sr. No.	Title	Author	Publisher, Edition and Year of publication, ISBN Number
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.machineworkshop.com
4.www.turningworkshop.com
5.www.smithyworkshop.com
6.www.plumbingworkshop.com

14. PO - COMPETENCY- CO MAPPING (Mechanical 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
CO1	3	2
CO2	3	2
CO3	3	2
CO4	3	2

Sign: Name: Mr. M. R. Mundhe (Course Expert)	Sign: Name: Dr. N. G.Kulkarni. (Head of Department)
Sign: Name: Dr. N. G. Kulkarni. (Program Head) (Mechanical Engg Dept.)	Sign: Name: Shri A. S. Zanpure. (CDC In charge)

Level 2 - B Curriculum

Government Polytechnic, Pune

'180OB' – Scheme

Programme	**Diploma in Mechanical Engineering**
Programme code	01/02/03/**04**/05/06/07/08/15/16/17/**18**/19/21/22/23/**24**/26
Name of Course	**Programming in C**
Course Code	**ME2105**
Prerequisite course code and name	**NA**
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	
0	0	4	4	Marks	00	00	100	25	125
				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 course describes the basics of problem-solving and logic development. It also describes the basics of programming using a C programming language. C is the most commonly used structured programming language.

3. COMPETENCY

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

- **To develop a C program for simple mechanical engineering problem**

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. Design an optimum algorithm using a flowchart.
2. Use looping statements, functions, and available data types in C,
3. Develop a program in C.
4. Execute programs in C.

5. SUGGESTED PRACTICALS/ EXERCISES

Sr. No.	Unit No.	Practical Exercises (Outcomes in Psychomotor Domain)	Relevant CO	Approximate Hours Required.
1	1	Understand the concept of the algorithm in 'C' with example	1	2
		Understand the concept of the flowchart in 'C' with example		2
2	2	Write simple 'C' programs based on declaring variables & assigning values to variables. (Minimum two)	2	2
3		Execute simple 'C' programs based on declaring variables & assigning values to variables. (Minimum two)		2
4	3	Write four simple C programs using various operators.	2,3,4	2
5		Execute four simple C programs using various operators		2
6	4	Write two programs each using nested if-else and switch statement.	2,3,4	2
7		Execute two programs each using nested if-else and switch statements.		2
8	4	Write two programs using the while loop.	2,3,4	2
9		Execute two programs using while loop		4
10	4	Write two programs using do-while loop	2,3,4	2
11		Execute two programs using a do-while loop		2
12	4	Write two programs each using switch and go to statement	2,3,4	2
13		Execute two programs each using switch and go to statement		2
14	4	Write two 'C' Programs illustrating the use of continue and break statements	2,3,4	2
15		Execute two 'C' Programs illustrating the use of continue and break statements		2
16	5	Write two programs using functions based on parameters passing by reference.	2,3,4	2
17		Execute two programs using function based on parameters passing by reference		2
18	5	Write 'C' Programs illustrating the use of user-defined functions	2,3,4	2
19		Execute 'C' Programs illustrating the use of user-defined functions		2
20	5	Write two simple programs, each using pointers.	2,3,4	2
21		Execute two simple programs, each using pointers.		2
22	6	Write a simple program using a character array.	2,3,4	2

Sr. No.	Unit No.	Practical Exercises (Outcomes in Psychomotor Domain)	Relevant CO	Approximate Hours Required.
23		Execute a simple program using a character array.		2
24	6	Write two simple programs each using string library functions.	2,3,4	2
25		Execute two simple programs each using string library functions.		2
26	6	Write & Execute two simple programs each using 1D and 2D arrays.	2,3,4	4
27	All	Complete a micro project based on guidelines provided in Sr. No. 11	2,3,4	6
		Total Hrs		**64**

Sr. No.	Performance Indicators	Weightage in %
a.	Writing program and Drawing flow chart	15
b.	Execution of program	05
c.	Question answer	05
Total		**25**

6. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

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

Sr. No.	Major Equipment/ Instruments Required	Experiment Sr.No
1	Desktop PC having I5 or I7 processor	1 to14
2	LCD PROJECT	1 to14
3	Printer	1 to14

7. THEORY COMPONENTS

No theory credit for this course. However following theory contents should be covered in appropriate practical

Unit Outcomes (UOs) (In cognitive domain)	Topics and Sub-topics
Unit-I: OVERVIEW OF C	
1a. Define various terms related to Programming **1b.** Write an algorithm and draw a flowchart for simple problems. **1c.** Describe the basic structure of the 'C' program	**1.1.** Problem, definition and analysis, Algorithm, Flow charts **1.2.** History of Programming Languages, Development of C **1.3.** The basic structure of 'C' program, Programming style, Simple 'C' programs

Unit Outcomes (UOs) (In cognitive domain)	Topics and Sub-topics
Unit-II: DATA TYPES AND EXPRESSION	
2a. Enlist C tokens, keywords, various rules, symbols, data types. **2b.** Identify valid / invalid variable names. **2c.** Compare various terms.	**2.1.** Data Types & Character set: C tokens, keywords & identifiers, constants, variables, Declaration of variables, assigning values to variables, defining symbolic constants **2.2.** Expressions: Arithmetic expressions, evaluation of expressions, the procedure of arithmetic operators, type conversions in expressions, operator precedence & associatively, mathematical functions.
Unit-III: OPERATORS IN C	
3a. List various operators, their types, and uses. **3b.** Describe various operators, their types, and uses	**3.1.** Operators: Arithmetic, relational, logical, increment & decrement, conditional **3.2.** Managing input & output operators: Introduction, reading a character, writing a character, formatted input, formatted output, viz. use of printf(), scanf(), getch(), clrscr(), \n etc.
Unit-IV: DECISION MAKING IN C	
4a. List and write Decision making statements. **4b.** Write C programs using decision-making and loop statements.	**4.1.** Decision making and branching: if statement (if, if-else, nested if-else). **4.2.** Decision making and looping: while, do, do-while, for loop, continue statement, break statement. **4.3.** Decision making using switch & go to statement
Unit-V: FUNCTIONS & POINTERS	
5a. Define function and terms related to function. **5b.** Write programs based on functions.	**5.1.** Functions: Need of user-defined functions, scope, defining functions, calling a function(call by value & call by reference) **5.2.** Pointers: Introduction to pointers, declaring pointer variable, initialization of pointer variable, accessing the address of a variable, pointer expressions.
Unit-VI: ARRAYS & STRINGS	
6a. Define Array, string, poi,nter and their related terms. **6b.** Write programs based on arrays, strings, and pointers.	**6.1.** Arrays: Defining and declaring one and two-dimensional arrays, reading and writing. **6.2.** Strings: Declaration and initialization of string variables, string handling functions From standard library like strlen (),strlwr(), strupr(), strcpy(), strcat(), strcmp() etc.

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 teach various topics/subtopics.
b. About ***15-20% of the topics/sub-topics*** which are relatively simpler or descriptive 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. For item No.8, teachers need to create opportunities and provisions for ***co-curricular activities***.
d. Guide student(s) in undertaking micro-projects.
e. Correlate subtopics with power plant systems and equipment.
f. Use proper equivalent analogy to explain different concepts.
g. Use Flash/Animations to explain various components, operations and
h. Teachers 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 them. 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 and integrate PrOs, UOs, and ADOs (Affective Domain Outcomes). Each student will have to maintain a dated work diary of individual contributions to the project work and give a seminar presentation before submission. The student should submit a 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. Generation of a sample mark sheet for practical batch students
b. Generate Class Time table
c. Customer billing system
d. Any other projects suggested by course faculty on a similar line

12. SUGGESTED LEARNING RESOURCES

Sr. No.	Title	Author	Publisher, Edition and Year of publication ISBN Number
1	Let us ‘C’	Yashwant Kanitkar	BPB Publications; 15th edition (July 13 2016) ISBN-10: 8183331637 ISBN-13: 978-8183331630
2	Programming in ‘C’	E. Balguru swami	McGraw Hill Education India Private Limited; Seventh edition (July 1 2017) ISBN-10: 9789339219666 ISBN-13: 978-9339219666
3	‘C’ for beginners	Madhusudhan Mothe	Shroff Publishers and Distributors Pvt. Ltd.; 1st edition (December 29, 2008)

			ISBN-10: 9788184046397 ISBN-13: 978-8184046397
4	Introduction to ‘C’ programming	Denis Ritchie and Kerninghan	PHI; 2nd edition (April 1 1988) ISBN-10: 0131103628 ISBN-13: 978-0131103627

13. SOFTWARE/LEARNING WEBSITES

1. www.nptel.com
2. http://www.computer-pdf.com/programming/c-cpp/284-c-programming

14. PO - COMPETENCY- CO MAPPING

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

	PSO1	PSO2
CO1	3	-
CO2	2	-
CO3	2	-
CO4	2	-

Sign: Name: Smt. P. S. Sarode Shri. B. B. Dome (Course experts)	Sign: Name: Dr. N. G. Kulkarni. (Head of Department)
Sign: Name: Dr. N. G. Kulkarni. (Program Head) (Mechanical Engg Dept.)	Sign: Name: Shri A. S. Zanpure. (CDC In charge)

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 Mathematics III**
Course Code	**SC2101**
Prerequisite course code and name	**SC1102 – Applied Mathematics II**
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	01	00	04	Marks	80	20	00	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

The student shall learn various integration and differential equation techniques and use them for their related Engineering problems.

3. COMPETENCY

This course aims 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. Solve the given problems of integration using suitable methods.
2. Apply the concept of integration to find the area under the curve, the area between the curves and the volume of a solid revolution.
3. Solve the differential equation of first order and first degree using suitable methods.
4. Obtain partial differential equations using suitable methods.
5. Use the concept of dot and cross product to calculate work done and moment of a force about a point & line, respectively.

5. SUGGESTED PRACTICALS/ EXERCISES

Sr. No.	Unit No.	Practical Exercises (Learning Outcomes in Psychomotor Domain)	Relevant COs	Approx. Hrs. Required
1	1	Solve problems based on methods of integration by substitution	1	2
2	1	*Solve problems based on integration by parts.	1	1
3	1	*Solve problems based on methods of integration by partial fractions	1	1
4	2	Solve practice problems based on properties of definite integration.	2	1
5	2	*Solve practice problems based on finding area under curve, area between two curves .	2	1
6	2	*Solve practice problems based on finding volume of revolutions.	2	1
7	3	*Solve the problems based on formation, order and degree of differential equations	3	1
8	3	*Develop a model using a variable separable method to related engineering problems.	3	1
9	3	Develop a model using the concept of linear differential equations to a related engineering problem.	3	2
10	4	*Solve the problems based on the formation of first order and second order PDE	4	1
11	4	*Application of partial differential equations and related engineering problem	4	1
12	5	Solve the problems based on the algebra of vectors (Equality, addition, subtraction and scalar multiplication)	5	1
13	5	Solve the problems based on Dot (Scalar) product with properties Vector (Cross) product with properties	5	1
14	5	Solve the practice problems based on Work done and moment of force about a point & line	5	1
15	ALL	Complete a Micro- project as per the guidelines in point no. 11 towards the fulfilment of the COs of the course.	ALL	4
		Total		16

***Perform experiment 2 or 3, experiment 5 or 6, experiment 7 or 8 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
g.	Follow Housekeeping	10
h.	Attendance and punctuality	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 practicals and aid in procuring equipment by authorities concerned.

S. No.	Equipment Name with Broad Specifications	Experiment Sr.No
1	LCD Projector	1-14
2	Interactive Classroom	1-14

7. THEORY COMPONENTS

Unit Outcomes (UOs) (in the cognitive domain)	Topics and Sub-topics
Units I : Integration (9 Hrs, 20 Marks)	
1a. Obtain the given simple integral(s) using substitution method. 1b. Integrate given simple functions using the integration by parts. 1c. Evaluate the given simple integral by partial fractions.	1.1 Methods of Integration: a. Integration by substitution. b. Integration by parts. c. Integration by partial fractions.
Unit II : Definite integrals (9 Hrs, 16 Marks)	
2a. Solve given simple problems based on properties of definite integration. 2b. Apply the concept of definite integration to find the area under the given curve(s). 2c. Utilize the concept of definite integration to find the area between given two curves. 2d. Invoke the concept of definite integration to find the volume of revolution of given surface	2.1 Definite Integration: a. Simple examples b. Properties of definite integral (without proof) and simple examples. 2.2 Applications of integration : a. Area under the curve. b. Area between two curves. c. Volume of revolution.

Unit Outcomes (UOs) (in the cognitive domain)	Topics and Sub-topics
Unit III : Differential Equations (12 Hrs, 20 Marks)	
3a. Find the order and degree of given differential equations 3b. Form simple differential equation for given simple engineering problems. 3c. Solve given differential equations using the method of Variable separable form. 3d. Solve the given differential equations using linear differential equations.	3.1 Concept of a differential equation. 3.2 Order, degree and formation of Differential equations 3.3 Solution of differential equation a. Variable separable form. b. Linear differential equation. 3.4 Application of differential equations and related engineering problem(s).
Unit IV : Partial Differential equations (9 Hrs, 12 Marks)	
4a. Form partial differential equation for given simple engineering problems 4b. Solve given partial differential equations by direct integration 4c. Solve the linear partial differential equations.	4.1 Concept of Partial Differential equations 4.2 Formation of Partial Differential equations 4.3 Solution of Partial Differential equations a. Equations solvable by direct integration b. Linear partial differential equations
Unit V : Vectors (9 Hrs, 12 Marks)	
5a. Define different types of Vectors. 5b. Find dot and cross product of vectors. 5c. Find work done and moment of force about the point and line.	5.1 Definition of vector, position vector, Algebra of vectors (Equality, addition, subtraction and scalar multiplication) 5.2 Dot (Scalar) product with properties. 5.3 Vector (Cross) product with properties. 5.4 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
I	Integration	09	04	04	12	20
II	Definite integration	09	--	08	08	16
III	Differential equation	12	04	08	08	20
IV	Partial Differential Equations	09	04	04	04	12
V	Vectors	09	04	04	04	12
	Total	**48**	**16**	**28**	**36**	**80**

9. SUGGESTED STUDENT ACTIVITIES

Other than the classroom and laboratory learning, the following are the suggested student-related ***co-curricular*** activities that 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 them with the free tutorials available on the 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. Identify 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 teach various topics/subtopics.
b. About ***15-20% of the topics/sub-topics,*** which is relatively simpler or descriptive, 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, operations and
d. A 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 them at the beginning of the semester. They ought to submit it by the end of the semester to develop industry-oriented COs. Each micro-project should encompass two or more COs that integrate PrOs, UOs. The Micro-Project could be industry application-based, internet-based, workshop-based, laboratory-based, or field-based. The assessment of the micro-project is to be done under Practical (PA) Assessment. The Micro Project is preferably assigned to the group of (4-6) students or an individual, taking into consideration the capabilities and circumstances at the time

A suggested list is given here. The concerned faculty could add a similar micro-project.

a. Prepare charts displaying the area of irregular shapes using the concept of integration.
b. Prepare charts displaying the volume of irregular shapes using the concept of integration.
c. Prepare models using the concept of differential equations for radiocarbon decay.
d. Prepare models using the concept of differential equations for population growth.
e. Prepare models using the concept of differential equations for thermal cooling.
f. Prepare models using the concept of partial differential equations to solve engineering problems.
g. Prepare models using the concept of vector to solve engineering problems.

12. SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publisher, Edition and Year of publication, ISBN Number
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

S. No.	Title of Book	Author	Publisher, Edition and Year of publication, ISBN Number
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 WEBSITES

1. *www.scilab.org/ -SCI Lab*
2. *www.mathworks.com/product/matlab/ -MATLAB*
3. *Spreadsheet Applications*
4. *www.dplot.com*
5. *https://www.khanacademy.org/math?gclid=CNqHuabCys4CFdOJaddHoPig*

14. PO - COMPETENCY- CO MAPPING

	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	2	2	-	-	-	-	1

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

Sign: Name: Mr.S. B. Yede Mr. V. B. Shinde Mrs. P. R. Nemade (Course Experts)	Sign: Name: (Head of Department)
Sign: Name: Dr. N. G. Kulkarni. (Program Head) (Mechanical Engg Dept.)	Sign: Name: Shri. A. S. Zanpure. (CDC In charge)

Level 3 Curriculum

Government Polytechnic, Pune

'180 OB' – Scheme

Programme	Diploma in Mechanical Engineering
Programme code	01/02/03/**04**/05/06/07/08/15/16/17/**18**/19/21/22/23/**24**/26
Name of Course	**Strength of Materials**
Course Code	**AM3104**
Prerequisite course code and name	**AM2101(Engg. Mechanics)**
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 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">04</td><td rowspan="2">00</td><td rowspan="2">02</td><td rowspan="2">06</td><td>Marks</td><td>80</td><td>20</td><td>--</td><td>25</td><td>125</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, 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

Strength of Materials is a core technology subject that enables the students to understand & analyze various types of loads, stresses & strains. All Mechanical Engineering components are subjected to different types of loads and behave in a specific way. The subject is a prerequisite for understanding machine design principles and the strengths of various materials used in industries. Understanding mechanical properties and the elastic behaviour of different mechanical engineering materials will help select suitable materials for various engineering applications.

3. COMPETENCY

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

- **Determine mechanical properties and calculate stresses in Machine 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 competency mentioned above**:**

1. Perform tests for evaluation of mechanical properties of different metals.
2. Estimate axial, bending, shear and combined stresses in machine components.
3. Compute shear force and bending moment in a beam subjected to point load and UDL.
4. Compute Moment of Inertia of symmetric and asymmetric structural sections.
5. Locate principal planes and compute principal stress for given stress conditions.

5. SUGGESTED PRACTICALS/ EXERCISES

Sr. No.	**Unit No.**	**Practical Exercises** (Outcomes in Psychomotor Domain)	**Relevant CO**	**Approx. Hrs. Required**
1	1	Study Universal Testing machine	1	02
2	1	Determine yield stress, ultimate stress and breaking stress of Mild Steel by conducting Tension test as per IS432 (I)	1	04
3	1	Plot stress-strain diagram for mild steel	1	04
4	1	Calculate compressive strength of Ductile & Brittle materials such as Mild Steel (MS), Aluminium (Al), Brass (Br), Copper (Cu)& Cast Iron (CI), using Compression testing machine as per IS 14858	2	02
5	1	Determine shear strength of various metals such as MS, Al, Br and Cu, (Any two metals) by Single & Double Shear test as per IS 5242	2	04
6	1	Calculate hardness of metals by conducting Brinell Hardness Test on Mild Steel (MS), Aluminium (Al), Brass (Br), Copper (Cu), Cast Iron (CI) (Any four metals) as per IS 1500	1	02
7	1	Evaluate toughness of Ductile & Brittle materials such as MS, Al, Br, CI and Cu, by conducting Izod Impact test on as per IS 1757	1	02
8	5	Determine flexural strength by conducting Bending Test on timber beam of Rectangular cross section for both the orientations as per IS 1708, IS 2408	5	04
9	3	Plot SFD and BMD of s imply supported beams, overhanging beams and cantilever beams subjected to UDL and point loads. (2 problems on each type of beam)	4	04
10	All	Complete a micro project based on guidelines provided in Sr. No. 11	1 to 5	04
		Total Hrs.		**32**

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/ 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	**Universal Testing Machine:** Capacity - 100 tons. Type: Mechanical type digital, electrically Operated. Accessories: (1) Tensile test attachment for flat and round specimen up to32 mm. (2) Compression test attachment (3) Shear test attachment with sizes of bushes 5,6,8,10,12,16,20,24 mm, (4) Transverse test attachment with bending Punch, (5) Service tools, (6) Operation and maintenance manuals - 2 nos. (7) Hardness attachment	**1,2,5,8**
2	**Digital Extensometer:** Least count - 0.001 mm. Max. Extension = 5 mm. Single dial gauge for 30,40 mm. 60 mm, 80 mm, 100 mm, 125 mm gauge length.	**2**
3	**Brinell Hardness Testing Machine:** Test loads from 500 to 3000 kgf in steps of 250kgf; The height X Throat is 380 X 200 mm; Indentation measurement by Brinell Microscope of 25 X Magnification; Special Test fixtures for odd jobs/production testing can be supplied (Optional); Computerized Brinell Impression measurement system (Optional); Manual / Optical /Computerized type Brinell Hardness testing machine are also available; Accuracy conform to IS:2281-2005 and BS:240	**6**
4	**Impact Testing Machine:** IZOD Impact Test Apparatus: Pendulum drop angle: 90°-120; Pendulum effective Wt: 20-25 kg; Striking velocity of a pendulum: 3-4 m/sec; Pendulum impact energy: 168 j; Min scale graduation: 2 J; Distance of axis of pendulum rotation from center of a specimen to specimen hit by pendulum: 815 mm	**7**
7	**Compression Testing Machine:**Digital display manual control compression testing; machine; Max. Capacity (KN): 2000; Measuring range: 4%-100% of FS; Relative error of reading: ≤ ±1%; Max. distance between two platen (mm): 330; Compression platen size (mm): 220×220; Max. piston stroke (mm): 0-20; Max. piston speed (mm/min): Approx. 30; Column clearance (mm): 300×200; Oil pump motor power (KW): 1.5; Whole dimensions (mm): 855*380*1435	**4**
9	Freeware for SF and BM diagrams	**9**
10	Freeware for Principal planes, Principal stresses and Mohr's circle method	**10**

7. THEORY COMPONENTS

Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
Unit - I Simple Stresses and Strains (12 Hrs., 12 Marks)	
1a. Define various engineering properties of metals 1b. Define stress and strain with their units. 1c. Calculate axial strain, axial stress and Modulus of Elasticity using Hooke's law. 1d. Determine nature and magnitude of thermal stress. 1e. Draw stress-strain curve for ductile and brittle material in tension. 1f. Calculate shear stresses for single/double/punching shear condition.	1.1 Recap of concepts of force and equilibrium. 1.2 Elastic, plastic & rigid bodies 1.3 Mechanical properties of materials – ductility, malleability, brittleness, hardness, strength and toughness. 1.4 Stress & Strain – concept & Definitions, types of stresses and related deformations- Axial, Flexure, torsion, shear. 1.5 Hooke's Law, Young's Modulus, Axial deformation in a body and bodies in series. 1.6 Behavior of ductile and brittle materials subjected to axial tension, stress-strain or Load-deformation curve, Limit of proportionality, yielding, permanent set, yield stress, ultimate stress. 1.7 Shear stress and shear strain, Modulus of rigidity, punching shear, single and double shear. 1.8 Temperature stress and strain – concept and numerical problems on thermal stress in bodies having uniform cross-section, deformation fully prevented.
Unit - II Generalized Hooke's Law (8 Hrs., 12 Marks)	
2a. Define lateral and longitudinal strain, Poisson's ratio, volumetric strain and Bulk modulus 2b. Calculate strain and deformation along all three axes, under bi and tri axial stresses 2c. Compute volumetric strain and change in volume under given biaxial or triaxial stresses 2d. Calculate instantaneous stresses, strains and deformations under given gradual, sudden or impact loads 2e. Estimate Resilience, Modulus of resilience, Proof Resilience.	2.1 Linear and lateral strain, Poisson's ratio, changes in lateral dimensions. 2.2 Uni axial- Bi axial and Tri axial stress systems, strain in each direction, generalized Hooke's law 2.3 Change in the dimensions and volume, volumetric strain, volumetric stress, Bulk modulus 2.4 Relation between three moduli. 2.5 Strain Energy, Resilience, Proof Resilience and Modulus of resilience. 2.6 Stress due to Gradual, Sudden and Impact load and corresponding deformations.

Unit Outcomes (UOs) (in cognitive domain)	**Topics and Sub-topics**
Unit - III Shear Force & Bending Moment (10 Hrs., 12 Marks)	
3a. Define Shear force and Bending moment with their units and sign convention. 3b. Calculate SF and BM for given load and beam. 3c. Draw SFD and BMD. 3d. Locate point of maximum BM and point of contra-flexure.	3.1 Types of Beams (Simply supported with or without overhang, Cantilever) , Types of loads (Point load, Uniformly Distributed load), Bending of beam, deflected shape, 3.2 Meaning of SF and BM, Relation between them, Sign convention, 3.3 Drawing SFD and BMD, Location of point of maximum BM, Location of Point of Contra-flexure.
Unit - IV Moment of Inertia (6 Hrs., 8 Marks)	
4a. Define MI and explain Parallel and Perpendicular axes theorems 4b. Calculate MI of standard shapes. 4c. Calculate MI of composite plane figures such as I and T sections. 4d. Calculate Polar MI and radius of gyration of a given section.	4.1 Concept of Moment of Inertia (MI) 4.2 Parallel and Perpendicular axes theorems, Polar MI, radius of gyration 4.3 MI of standard basic shapes, 4.4 Determination of MI of Composite plane figures such as I and T sections.
Unit - V Bending Stresses (6 Hrs, 8 Marks)	
5a. State the assumptions of theory of bending & explain flexural formula 5b. Use flexural formula to calculate bending stresses for given section at given point in a simply supported and cantilever beam. 5c. Determine maximum bending stress in the given beam. 5d. Determine Section modulus and moment of resistance for given beam..	5.1 Theory of simple bending, Assumptions in theory of bending, Flexural formula, concept of Neutral axis 5.2 Concept and calculation of moment of resistance, Section modulus. 5.3 Bending stress variation diagram across depth for cantilever and simply supported beams for symmetrical and unsymmetrical sections such as. Rectangular, circular, T and I sections only.
Unit - VI Direct and Bending Stresses (6 Hrs., 8 Marks)	
6a. Define eccentricity, Limiting eccentricity and Core of section 6b. Calculate resultant stress and draw resultant stress variation diagram in a member subjected to eccentric loading. 6c. Mark core of standard sections **6d.** Determine size of component for given stress condition	6.1 Axial and eccentric load, effects of eccentricity, Field cases (Hook, clamp, Bench Vice, Frame etc) 6.2 Axial stress and bending stress, resultant stress intensities, resultant stress distribution diagram (Eccentricity about one axis only) 6.3 No tension condition Limiting eccentricity, Core of section.

Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
Unit -VII Principal Planes and Principal Stresses (8 Hrs., 12 Marks)	
7a. Define principal planes and principal stresses. 7b. Calculate stresses on an inclined plane under a given stress condition. 7c. Locate Principal planes, planes carrying maximum shear stress and calculate principal stresses using standard formulae. 7d. Locate Principal planes and calculate principal stresses using Mohr's circle method.	7.1 Normal stress, Shear stress & resultant stress on oblique planes, angle of obliquity. 7.2 Concept of principal planes and principal stresses, major and minor principal planes and principal stresses. 7.3 Analytical method to locate Principal planes, planes carrying maximum shear stress and to calculate principal stresses, 7.4 Mohr Circle method – concept and application to problems based on stresses on inclined planes and problems on calculating principal planes and principal stresses
Unit -VIII Torsion (8 Hrs., 8 Marks)	
8a. State assumptions in theory of torsion 8b. State and explain torsional formula, 8c. Calculate torque and power transmitted by shaft 8d. Determine shear stress and angle of twist in a shaft for given power to be transmitted/ given torque. 8e. Determine diameter of shaft for given shear stress/ angle of twist.	8.1 Torsion: Concept, field applications (Shaft, flange couplings, shear bolts), torsional rigidity, torsional equation and assumptions 8.2 Torsional resistance for hollow and solid circular shafts, 8.3 Power transmitted by shaft, shear stress in the shaft and angle of twist

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	Simple Stresses and Strains	12	04	04	04	12
II	Generalized Hooke's Law	08	02	04	06	12
III	Shear Force and Bending Moment	10	02	04	06	12
IV	Moment of Inertia	06	02	--	06	08
V	Bending Stresses	06	02	--	06	08
VI	Direct and Bending Stresses	06	--	02	06	08
VII	Principal Planes and Principal Stresses	08	02	04	06	12
VIII	Torsion	08	--	02	06	08
Total		**64**	**14**	**20**	**46**	**80**

9. SUGGESTED STUDENT ACTIVITIES

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

a. Prepare journals based on practicals performed in a laboratory.
b. Prepare charts of maximum bending moment and shear force values in standard beams.
c. Collect information and present values of different engineering properties of five standard mechanical engineering materials in tabular form.
d. Present a seminar on different testing methods used in the industry
e. Prepare a shaft model to demonstrate a relation between length and angle of twist.
f. Collect information comprising of different machine components subjected to direct and bending stresses.

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/sub topics.
b. About ***15-20% of the topics/sub-topics,*** which is relatively simpler or descriptive, 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. For item No.8, teachers need 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, operations and
g. The 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 them. 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 that integrate PrOs, UOs and ADOs.(Affective Domain Outcomes) .Each student must maintain an activity chart consisting of individual contribution to the project work and give a seminar presentation before submission. The student should submit a 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. Calculate stresses on an inclined plane under provided stress conditions by analytical and Mohr's Circle method. (4 problems)
b. Locate Principal planes, and calculate principal stresses using analytical and Mohr's circle method. (4 problems)
c. Study Compression testing machine.
d. Collect information and present in tabular form, values of Brinell Hardness and Rockwell hardness of commonly used metals
e. Prepare demonstration model of Torsion testing machine.
f. Prepare excel program for calculation of SF and BM at any given location for Simply supported and cantilever beams
g. Prepare charts of Centroid and MI of standard plane figures.

12. SUGGESTED LEARNING RESOURCES

S. No.	Title	Author	Publisher, Edition and Year of publication, ISBN Number
1	Strength of Materials	Punmia B C	Laxmi Publications (p) Ltd. New Delhi, 10/e, 2015 ISBN-10: 8131809250 ISBN-13: 978-8131809259
2	Strength of Materials	Ramamurtham S	Dhanpat Rai Publishing Company -New Delhi; Eighth edition, 2014 ISBN-10: 9384378267 ISBN-13: 978-9384378264
3	Strength of Materials	Timoshenko Gere	CBS,2 edition, 2006 ISBN-10: 8123908946 ISBN-13: 978-8123908946
4	Strength of Materials	Khurmi R S	S. Chand Publishing, New Delhi, 2006 ISBN-10: 8121928222 ISBN-13: 978-8121928229
5	Strength of Materials	Kulkarni S. M.	PVG Prakashan, Pune 411030 ISBN -10 :8123563521

13. SOFTWARE/LEARNING WEBSITES

1. www.nptel.com
2. nptel.iitm.ac.in/courses/.../IIT.../lecture%2023%20and%2024.htm
3. en.wikipedia.org/wiki/Shear_and_moment_diagram
4. www.freestudy.co.uk/mech%20prin%20h2/stress.pdf
5. www.engineerstudent.co.uk/stress_and_strain.html
6. www.iit.edu/arc/workshops/pdfs/Moment_Inertia.pdf

14. PO - COMPETENCY- CO MAPPING

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

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

Sign: Name: Smt. S.M. Kulkarni (Course Expert)	Sign: Name: Shri.H.P.Naiknavare (Head of Department)
Sign: Name: Dr. N. G. Kulkarni. (Program Head) (Mechanical Engg Dept.)	Sign: Name: Shri. 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**/05/06/07/08/16/17/**18**/21/22/23/**24**/26
Name of Course	**Machine Drawing**
Course Code	**ME3101**
Prerequisite course code and name	**ME2102 Mechanical Engineering Drawing.**
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	04	06	**Marks**	80	20	00	50	150
				Exam Duration	4 Hrs	1.5 Hrs	--	--	--

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

With Science & Technology advancing at a rapid pace, the type of workforce required by the industry and society is becoming more & more specific. The industry needs a workforce with a technological bent of mind and the desired temper and competencies to maintain high-quality standards & productivity. The quality & productivity depends mainly on the ability of the Technician to communicate through drawing. Mechanical Technicians can read the drawing correctly. The drawing prepared must be precise, and it should not have any scope for different interpretations. Machine drawing is more of a performance-based rather than knowledge-based. The course aims to develop ability to visualize and draw assembly and detail drawings.

3. COMPETENCY

This course aims to help the student to attain the following industry identified competency through various teaching-learning experiences:

- Interpret and prepare mechanical working drawing /production drawing of given component or assembly.

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. Develop a lateral surface of a given object.
2. Draw intersection curves of different solids.
3. Draw an auxiliary view of a given object.
4. Use various drawing codes, conventions and symbols as per IS SP-46.
5. Draw assembly and detailed drawings of products.

5. SUGGESTED PRACTICALS/ EXERCISES

Sr. No.	Unit No.	Sheet No.	**Practical Exercises** (Outcomes in Psychomotor Domain)	Relevant CO	Approx. Hours
1	1	01	Development of solids – two problems.	1	08
2	2	02	Intersection of solids – two problems.	2	10
3	3	03	Auxiliary views -- two problems.	3	10
4	4	04	Conventional representations, Tolerance and fits symbols, surface roughness symbol, welding symbols etc.	4	08
5	4	05	Production drawing- Production drawing of minimum two components showing tolerances , surface roughness etc.	4	08
6	5	06	Details to Assembly – one problem.	5	08
7	6	07	Assembly to Details– one problem.	5	08
8	All	--	Complete a micro project based on guidelines provided in Sr. no. 11	1 to 5	04
			Total		**64**

Sr. No.	Performance Indicators	Weightage in %
a.	Draw sheet using different drafting instrument	20
b.	Follow line work for neat and accurate drafting	20
c.	Answers to sheet related questions	20
d.	Submit the assigned sheet on time	20
e.	Attendance and punctuality	20
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.	Equipment Name with Broad Specifications	Experiment Sr.No
1	Drawing Table with Drawing Board of Full Imperial/ A1 size.	All
2	Models/ Charts or actual parts of objects and assemblies.	All
3	Set of various industrial drawings being used by industries.	05
4	Drawing equipments and instruments for classroom teaching-large size: a. T-square or drafter (Drafting Machine) b. Set squares (450 and 300- 600) c. Protractor d. Drawing instrument box (containing a set of compasses and dividers)	All
5	Interactive board with LCD overhead projector	All

7. THEORY COMPONENTS

Unit Outcomes (UOs) (in the cognitive domain)	**Topics and Sub-topics**
Unit I: Development of Surfaces (06 Hrs, 12 Marks)	
1a. Draw development of lateral surfaces of the given solid. **1b.** Identify parts where the concept of development of the given surfaces is required. **1c.** Draw development of given sheet metal/non sheet metal parts.	**1.1** Developments of Lateral surfaces of cube, prisms, cylinder, pyramids, cone. **1.2** Applications of development of surfaces such as tray, funnel, Chimney, Pipe Bends etc.
Unit II: Intersection of Solids (06 Hrs, 12 Marks)	
2a. Identify parts where the concept of the intersection of the given solids is required. **2b.** Draw curves of the intersection of the given solid combinations.	**2.1** Curves of intersection of surfaces of the regular solids in the following cases:Prism with prism (Tri-angular and square), Cylinder with cylinder, Square Prism with Cylinder . When (i) The axes are at 90° and bisecting (ii) The axes are at 90° and Offset **2.2** Cylinder with Cone. when axis of cylinder is parallel to both the reference planes and cone resting on base on HP with axis intersecting OR offset from axis of cylinder.

Unit Outcomes (UOs) (in the cognitive domain)	**Topics and Sub-topics**
Unit III: Auxiliary Views (06 Hrs, 08 Marks)	
3a. Draw an auxiliary view of a given object. **3b.** Complete an incomplete principle view from the given auxiliary view.	**3.1** Study of auxiliary planes, projection of objects on auxiliary planes. **3.2** Completing the principle view with the help of given auxiliary views.
Unit IV: Conventional Representations and Production Drawing (06 Hrs, 16 Marks)	
4a. Use IS SP-46 (1988) codes. **4b.** Interpret standard conventions used in given mechanical working drawing. **4c.** Use standard conventions in practice. **4d.** Represent tolerances on the given machine components. **4e.** Identify fit required between mating parts of machine components based on the given tolerance values. **4f.** Interpret welding symbols in the given working drawing. **4g.** Interpret surface roughness characteristics from the values given on component drawing. Draw above conventional representations for the given situation.	**4.1** Conventional breaks in pipe, rod and shaft. **4.2** Conventional representation of common features like slotted head, radial rib, knurling, serrated shaft, splined shaft, ratchet and pinion, repeated parts, square on shafts, holes on circular pitch, internal and external thread. **4.3** Conventional representation of standard parts like ball and roller bearing, gears, springs. **4.4** Counter sunk and Counter bored holes. **4.5** Tapers. **4.6** Limits, Fits and Tolerances: a) Definitions, introductions to ISO system of Tolerance. b) Dimensional tolerances:- Terminology, selection and representation of dimensional Tolerance-number and grade method. Definitions concerning Tolerancing and Limits system, unilateral and bilateral Tolerance, Hole and shaft base systems, Types of fits- Clearance, transition and Interference, Calculation of limit sizes and identification of type of fit from the given sizes like 50 H7/s6, 30 H7/d9 etc. **4.7** Geometrical Tolerances:Types of geometrical tolerances, representation of geometrical Tolerance on drawing. **4.8** General welding symbols, length and size of weld. surface contour and finish of weld. all round and site weld, symbolic representation in Engineering practices and its interpretation. **4.9** Machining symbol and surface texture: Indication of machining symbol showing direction of lay, sampling length, roughness grades, machining allowances, manufacturing methods. **4.10** Draw a production drawing of a component/ part using above conventions and methods.

Unit Outcomes (UOs) (in the cognitive domain)	Topics and Sub-topics
Unit V: Details to Assembly (04 Hrs, 16 Marks)	
5a. Explain the general procedure for the assembly of components. **5b.** Draw the assembly drawing from the given detail drawing.	**5.1** Introduction. The sequence of preparing assembly drawing, Bill of materials. Any assembly consists of 6 to 10 parts. for example- i) Cotter Joint, Knuckle Joint, Turnbuckle. ii) Universal Coupling, Oldhams Coupling, Flange coupling iii) Journal Bearing.Pedestal Bearing, Footstep bearing, ball bearing, roller bearing. iv) Piston and connecting rod of IC engine. v) Lathe tool post. vi) Lathe tail stock vii) Screw Jack. viii) Drill Jig. ix) Gland and stuffing Box. x) Stop valve, Non return valve.
Unit VI: Assembly to Details (04 Hrs, 16 Marks)	
6a. Identify various components in the assembly. **6b.** Draw detailed drawings from the given assembly drawing.	**6.1** Introduction. Process of drawing detail drawings from the assembly drawing. **6.2** Details of all assemblies mentioned in Unit V.

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	Development of Surfaces	06	-	-	12	12
II	Intersection of solids.	06	-	-	12	12
III	Auxiliary Views	06	-	-	08	08
IV	Conventional Representation and Production Drawing.	06	08	04	04	16
V	Details to Assembly.	04		-	16	16
VI	Assembly to Details.	04			16	16
Total		32	**08**	**04**	**68**	**80**

9. SUGGESTED STUDENT ACTIVITIES

Other than the classroom and laboratory learning, the 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 maintain a separate A3 size sketchbook which will be part of term work, and submit it along with drawing sheets.

Students should collect Production drawings, Layouts from nearby workshops/industries and study the drawings.

Students should visit workshop, other laboratories and industries to study various assemblies.
Prepare paper models of development of lateral surfaces of solids.
Visit Institute's Power engineering Lab, TMM Lab, Hydraulics Lab or Workshop and prepare detailed drawings and assembly drawing of anyone available assembly. The dimensions are to be measured by using proper measuring instruments.

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. Show video/animation films to explain orthographic and sectional orthographic projection.
c. Demonstrate/ explain the problems using models. Actual working assemblies e.g. Bench vice, pipe vice, screw jack, tool post, tailstock piston, cylinder connecting rod, crank and models of keys, cotter joints knuckle joints can be used.
d. Use charts and industrial drawings to teach standard symbols Teacher should ask the students to go through instruction and Technical manuals
e. Encourage students to refer to different websites to understand the subject deeper.

11. SUGGESTED MICRO-PROJECTS

Only one micro-project is planned to be undertaken by a student that needs to be assigned to them. 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 that integrate PrOs, UOs and ADOs (Affective Domain Outcomes). Each student will have to maintain a dated work diary of individual contributions to the project work and give a seminar presentation before submission. The student should submit a 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:

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. Visit a nearby fabrication workshop and prepare reports on various welding symbols used for fabrication work.
b. Visit nearby process industries like sugar factories, chemical industries, etc and prepare reports representing various piping joints' conventional representation.
c. Visit Institute's Power engineering Lab and prepare detailed drawings of Various IC Engine components using proper measuring instruments.
d. Visit Institute's workshop and prepare assembly drawing and working drawing of machine vice/ lathe tailstock/ tool post etc.
e. Any other micro-projects suggested by subject faculty on a similar line.

12. SUGGESTED LEARNING RESOURCES

Sr. No.	Title	Author	Publisher, Edition and Year of publication, ISBN Number
1	Elementary Engg. Drawing (Including plane and solid geometry)	N.D. Bhatt	Charotar Publication, Anand. ISBN:9789380358178
2	A Workbook in Engineering Drawing	Curriculum Development Centre, TTTI, Bhopal	Somaiyya Publication Pvt. Ltd., Mumbai
3	Geometrical and Machine Drawing	N.D. Bhatt	Charotar Publishing house Pvt. Ltd., Anand, Gujarat, 2013, ISBN 9789380358635
4	Machine Drawing	Sidheshwar	McGraw I-Iill, New Delhi, 2009 ISBN: 9780074603376
5	Machine Drawing	Kannaiah, Narayan & K. vekanta Reddy	New Age International Publishers. New Delhi, 2009 ISBN:
6	S.P. 46 – 1988 Code of Engg. Drawing for Schools & Colleges	Bureau of Indian Standards	Bureau of Indian Standards, New Delhi Third reprint, October 1998 ISBN 8170610912
7	I.S. 813 – 1988 Code of welding symbols	Bureau of Indian Standards	Bureau of Indian Standards, New Delhi

13. SOFTWARE/LEARNING WEBSITES

1. www.nptel.com
2. https://en.wikipedia.org/
3. http://www.technologystudent.com/
4. Engineering graphics and Drawing v 1.0 from cognifront
5. www.slideshare.net/
6. https://www.youtube.com/watch?v=2sM04tkgD2Y&list=PLIhUrsYr8yHwAbiCATZUbzd_CpF0EHF3v&index=7
7. https://www.youtube.com/watch?v=u0VQ3xYHpCk&list=PLIhUrsYr8yHwAbiCATZUbzd_CpF0EHF3v&index=8
8. https://www.youtube.com/watch?v=V4AAU9tXCYU&list=PLIhUrsYr8yHwAbiCATZUbzd_CpF0EHF3v&index=9
9. https://www.youtube.com/watch?v=YSzIUzLLPOY&list=PLIhUrsYr8yHwAbiCATZUbzd_CpF0EHF3v&index=10
10. https://www.youtube.com/watch?v=DMtZxp8eFWk&list=PLIhUrsYr8yHwAbiCATZUbzd_CpF0EHF3v&index=1
11. https://www.youtube.com/watch?v=Tkz-OevEddM&list=PLIhUrsYr8yHwAbiCATZUbzd_CpF0EHF3v&index=4

12. https://www.youtube.com/watch?v=9hD7q2CqAOA&list=PLIhUrsYr8yHwAbiCATZUbzd_CpF0EHF3v&index=6
13. http://www.youtube.com/watch?v=_MSeYB60S6M
14. http://www.youtube.com/watch?v=UyROI-bAMu4
15. http://www.youtube.com/watch?v=eix8xbqb93
16. http://www.youtube.com/watch?v=kWOI6ttDTBc
17. http://www.yolltube.com/watch?v=g.Jbr02jtoa8eature=related
18. http://www.youtube.com/watch?v=PXgkBadGHE

14. PO - COMPETENCY- CO MAPPING

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

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

Sign: Name: Shri. M. W. Giridhar Shri. M. R. Mundhe. (Course Experts)	Sign: Name: Dr. N. G. Kulkarni. (Head of Department)
Sign: Name: Dr. N. G. Kulkarni. (Program Head) (Mechanical Engg Dept.)	Sign: Name: Shri A. S. Zanpure. (CDC Incharge)

Government Polytechnic, Pune

'180OB'– Scheme

Programme	**Diploma in Mechanical Engineering**
Programme code	01/02/03/**04**/05/06/07/08/15/16/17/**18**/19/21/22/23/**24**/26
Name of Course	**Thermal Engineering**
Course Code	**ME3102**
Prerequisite course code and name	**NA**
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	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

Thermal Engineering incorporating basic thermodynamics and heat transfer principles is an essential element of any mechanical engineering course. Students will be able to solve many problems related to this and inter areas in this core area because the principles involved have universal applications. Keeping this in mind, the present course emphasizes understanding the basic principles of thermodynamics and heat transfer and applying these to practical thermodynamics problems. The understanding of fundamentals will also be of direct relevance later when power engineering is studied.

Steam power plants are being established in the country in a big way to cater for the spurt in power demand. It is expected that many mechanical technicians will be associated with planning erecting, running and maintaining the steam power plant. The present course includes studying essential components of such plants so that these technicians do not find themselves strangers if called upon to perform these jobs.

3 COMPETENCY

This course aims to help the student to attain the following industry identified competency through various teaching-learning experiences:

- **Use principles of thermal engineering to maintain thermal related equipment.**

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 laws of thermodynamics to devices based on thermodynamics.
2. Calculate thermodynamic properties of Ideal gases and Steam
3. Differentiate various types of heat exchangers in various aspects.
4. Illustrate the working of various components of a steam power plant.

5 SUGGESTED PRACTICALS/ EXERCISES

Sr. No.	Unit No.	Practical Exercises (Outcomes in Psychomotor Domain)	Relevant CO	Approx. Hours Required.
1	1	Measure temperature, pressure, power, discharge, Volume using instruments of different equipment available in Thermal Engineering Laboratory.	01	02
2	1	Determine the rate of work done of a given thermodynamic system	01	02
3	2	Plot steam properties on Mollier chart for a given sample of wet steam.	02	02
4	3	Calculate the thermal conductivity of Metallic Rod.	03	02
5	3	Identify different equipment in power engineering lab having heat exchangers and classify heat exchangers. Write construction and working of any 03 of above heat exchangers.	03	02
6	3	Calculate mass flow rate of one fluid using energy balance equation in heat exchanger.	3	02
7	3	Calculate the convective heat transfer coefficient for the given fluid.	3	02
8	4	Trace the path of Flue Gases and Water Steam circuit of the boiler.	4	02
9*	4	Assembly and dismantling of boiler mounting model available in the laboratory	4	04

10*	4	Assembly and dismantling of boiler accessories available in the laboratory	4	04
11*	5	Assembly and dismantling of impulse and reaction turbines (working Model).	4	04
12*	6	Assembly and dismantling of cooling tower (working Model).	4	04
13	6	Dismantle given model of surface condenser, draw sketches of various parts and assemble it.	4	02
14	4,5,6	Observe simulation of Thermal Power Plant and write specifications of boilers, turbines, condensers and electrical generators.	4	02
15	1 to 6	Complete a micro project based on guidelines provided in Sr. No. 11	1,2,3,4	04
		Total		**32**

Note-Perform experiment no. 9 or 10 and 11 or 12.

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

Sr. No.	Major Equipment/ Instruments Required	Experiment Sr.No
1	Models of water tube and fire tube boilers (cut section models).	2,3
2	Various mountings and accessories of boilers for assembly and dismantling purpose.	2,3
3	Relevant simulation software.	4
4	Cut section models of impulse turbine and reaction turbine.	6
5	Experimental setup with convergent and divergent nozzle.	6

6	Model of a surface steam condenser with assembly and dismantling purpose.	8
7	Experimental setup of shell and tube steam condenser. (Minimum shell diameter 45cm).	8
8	Experimental set-up for determination of thermal conductivity.	9
9	Models of different heat exchangers.	10
10	Models of different cooling towers	7
11	Experimental set-up to determine convective heat transfer coefficient.	12

7 THEORY COMPONENTS

Unit Outcomes (UOs) (in cognitive domain)	**Topics and Sub-topics**
Unit-I Thermodynamic Principles (08 Hrs, 14 Marks**)**	
1a. Determine the properties of the given substance using thermodynamic property tables. 1b. Explain the phenomena when thermodynamic principles are applied to the given condition of gas. 1c. Explain the phenomena when first law of thermodynamics is applied in the given thermodynamic system. 1d. Explain the phenomena when the second law of thermodynamics is applied in the given thermodynamic system 1e. Determine the rate of work done and thermal energy transfer during a thermodynamic process in the given type of open system.	1.1 Definitions and units-- of Force, Pressure, Volume, Temperature, Work, Torque, Power (Linear & Rotary). (S.I. units). 1.2 Basic concepts – Thermodynamic system, boundary, surroundings. Types of the system- closed and open, point function and path function. Definition of property, intensive and extensive property, properties like specific volume, density, pressure, temperature. Process, work-thermodynamic definition, work done at the moving boundary, heat- thermodynamic definition, difference between heat and work. 1.3 First law of thermodynamics: -First law for closed system, internal energy, Types of energy- potential energy, kinetic energy, flow energy. First law for open system -steady flow energy equation, enthalpy. Application of first law to the close system and open systems like boiler, turbine, engine, nozzle, condenser, pump, compressor, and throttling. Definition of specific heat Cp and Cv. 1.4 The second law of thermodynamics: Concept of Heat engine, Heat pump and refrigerator, thermal efficiency, COP. Second law of thermodynamics- Kelvin -Plank and Clausius statement, equivalence of two statements, reversible process, factors making process irreversible, Entropy, entropy change in reversible process..

Unit Outcomes (UOs) (in cognitive domain)	**Topics and Sub-topics**
Unit-II - Ideal gas processes and steam properties (12 Hrs, 14 Marks)	
2a. Evaluate the work done and thermal energy transfer according to Boyle's law and Charles' law for the given situation. 2b. Calculate the mass of a gas and its final condition parameters after undergoing a particular process for the given situation. 2c. Determine characteristic gas constant of commonly used gases for the given data. 2d. Calculate different energy changes during ideal gas processes for the given situation. 2e. Determine dryness fraction for the given steam sample	2.1 Definition of an ideal gas, ideal gas laws ,equation of state , characteristic of gas equation, specific and universal gas constant, specific heat, internal energy and enthalpy analysis of ideal gas processes assuming constant specific heats. 2.2 Process like constant volume (isochoric), constant pressure (isobaric), adiabatic (isentropic), irreversible adiabatic, polytrophic, throttling etc. In each case change in internal energy, enthalpy, entropy and determination of heat and work may be considered, and processes plotted on Pressure-Volume (P-V) and Temperature- Entropy (T-S) diagrams 2.3 Two phase system:- Generation of Steam at constant pressure with representation on various charts such as P-V, T-S and H-S. Properties of Steam and use of steam table, dryness fraction, degree of superheat, sensible and latent heat, Mollier or (H-S) diagram. Numerical using steam table to determine dryness fraction and enthalpy of wet, dry saturated and superheated Steam.
Unit-III Heat Transfer Principles (08 Hrs, 12 Marks)	
3a. Calculate heat transfer by conduction through composite slabs and pipes for the given data. 3b. Use Stefan Boltzmann's law of radiation in the given situation. 3c. Solve thermal engineering problems with the given data using principles of energy mechanisms. 3d. Explain construction and working of a given type of heat exchangers with sketches. Select heat exchangers for the given situation with justification	3.1 Modes of heat transfer - Conduction, convection and radiation. 3.2 Conduction - Fourier's law, thermal conductivity, conduction through cylinder, thermal resistance, composite walls, list of conducting and insulating materials. Simple numerical. 3.3 Convection - Newton's law of cooling, natural and forced convection. 3.4 Radiation- Thermal Radiation, absorptivity, transmissivity, reflectivity, emissivity, black and gray bodies, Stefan-Boltzmann law. 3.5 Heat Exchangers - Classification, construction and working of shell and tube, shell and coil, pipe in pipe type and plate type heat exchanger, automotive heat exchanger and its applications, importance of equation for LMTD(no derivation) simple numerical problems(Understand level)

Unit Outcomes (UOs) (in cognitive domain)	**Topics and Sub-topics**
Unit-IV Steam generators and boiler draught (08 Hrs, 14 Marks)	
4a. Calculate the efficiency of given type of boiler for the given conditions. 4b. Calculate the rates of thermal energy transfer in the given type of boiler and superheater for the given conditions. 4c. Describe different types of high pressure boilers. 4d. Name and describe different types of boiler draught	4.1 Rankine cycle, Steam boilers : Classification (sub critical and super critical boilers), description and working of common boiler (this may be included in laboratory work only and should be as a demonstration in laboratory with available models, charts and virtual laboratory) 4.2 Maintenance and inspection of boilers. 4.3 High pressure boilers - **(1)** Lamont **(2)** Loeffler **(3)** Velox **(4)** Benson boiler. Application of boilers in process engineering. 4.4 Boiler mountings and accessories, study of various boiler mountings such as safety valve, water level indicators, pressure gauge, feed check valve, blow off cock, fusible plug (this should be done in laboratory with available models and charts). Study of various boiler accessories such as feed water injector, economizer, super heater, air preheated, (this should be done in laboratory with available models and charts) 4.5 Boiler draught – natural and artificial draught, relative merits and demerits (No analytical treatment).
Unit V -Steam nozzles and steam turbines (06 Hrs, 14 Marks)	
5a. Select the nozzles for the given situation. 5b. Determine thermal efficiency for the specified type of steam turbine for given conditions. 5c. Interpret the given types of steam cycles to estimate efficiencies in a steam power plant 5d. Compare the performance for the given steam turbine	5.1 Steam nozzles-Function, types, steady flow energy equation for nozzle. 5.2 Steam turbine - Classification of turbines, construction and working of impulse and reaction turbine. 5.3 Compounding of steam turbines and various methods of compounding, their relative comparison, Regenerative feed heating, bleeding of steam turbines.

Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
Unit VI Condensers and cooling tower (06 Hrs, 12 Marks)	
6a. Identify the elements and processes of the given type of steam condensers. 6b. Identify the elements and processes of the given cooling towers. 6c. alculate condenser efficiency and vacuum efficiency for the given parameters. 6d. Evaluate the thermal performance for the given data of the steam condenser 6e. Interpret the thermal design of the given type of cooling tower. 6f. Select condensers for the given situation with justification 6g. Select cooling tower for the given situation with justification.	6.1 Functions of condenser,location of condenser in thermal power plant, classification of condensers, Dalton's law of partial pressure, 6.2 Construction and working of Jet and Surface condensers 6.3 Sources of air leakage into condenser, effects of air leakage, definitions of vacuum efficiency, condenser efficiency (simple numericals) 6.4 Cooling Towers-Construction and working of natural, forced and induced draught cooling tower.

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 thermodynamics	08	04	04	06	14
II	Ideal gases and ideal gas processes	12	04	04	06	14
III	Heat Transfer Principles	08	04	04	04	12
IV	Steam generators and boiler draught	08	02	04	08	14
V	Steam nozzles and steam turbines	06	02	04	08	14
VI	Condensers and cooling tower	06	02	04	06	12
Total		**48**	**18**	**24**	**38**	**80**

9 SUGGESTED STUDENT ACTIVITIES

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

Students should conduct the following activities in groups and prepare reports of about five pages for each activity, also collect/record physical evidence for their (student's) portfolio, which will be helpful in their placement interviews:

a. Prepare journals based on practicals performed in the laboratory.
b. Prepare and present a seminar on boiler instrumentation using appropriate sources of information.
c. Prepare charts on compounding, regenerative feed heating processes.
d. Prepare P-V & T-S charts of different ideal gas processes.
e. Prepare P-H, H-S, T-S diagrams for other steam processes.
f. Draw an enthalpy-entropy (Mollier) chart and represent different vapor processes using different color combinations.
g. Prepare a report on a visit to Sugar Factory / Steam Power Plant / Dairy industry with a specification of boiler and list of mountings and accessories and their functions.
h. List insulating and conducting materials used in various applications.

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. 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 COs through classroom presentations (see implementation guideline for details).
c. For item No.9, teachers need 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, operations and
g. The 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 them. In the first four semesters, the micro-project are group-based. However, in the fifth and sixth semesters, it should preferably 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. 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 that integrate PrOs, UOs and ADOs (Affective Domain Outcomes). Each student must maintain a dated work diary of individual contributions to the project work and give a seminar presentation before submission. The student should submit a 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 Prepare charts on fundamental concepts of thermodynamics. E.g. First/Second law applications, heat and work transfer.
b Investigate energy transfer in a thermodynamic system.
c Prepare at least one Model explaining ideal gas processes.
d Prepare at least one Model of boiler mountings and accessories.
e Collect and analyze technical specifications of steam turbines boilers from manufacturers' websites and other sources.
f Prepare a report on steam traps used in steam piping.
g Carry out comparative study of conventional cooling towers, cooling towers used in power plants and upcoming cooling towers. .
h Make power point presentation including videos on heat exchangers commonly used.
i Make models of Shell and Tube, Plate, tube in tube heat exchangers in workshop.
j Organize a group discussion session on the relative merits and demerits of different types of turbines, condensers, boilers.
k Make a model of a steam condenser and show how a vacuum is created after steam condensation.
l Undertake a 03 days training at Thermal Power Plant.

12 SUGGESTED LEARNING RESOURCES

S.N.	Title	Author	Publisher, Edition and Year of publication ISBN Number
1	Thermal Engineering	Rathore, Mahesh M.	Tata McGraw-Hill Education, New Delhi 2010, ISBN: 9780070681132
2	Basic Thermodynamics	Nag, P. K.	McGraw-Hill Education, New Delhi
3	Thermal Engineering	Rajput, R. K.	Firewall Media, New Delhi 2005, ISBN: 978-8170088349
4	A Textbook of Thermal Engineering	Gupta, J. K.; Khurmi R. S.	S. Chand Limited, New Delhi 1997, ISBN: 9788121925730
5	A course in Thermal Engineering	Domkundwar, S; Kothandaraman, C.	Dhanpat Rai and company, New Delhi, 2004, ISBN:9788177000214

		P;Domkundwar, A. V.	
6	Elements of heat engines Vol I, II and III	Patel and Karamchandani	Acharya Publication, Vadodara
7	Engineering thermodynamics	P.B. Joshi, V.S.Tumane	Pune Vidyarthi Griha Prakashan, Pune30
8	Thermal Engineering	A.S.Sarao	Satya prakashan ,New Delhi
9	Heat Engineering	Kumar,Vasandani	Metropolitan book company (p) Ltd. Delhi-6
10	Lewitt	Thermodynamics applied to Heat Engines	Sir Isaac Pitman and sons Publication Ltd.

13 SOFTWARE/LEARNING WEBSITES

1. http://www.sfu.ca/~mbahrami/ENSC%20388/Notes/Intro%20and%20Basic%20Concepts.pdf
2. http://web.mit.edu/16.unified/www/FALL/thermodynamics/notes/node12.html
3. https://www.youtube.com/watch?v=9GMBpZZtjXM
4. https://www.youtube.com/watch?v=3dyxjBwqF-8
5. https://www.youtube.com/watch?v=02p5AKP6W0Q
6. http://www.learnengineering.org/2013/02/working-of-steam-turbine.html
7. https://www.youtube.com/watch?v=MulWTBx3szc
8. http://nptel.ac.in/courses/103106101/Module%20-%208/Lecture%20-%202.pdf
9. https://www.youtube.com/watch?v=Jv5p7o-7Pms
10. http://www.cdeep.iitb.ac.in/webpage_data/nptel/Mechanical/Heat%20and%20Mass%20Transfer/Course_home_1.html
11. http://www.rinfra.com/energy_generation.html
12. https://www.youtube.com/watch?G2z9gAfREt0
13. https://www.youtube.com/watch?FPaKjYyUea8
14. https://www.youtube.com/watch?IFWpDzzq0CE
15. https://www.youtube.com/watch? JCYI-ZjHPGg

14 PO - COMPETENCY- CO MAPPING

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

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

Sign: Name: Shri A.S.Zanpure Shri. V. J. Deshpande (Course Experts)	Sign: Name: Dr. N. G. Kulkarni (Head of Department)
Sign: Name: Dr..N.G.Kulkarni (Program Head) (Mechanical Engg Dept)	Sign: Name: Shri A.S.Zanpure (CDC In charge)

Government Polytechnic, Pune

'180 OB' – Scheme

Programme	**Diploma in Mechanical Engineering**
Programme code	01/02/03/**04**/05/06/07/08/15/16/17/**18**/19/21/22/23/**24**/26
Name of Course	**Fluid Mechanics and Fluid Machinery**
Course Code	**ME 3103**
Prerequisite course code and name	**NA**
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	25	25	150
				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

Knowledge of fluid pressure, fluid flow, and related machinery are essential in all engineering fields. Hydraulic machines and hydraulic devices have important roles in power generation, power transmission, water supply, irrigation, and other engineering segments.

This subject requires the knowledge of basic engineering science, applied mechanics and mathematics, etc. The fundamentals of this subject are essential for the subject Industrial Hydraulics to be taught in higher semesters.

3. COMPETENCY

This course aims to attend following industry identified competency through various teaching learning experiences.

- **Maintain hydraulic machinery using knowledge of fluid mechanics.**

4. COURSE OUTCOMES (COs)

The theory, practical experience,es 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. Identify different characteristics of fluids.
2. Identify the patterns of fluid flow.
3. Determine different losses inflow through pipes.
4. Calculate the efficiency of different turbines and pumps.
5. Select suitable turbines and pumps based on given parameters.

5. SUGGESTED PRACTICALS/ EXERCISES

Sr. No.	Unit No.	Practical Exercises (Outcomes in Psychomotor Domain)	Relevant CO	Approximate Hours Required.
1	1	Determine the coefficient of discharge of rectangular Notch/Orifice.	01	04
2	2	Measure the Total Energy available at different sections of a pipe layout	02	04
3		Determine the coefficient of discharge of the Venturimeter.	03	04
4	3	Estimate Darcy's friction factor 'f' for a given pipe	03	04
5		Calculate the head loss due to sudden enlargement and sudden contraction in pipes.	03	04
6	4	Determine the force exerted by a jet on flat plate	04	04
7		Observe construction, working and find power and efficiency of a Pelton wheel or Francis turbine.	04	02
8	5 and 6	Observe construction working & find power & efficiency of centrifugal /reciprocating pump	05	02
9	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 a report in time	10
Total		**100**

6. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

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

Sr. No.	Major Equipment/ Instruments Required	Experiment Sr. No.
1	Hydraulic Bench	1, 2
2	Venturimeter Testing Apparatus	3
3	Impact of jet test rig	4
4	Centrifugal pump Test rig	6
5	Reciprocating Pump Test Rig	6
6	Pelton Wheel test rig	4
7	Francis Turbine test rig	4
8	Mercury Manometers, Stop watch, Bourdon Pressure Gauge	All

7. THEORY COMPONENTS

Unit Outcomes (UOs) (in the cognitive domain)	**Topics and Sub-topics**
Unit I. Fluids, Fluid Pressure & Measurement of Pressure (10 Hrs, 14 Marks)	
1a. Compare the given two fluids based on the given physical properties. 1b. Calculate fluid pressure, total pressure and centre of pressure on the given immersed body in the specified liquid and the given position. 1c. Choose the relevant pressure measuring device for the given situation with justification. 1d. Calculate pressure using different types of Manometers and Bourdon pressure gauge.	1.1 Fluid, types of fluids, properties of fluids: mass density, weight density, specific volume, specific gravity, viscosity, kinematic viscosity, Newton's law of viscosity and units, compressibility bulk modulus, surface tension, capillary action, vapour pressure, cavitations. Types of fluids: Ideal, Real, Newtonian, Non-Newtonian, Plastic. 1.2 Pascal's Law, concept of static pressure, pressure head, centre of pressure and total pressure for rectangular, circular and triangular plane surfaces. 1.3 Concept of atmospheric pressure, gauge pressure and vacuum pressure. Pressure head measurement by Piezometer, U-tube manometer, inverted U-tube manometer, micro

	manometer and Bourdon's pressure gauge.
Unit-II Flow of Fluids (10 Hrs, 12 Marks)	
2a. Compare the types of fluid flow based on the given characteristic properties. 2b. Determine energies possessed by flowing fluids. 2c. Apply Bernoulli's theorem and Continuity equation to the given discharge measuring device and data. 2d. Determine Hydraulic coefficients. 2e. Describe with sketches the procedure to calculate discharge using the given flow devices. 2f. Select the relevant discharge measuring device for the given situation.	2.1 Types of flows: Steady-unsteady, uniform-non uniform, laminar-turbulent, compressible-incompressible, rotational-irrotational, 1, 2, 3 Dimensional, rate of flow (discharge).law of continuity, Reynolds number. 2.2 Energies possessed by flowing liquids like pressure, kinetic and potential energy, total energy equation. 2.3 Bernoulli's theorem and its application to venturimeter and pitot tube. 2.4 Derivation for discharge through venturimeter. 2.5 Hydraulic coefficients, determination of coefficient of velocity by trajectory method. 2.6 Flow through small circular orifice, rectangular and V- notches.
Unit-III Flow through Pipes (10 Hrs, 12 Marks)	
3a. Use laws of fluid friction for the given Laminar and turbulent flow. 3b. Use Darcy's equations and Chezy's equation for the given frictional losses. 3c. Estimate losses in flow for the given pipe layout. 3d. Calculate power transmitted and transmission efficiency for the given pipe layout and data.	3.1 Laws of fluid friction for laminar and turbulent flow. Darcy's and Chezy's equation for frictional loss. Different types of head losses in pipes. Minor losses: sudden expansion, sudden contraction, bend, pipe fittings, entry, exit. equivalent length of pipe. 3.2 Hydraulic gradient line, total energy line. 3.3 Power transmitted through pipes, transmission efficiency, water hammer and its effects. (numerical based on connected reservoirs are not expected)
Unit-IV Impact of Jet and Water turbines (14 Hrs, 16 Marks)	
4a. Apply impulse momentum equation to the given geometry of vanes and find equations for force and work done. 4b. Calculate force exerted by a jet, work done and efficiency for the given vane and data. 4c. Draw velocity diagram for the given curved vane with special reference	4.1 Impact of jet and generation of force on stationary and moving flat plate, stationary and moving curved vanes. 4.2 Tangential entry on the moving vanes mounted on the wheel, calculation of work done and efficiency. 4.3 Simple layout of hydroelectric power plant showing dam, reservoir pen stock, and surge tank pressure relief valves turbine penstock and

to turbines. 4d. Draw velocity diagram for the given curved vane with special reference centrifugal pumps. 4e. Select the hydraulic turbine for the given application with justification. 4f. Calculate work done, power, specific speed and efficiency of the given turbine and data. 4g. Describe with sketches the functioning of the given types of Draft tubes. 4h. Draw characteristic curves of the given turbine. 4i. Describe the procedure to troubleshoot the given type of hydraulic turbine with sketches.	tail race. 4.4 Classification of turbines, principles of working and construction of Pelton, Francis, and Kaplan Turbines, calculation of work done, power developed, losses and different efficiencies including velocity diagram. 4.5 Draft tubes – types and construction, Concept of cavitation in Turbines. 4.6 Methods of governing, performance characteristics, Turbine selection criteria
Unit-V Centrifugal Pumps (12 Hrs, 16 Marks)	
5a. Select the relevant hydraulic pumps for the given application with justification. 5b. Calculate work required and efficiency of the given centrifugal pump. 5c. Draw characteristic curves of the given pump. 5d. Describe the procedure to troubleshoot the given type of hydraulic pump with sketches.	5.1 Classification and applications of pumps, construction, and working. Priming, different heads of pumps, velocity diagrams, calculation of power required to drive the pump, manometric efficiency and overall efficiency. NPSH and performance characteristic curves. (numerical based on velocity diagrams are expected) 5.2 Multistage pumps, submersible pumps, jet pumps, maintenance and fault finding, their remedies. Installation and testing of centrifugal pumps and pump selection.
Unit-VI Reciprocating pumps and Hydraulic devices (8 Hrs, 10 Marks)	
6a. Calculate slip, efficiency, and power required to drive the given reciprocating pump and data. 6b. Define the working principle of different hydraulic devices with sketch and applications.	6.1 Construction and working of single acting and double acting pumps, indicator diagram, positive and negative slip, calculation of power required. air vessels, functions and advantages. 6.2 Working principle, construction & applications of hydraulic intensifier, hydraulic press and hydraulic lift.

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	Fluid, Fluid Pressure and Measurement of pressure	10	06	04	04	14
II	Flow of Fluids	10	08	02	02	12
III	Flow through Pipes	10	06	02	04	12
IV	Impact of Jet and Water turbines	14	04	04	08	16
V	Centrifugal Pumps	12	04	06	06	16
VI	Reciprocating pumps and hydraulic devices	08	04	04	02	10
Total		**64**	**32**	**22**	**26**	**80**

9. SUGGESTED STUDENT ACTIVITIES

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

Students should conduct the following activities in groups and prepare reports of about five pages for each activity, also collect/record physical evidence for their (student's) portfolio, which will be helpful in their placement interviews:

a. Prepare journals based on practical performance in the laboratory.
b. Follow the safety precautions.
c. Use various mechanical measuring instruments and equipment related to fluid mechanics and machinery.
d. Read and use specifications of the hydraulic machines and equipment.
e. Library / Internet survey of hydraulics and hydraulic machines
f. Prepare power point presentation or animation for understanding constructional details and working of different hydraulic machines.
g. Visit nearby shops to identify different PVC and GI pipe fittings. Collect manufacturing catalogs related to the same.
h. Visit nearby shops to identify different pumps. Collect manufacturing catalogue related to the same and compare their salient features.
i. Prepare a list of commercially available software related to computational Fluid dynamics (CFD).
j. Visit any hydraulic power plant and write reports.

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. About 15-20% of the topics/sub-topics which are relatively simpler or descriptive 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. For item No.9, teachers need to create opportunities and provisions for co-curricular activities.
d. Guide student(s) in undertaking micro-projects.
e. Correlate subtopics with power plant systems and equipment.
f. Use the 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

Only one micro-project is planned to be undertaken by a student that needs to be assigned to them. 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 that 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 should submit a 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. Prepare a pipe layout of the water supply of your lab from the supply reservoir and calculate the loss of head.
b. Prepare a chart showing all the pressure and flow measuring devices.
c. Prepare a demonstration model of a hydroelectric power plant/ any hydraulic device.
d. Calculate the running cost of your house/hostel pump and verify the electricity bill.
e. Gather information on hydroelectric power plants in Maharashtra, India and the world.
f. Visit a hydroelectric power plant and write a report.
g. Make a video explaining hydraulic power generation that the common person could understand.
h. Select a pump for a coolant recirculation in the lathe machine, bore well pumps, pump at a service station, the pump used in water coolers, and pump in purified water filter system with justification.
i. Download catalogue of pump manufacturers like Kirloskar, CRI, Texmo, etc and compare their parameters.
j. Disassemble and assemble a centrifugal pump for fault finding, troubleshooting, and identifying worn-out parts.
k. Prepare a display chart of pipes based on material, size and applications.
l. Study pressure gauges used by roadside tyre works, blood pressure measurement by doctors, pressure gauges mounted on turbine test rigs.
m. Visit to a nearby pump manufacturing unit.
n. Conduct a market survey of pump suppliers and prepare reports on technical specifications, area of applications, cost, the material of different parts and maintenance procedure.

12. SUGGESTED LEARNING RESOURCES

S.N.	Title	Author	Publisher, Edition and Year of publication, ISBN Number
1	Hydraulics and Fluid Mechanics including Hydraulic Machines.	Modi P.N.	Seth S M Standard Book House New Delhi, 2013 ISBN: 978818940126
2	Fluid Mechanics and Hydraulic m/c.	Bansal R. K.	Laxmi Publication Pvt. Ltd. New Delhi, 2013, ISBN 9788131808153
3	A textbook of Fluid Mechanics and Hydraulic Machines.	R. K. Rajput	S. Chand and Company Pvt. Ltd. New Delhi, 2000, ISBN 9789385401374
4	Fluid Mechanics and Hydraulic Machines: problems and solution.	Subramanya K.	Tata McGraw-Hill Co. Ltd. New Delhi 2011, ISBN 9780070699809
5	Fluid Mechanics and Machinery.	Ojha, Berndtsson,	Chandramouli Oxford University Press, New Delhi 2000, ISBN 9780195699630
6	Introduction to Fluid Mechanics and Fluid Machines.	Som S. K. Biswas G.	Tata McGraw-Hill Co. Ltd. New Delhi 2005, ISBN 9780070667624
7	A Textbook of Hydraulics, Fluid Mechanics and Hydraulic Mechanics.	Khurmi R. S.	S. Chand and Co. Ltd. New Delhi 2015, ISBN-13: 9788121901628
8	Hydraulic, fluid mechanics and fluid machines.	Ramamrutham S.	Dhanpat Rai and Sons New Delhi 2011, ASIN: 8187433809
9	Fluid Mechanics.	Streeter Victor, Benjamin Wylie E. Bedford K.W.	McGraw Hill Education; New Delhi, 2017, ISBN 978-0070701403
10	Hydraulic Machines.	Jagdish lal	Metropolitan; 2008, ISBN-13: 9788120004221

13. SOFTWARE/LEARNING WEBSITES

1. www.nptel.ac.in/courses
2. www.learnerstv.com www.ni.com/multisim
3. https://www.youtube.com/watch?v=e6a2q9k2JCA
4. https://www.youtube.com/watch?v=5TTnFccqJEE
5. https://www.youtube.com/watch?v=3Gq3tR3fkM0
6. https://www.youtube.com/watch?v=UNBWI6MV_lY
7. https://www.youtube.com/watch?v=ljMVt7T4HQM
8. https://www.youtube.com/watch?v=wnOQMk7pKak
9. https://www.youtube.com/watch?v=IcJOkRZPNMI
10. https://www.youtube.com/watch?v=w7n0srAzm8g
11. https://www.youtube.com/watch?v=f9LY0-WP9Go
12. https://www.youtube.com/watch?v=tXLI-IeAynI
13. https://www.youtube.com/watch?v=qbyL--6q7_4
14. https://www.youtube.com/watch?v=3BCiFeykRzo

15. https://www.youtube.com/watch?v=0p03UTgpnDU
16. https://www.youtube.com/watch?v=BaEHVpKc-1Q
17. https://www.youtube.com/watch?v=oQqMrtc6kJQ

14. PO - COMPETENCY- CO MAPPING

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

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

Sign: Name: Mr. V. S. Sonawane Dr. S. R. Adhau (Course Experts)	Sign: Name: Dr. N. G. Kulkarni (Head of Department)
Sign: Name: Dr.N.G.Kulkarni (Program Head) (Mechanical Engg Dept.)	Sign: Name: Shri A.S.Zanpure (CDC In charge)

Government Polytechnic, Pune

'180 OB' – Scheme

Programme	**Diploma in Mechanical Engineering**
Programme code	01/02/03/**04**/05/06/07/08/15/16/17/**18**/19/21/22/23/**24**/26
Name of Course	**Metrology and Measurements**
Course Code	**ME 3104**
Prerequisite course code and name	**NA**
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">04</td><td rowspan="2">00</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, 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. RATIONAL:

The course has been included in the curriculum as inspection and quality control activities are given prime importance in industry. A diploma technician working in the industry has to identify the variables to be measured, decide the accuracy required, Select the instrument, investigate reasons for defects and give suggestions, decide whether to accept or reject the jobs.
Methods and measurements techniques are becoming increasingly important in engineering in recent years. Laboratory programs have been modernized, sophisticated electronic instrumentation has been incorporated into the program, and newer techniques have been developed. The course aims at making a Mechanical Engineering student familiar with the principles of instrumentation, transducers & measurement of parameters like temperature, pressure, flow, speed, force and stress.

3. COMPETENCY:

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

- **Use relevant analog and digital instruments to measure various parameters of machine components and Mechanical Engineering related 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. Select the relevant instrument for the measurement of length and angle.
2. Select gauges, fits and tolerances for machine components.
3. Use relevant instruments for thread, gear and surface measurement.
4. Identify different components of a control system.
5. Select relevant instruments to measure displacement, temperature, flow and miscellaneous quantities.

5. SUGGESTED PRACTICALS/EXERCISES: Any Twelve to be performed

Sr. No.	**Unit No.**	**Practical Exercises** (Outcomes in Psychomotor Domain)	**Relevant CO**	**Approximate Hours Required.**
1	1	Study & use of various basic measuring instruments.	1	02
2		To find unknown angle of component using Sine-Bar, slip gauge and dial indicator	2	02
3	2	Use of dial indicator for run out measurement.	2	02
4		Study & use of pneumatic comparator	3	02
5	3	Measurement of different Parameters of screw thread by optical profile projector/ Tool maker microscope.	3	02
6		Study and use of Autocollimator/ Angle Dekker.	3	02
7		Measurement of gear tooth elements by using gear tooth Vernier.	3	02
8		Measurement of surface finish – Ra, Rz values.	4	02
9	4	Study of generalized measurement & identification of components	4	02
10		Study & detection of different types of errors in any one measurement system	5	02
11		Calibration of pressure gauge using Dead weight Tester	5	02
12	5	Temperature Measurement using thermocouples, pyrometers.	5	02
13		Displacement measurement using Linear variable differential transducer.	5	02
14	6	Force measurement on load cell demonstrator.	5	02
15		Speed measurement with Magnetic pickup transducer/ Stroboscope	5	02
16	All	Complete a micro project based on guidelines provided in Sr. No. 11	1 to 5	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 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	Vernier, micrometers of various types, vee block, spirit level, combination set, gauges	1
2	Dial indicator, Pneumatic comparator, sine bar	2,3,4
3	Optical profile projector, tool maker's microscope	5
4	Autocollimator, Angle Dekker	6
5	Gear tooth Vernier, Parkinson's gear tester	7
6	Surface roughness tester	8
7	Various transducers	9,10,11,12,13,14,15

7. THEORY COMPONENTS:

Unit Outcomes (UOs) (in the cognitive domain)	Topics and Sub topics
Section I	
Unit-I. Introduction to Metrology (10 Hrs, 12 Marks)	
1a. Explain the testing parameters used for the given instrument. 1b. Select relevant measuring instrument for the given job with justification. 1c. Calculate the least count of all basic instruments. 1d. Identify the errors in given instrument. 1e. Select slip gauges to be used along with sine bar for given job. 1f. Select angular measuring instrument for the given job.	1.1 Definition of metrology, objective of metrology, Need of inspection. 1.2 Static characteristics of instruments – Least count (resolution), range and span, accuracy and precision, reliability, calibration, hysteresis, dead zone, drift, sensitivity, threshold, repeatability, reproducibility, linearity, Amplification, Magnification. Dynamic characteristics of instruments - speed of response, fidelity, overshoot. 1.3 Errors- Sources of errors, Types of errors, sine and cosine errors, Abbe's principle of alignment, factors affecting accuracy. 1.4 Selection of instruments, general precautions of

Unit Outcomes (UOs) (in the cognitive domain)	Topics and Sub topics
	instruments. 1.5 Standards in Measurement: Definition and introduction to Line standard & end standard, wavelength standard 1.6 Study of sine bar, slip gauges (With Numericals on setting of slip gauges) 1.7 Angular Measurement: Bevel protractor, spirit level, Sine Bar, Angle Gauges (With Numerical on Setting of Angle Gauges).
Unit II. Limits, Fits, Gauges and Comparators (10 Hrs, 12 Marks)	
2a. Apply limits, fits and tolerances on the given job. 2b. Select the gauges for the given job with justification. 2c. Select slip gauges for adjusting adjustable snap gauge. 2d. Explain construction and working of given comparator.	2.1 Limits Fits and tolerances: Concept of Limits, terminology, Selective Assembly, Interchangeability. 2.2 Indian standard (IS 919-1993), types of fits, Hole and Shaft Basis System, (Numericals on finding the limit and tolerances of hole and shaft assembly) 2.3 Gauges: Limit gauges. Taylor's principle of gauge design, Plug, Ring Gauges, snaps gauges, adjustable snap gauges. 2.4 Comparators: Definition, Requirement of good comparator, Classification, use of comparators, Working principle of comparators, Dial indicator, Sigma comparator, Pneumatic comparator.
Unit- III. Screw Thread, Gear and other Measurements (12 Hrs, 16 Marks)	
3a. Calculate screw thread parameters using given method. 3b. Explain the procedure of measuring the given gear parameters. 3c. Measure surface finish of the given component. 3d. Explain the procedure to check surface pattern by optical flat. 3e. Explain the procedure for Measurement by CMM.	3.1 Screw thread Measurements: Screw thread terminology, measurement of different elements such as major diameter, minor diameter, effective diameter, pitch, thread angle. Best size wire, two wire method, working principle of floating carriage dial micrometer, Thread gauge micrometer, Errors in threads. 3.2 Gear Measurement: Gear terminology, Analytical and functional inspection, Parkinson Gear tester, gear tooth Vernier, Profile projector, Errors in gears. 3.3 Meanings of surface texture and definitions, terminology as per Indian standard, methods of surface measurement -Ra, Rz and RMS values (Numericals on finding these values), Tomlinson's surface tester. 3.4 Flatness checking by optical flat. 3.5 Introduction to coordinate measurement machine (CMM).

SECTION II	
Unit IV Generalized Measuring System (10 Hrs, 12 Marks)	
4a. Identify different characteristics of given instrument. 4b. Classify the transducers for the given application. 4c. Identify the given contact and non-contact transducer with justification. 4d. Identify components in the control systems for boilers and ACs.	4.1 Generalized measuring system and its components. 4.2 Transducers: Classification of transducers- active and passive, contact, non-contact, Mechanical, Electrical, analog, digital. Applications of transducers. 4.3 Block diagram of automatic control system, closed loop system, open loop system, feedback control system, feed forward control system, servomotor mechanism. 4.4 Applications of control systems for boiler and air conditioners.
Unit-V Displacement, Speed and Temperature Measurement (12 Hrs, 14 Marks)	
5a. Select displacement measuring sensor in the given system with justification. 5b. Describe with sketches the use of speed measuring instrument for given system. 5c. Choose relevant instruments to measure temperature of given system. 5d. Describe with sketches the procedure of temperature measurement by given device.	5.1 Specification, selection and application of displacement transducer, LVDT, RVDT, Potentiometer. 5.2 Speed measurement: Tachometers-Classification Mechanical Tachometers: Revolution counters, Slipping Clutch Tachometer. Electrical tachometers: Eddy current Drag Cup Tachometer, Tachogenerator, Contact less Electrical tachometer - Inductive Pick Up, Capacitive Pick Up, Stroboscope. 5.3 Temperature measurement: Non-electrical methods- bimetal and liquid in glass thermometer, pressure thermometer. 5.4 Electrical methods- RTD, platinum resistance thermometer. 5.5 Thermoelectric methods - elements of thermocouple, law of intermediate temperature, law of intermediate metals.
Unit-VI. Flow and Miscellaneous Measurement (10 Hrs, 14 Marks)	
6a. Identify the flow meter for given situation with justification. 6b. Select relevant flow meter to measure flow in given system with justification. 6c. Identify relevant sound measuring device for the given situation with justification. 6d. Select the relevant humidity measuring device for the given system with justification. 6e. Select relevant dynamometer for measuring the given torque with justification	6.1 Flow measurement: Types of flow meters. Selection criteria for flow meters. Variable area meter - Rota meter, turbine meter. Anemometer - hot wire and hot film. Electromagnetic flow meter, ultrasonic flow meter. 6.2 Acoustics measurement- sound characteristics - intensity, frequency, pressure, power, sound level meter. 6.3 Humidity measurement - hair hygrometer 6.4 Force measurement -Tool Dynamometer (Mechanical type), Load cell 6.5 Shaft Power Measurement - Eddy Current Dynamometer,

8. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN:

Unit No.	Unit title	Teaching hours	Distribution of Theory Marks			Total
			R Level	U Level	A Level	
1	Introduction To Metrology	10	04	04	04	12
2	Limits Fits and Gauges and Comparators	10	04	04	04	12
3	Screw Thread, Gear and other Measurements	12	06	04	06	16
4	Generalized Measuring system	10	04	04	04	12
5	Displacement, Speed and Temperature Measurement	12	04	04	06	14
6	Flow and Miscellaneous Measurements	10	04	04	06	14
Total		**64**	**26**	**24**	**30**	**80**

9. SUGGESTED STUDENT ACTIVITIES:

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

a. Prepare journals based on practical performance in the laboratory.
b. Prepare charts showing a construction of different instruments.
c. Prepare charts of limits, fits and gauges.
d. Search information about various ISO standards of measurement.
e. Collect information of transducers and prepare charts of the same.

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. About 15-20% of the topics/sub-topics that are relatively simpler or descriptive are given to the students for self-directed learning and assess the development of the COs through classroom presentations.
c. Teachers need to ensure to create opportunities and provisions for co-curricular activities.
d. Guide student(s) in undertaking micro-projects.
e. Use Flash/Animations to explain the working of various instruments.
f. Teachers 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 them. In the first four semesters, the micro-projects are group-based. However, in the fifth and sixth semesters, it should preferably 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. 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 that 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 should submit a 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. Various charts.
b. Various models
c. Simple transducers.
d. Various PPTs on advanced topics.
e. Study of coordinate measurement machine (CMM)
f. Study of Parkinson's gear tester.

12. SUGGESTED LEARNING RESOURCES :-

S.N.	Title	Author	Publisher, Edition and Year of publication ISBN Number
1	Engineering Metrology	R. K. Jain	Khanna Publication, New Delhi ISBN: 978-81-7409-153-6
2	A text book of Engineering Metrology	I. C. Gupta	Dhanpat Rai and Sons, ISBN: 9788189928452,
3	Engineering metrology	K. J. Hume	Kalyani Publication, Ludhiana ISBN: 8170961823, 9788170961826
4	Mechanical Measurements & Instrumentation	A. K. Sawhney	Dhanpat Rai & Sons, New Delhi. ISBN: B01N5QABO6
5	Mechanical Measurements & Control	D. S. Kumar	Metropolitan Publications, New Delhi ISBN: 978-8120004382
6	Mechanical & Industrial Measurements	R. K. Jain	Khanna Publications, New Delhi ISBN: 978-8174091918

13. SOFTWARE/LEARNING WEBSITES:

1. Introduction to metrology: https://www.youtube.com/watch?v=HpIEeBtJupY&list=PLbMVogVj5nJSZiwuh_tp50dKry8mCxzKA&index=1
2. MQC terminologies: https://www.youtube.com/watch?v=jpHzjhYyKO4&list=PLbMVogVj5nJSZiwuh_tp50dKry8mCxzKA&index=2
3. Measurement errors: https://www.youtube.com/watch?v=7VNyyInaVsU&list=PLbMVogVj5nJSZiwuh_tp50dKry8mCxzKA&index=3
4. Angle plate, steel rule, spring calipers: https://w ww.youtube.com/watch?v= u8UW9O1UHCw&list PLbMVogVj5nJSZiwuh_tp50dKry8m CxzKA&index=4
5. Combination set, Vernier calipers: https://www.youtube.com/watch?v=SBGacenZ_80&list=PLbMVogVj5nJSZiwuh_tp50dKry8mCxzKA&index=5
6. Height gauge, micrometers: https://www.youtube.com/watch?v=ioyRjm-dSuI &list=PLbMVogVj5nJSZiwuh_tp50dKry 8mCxzKA&index=6
7. Micrometer, Bore gauge: https://www.youtube.com/watch?v=E7KWQTQOV3M&list=PLbMVogVj5nJSZiwuh_tp50dKry8mCxzKA&index=7
8. Dial indicators, thickness gauges, depth gauges: https://www.youtube.com/watch?v=xPUjQAtre7Q&list=PLbMVogVj5nJSZiwuh_tp50dKry8mCxzKA&index=8
9. Manufacturing tolerances and fits: https://www.youtube.com/watch?v=-_qz8_sbhwY&list=PLbMVogVj5nJSZiwuh_tp50 dKry8mCxzKA&index=9
10. Terminology of limits, fits and tolerances: https://www.youtube.com/watch?v=c8TKftViusQ&list=PLbMVogVj5nJSZiwuh_tp50dKry8mCxzKA&index=10
11. Numerical problems on fit and tolerances: https://www.youtube.com/watch?v=uAntebtIgCY&list=PLbMVogVj5nJSZiwuh_tp50dKry8mCxzKA&index=11
12. Selection of fits and tolerances: https://www.youtube.com/watch?v=rbk28swIiHU&list=PLbMVogVj5nJSZiwuh_tp50dKry8mCxzKA&index=12
13. Limit gauging: https://www.youtube.com/watch?v=OcbkOvjZujU&list=PLbMVogVj5nJSZiwuh_tp50dKry8mCxzKA&index=14
14. Surface finish parameters: https://www.youtube.com/watch?v=99zzBRKYLwQ&list=PLbMVogVj5nJSZiwuh_tp50dKry8mCxzKA&index=20
15. Screw thread terminology: https://www.youtube.com/watch?v=O7WvzU3FQ5c&list=PLbMVogVj5nJSZiwuh_tp50dKry8mCxzKA&index=23
16. Screw thread measurement:https://www.youtube.com/watch?v=xPGi2e-gOo8&list=PLbMVogVj5nJSZiwuh_tp50dKry8mCxzKA&index=24
17. Gears: https://www.youtube.com/watch?v=n1EzCOnZn3s&list=PLbMVogVj5nJSZiwuh_tp50dKry8mCxzKA&index=25

18. Angle measurement: https://www.youtube.com/watch?v=U_LMe40gxds&list=PLbMVogVj5nJSZiwuh_tp50dKry8mCxzKA&index=27
19. Comparators: https://www.youtube.com/watch?v=Hi7NUJdznc0&list=PLbMVogVj5nJSZiwuh_tp50dKry8mCxzKA&index=32
20. Pneumatic comparator: https://www.youtube.com/watch?v=TyM28gmhJcc&list=PLbMVogVj5nJSZiwuh_tp50dKry8mCxzKA&index=34
21. Universal testing machine: https://www.youtube.com/watch?v=cjzSXPDBA_Q&list=PLbMVogVj5nJSZiwuh_tp50dKry8mCxzKA&index=37
22. Generalized measuring system: https://youtu.be/oAdNKL8SgNY
23. Transducers: https://youtu.be/bfw_So5cCp4?list=PLVsrfTSlZ_40qYhVeqtLiNhnQ_40IfOyM
24. Temperature measurement: https://youtu.be/tg8M3uOJi2M

14. PO - CO MAPPING:

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

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

Sign: Names: Mr. N B Hirlekar, LME Dr. S. R. Adhau (Course Experts)	Sign: Name: Dr. N. G. Kulkarni. (Head of Department)
Sign: Name: Dr. N. G. Kulkarni. (Program Head) (Mechanical Engg. Dept.)	Sign: Name: Shri. A. .S. Zanpure. (CDC In charge)

Government Polytechnic, Pune

'180 OB' – Scheme

Programme	**Diploma in Mechanical Engineering**
Programme code	01/02/03/**04**/05/06/07/08/15/16/17/**18**/19/21/22/23/**24**/26
Name of Course	**Theory of Machines and Mechanisms**
Course Code	**ME 3105**
Prerequisite course code and name	**NA**
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>$OE</th><th>*PA</th><td rowspan="2">150</td></tr>
<tr><td rowspan="2">4</td><td rowspan="2">--</td><td rowspan="2">2</td><td rowspan="2">6</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, 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

In this machine age, it is necessary to know the mechanism of a machine to understand its functioning. The number of links transferring the forces and motion will comprise the mechanism.

This course deals with geometry of mechanism, velocity and acceleration of links, inversions of the kinematic chain, different power drives.

The course scope is kinematics and dynamics of machines, the role of friction, flywheels and governor, power transmission and application of cams.

3. COMPETENCY

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

- **Use principles of kinematics in the Design or maintenance of various equipment**

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. Illustrate Inversions of various mechanisms using basic definitions.
2. Calculate velocities and accelerations of various links of mechanisms using graphical solutions.
3. Justify the role of Flywheel, Governors, Brakes, and Clutches in Mechanical applications.
4. Draw cam profiles for various follower motions.
5. Calculate power transmitted by belt drives and Velocity ratios of various Gear trains.

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)	**Relevant CO**	**Approximate Hours Required.**
1	1	Identify the types of kinematic pairs and inversions of mechanisms in the various models available in the laboratory (sketches and explanation is expected) four bar, single slider ,double slider crank chains	1	4
2	1	Measure the ratio of time of cutting stroke to the return stroke in shaping machine available in institute's workshop by varying the stroke length. (Sketch or photograph of the mechanism is expected)	1	4
3	2	Determine velocity and acceleration of various links of the given mechanism (any two) by relative velocity method for analysis of motion of links (Minimum 2 problems on A3 size drawing sheet).	2	6
4	2	Determine velocity and acceleration in an I. C. engine's slider crank mechanism by Kleins's construction (Minimum 2 problems on A3 size drawing sheet).	2	2
5	3	Measure the lift of sleeve of the centrifugal governor for various speeds. Draw the turning moment diagram of four strokes I.C. Engine and define various terms related to flywheel and governor.	3	2

Sr. No.	Unit No.	**Practical Exercises** (Outcomes in Psychomotor Domain)	Relevant CO	Approximate Hours Required.
6	4	Identify different types of brakes and clutches such as band brake, block brake, single plate clutch, multiplate clutch, cone clutch, centrifugal clutch and observe their working by actually handling the working models. Demonstration of calculation of breaking torque on a dynamometer.	3	4
7	5	Draw the profile of a radial cam for given Follower motion (Minimum 3 problems on A3 size drawing sheet).	4	4
8	6	Collect information of belt drives, chain drives and gear drives by surveying different laboratories and workshop (Students will visit PE lab, App Mechanics Lab, workshop and take photographs and relevant information about drives and prepare report of it) i.e. velocity ratio, types of belts, types of gear drives etc.	5	2
9	All	Complete a micro project based on guidelines provided in Sr. No. 11	1 to 5	4
		Total Hrs		**32**

S. No.	Performance Indicators	Weightage in %
a.	Arrangement of available equipment or model	20
b.	Line work and presentation of graphical solutions of problems	20
c.	Safety measures	10
d.	Observations and Recording	10
e.	Mini Project	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	Experiment Sr. No.
1	Ackerman's steering gear mechanism and foot operated air pump mechanism, slider crank mechanism, elliptical trammel; skotch yoke mechanism, oldham's coupling, and hooks joint, inversions of four bar mechanisms.	1
2	Working models of locomotive coupler, Beam engine, Pantograph, Pendulum pump, Rotary I.C. engine mechanism, Oscillating cylinder engine, Whitworth quick return Mechanism, Quick return mechanism of shaper, Scotch Yoke mechanism, Elliptical trammel and Oldham's Coupling.	1
3	Working models of various cam follower arrangements for demonstration.	7
4	Working and cut section models of various types of brake assemblies.	6
5	Various types of clutch assemblies.	6
6	Working models of various types of governors.	5
7	Working models of various belt drives, chain and sprocket, various gear drives.	8
8	Working Models of Gear trains - all types. (Simple, compound, reverted, epicyclical).	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**
Unit-I Kinematics of Machines (08 Hrs, 12 Marks)	
1a. Identify various types of constraints of motions in the given mechanism with justification. 1b. Describe the constructional details of the given mechanism 1c. Select suitable mechanism for the given application with justification.	1.1 **Kinematics of Machines:** Introduction to Statics, Kinematics, Kinetics, Dynamics. Kinematic links, joints, pairs, chain and its types, Constrained motion and its types, Inversion, Mechanism, Machine and Structure. 1.2 **Inversions of Kinematic Chains:** Four bar chain – Locomotive coupler, Beam engine and Pantograph,

	Ackermann steering mechanism Single slider Crank chain – Pendulum pump, Rotary I.C. engine mechanism, Oscillating cylinder engine, Whitworth quick return Mechanism, crank and slotted lever quick return mechanism, hand pump. 1.3 Double Slider chain - Scotch Yoke mechanism, Elliptical trammel, Oldham's Coupling.
Unit-II Velocity and Acceleration in Mechanisms (12 Hrs, 12 Marks)	
2a. Draw dimensioned sketch of the given mechanism. 2b. Draw velocity diagram for a given mechanism using relative velocity method. 2c. Draw acceleration diagram for the given mechanism. 2d. Draw velocity and acceleration diagram for the given mechanism using Klein's construction. 2e. Estimate velocity and acceleration of any link at any instant in the given mechanism.	2.1 Concept of relative velocity and relative acceleration of a point on a link, angular acceleration, inter-relation between linear and angular velocity and acceleration. 2.2 Klein's construction to determine velocity and acceleration of different links in single slider crank mechanism. 2.3 Drawing of velocity and acceleration diagrams for simple mechanisms. Determination of velocity and acceleration of a point on link by relative velocity method.
Unit-III Flywheel, Governor and Balancing (08 Hrs, 12 Marks)	
3a. Draw turning moment diagram for the given single cylinder 4-Stroke I.C Engine 3b. Explain the method of balancing a rotating mass as per the given conditions. 3c. Estimate the balancing mass and position of plane analytically and graphically in the given problem.	3.1 Flywheel-Introduction to flywheel – need, function and application of flywheel with the help of turning moment diagram for single cylinder 4-Stroke I.C Engine. 3.2 Coefficient of fluctuation of energy, coefficient of fluctuation of speed and its significance. 3.3 Governors- Introduction, types, functions and applications, Terminology of Governors. Comparison of Flywheel and Governor. 3.4 Balancing- Need and types of balancing, Balancing of single rotating mass, balancing of several masses revolving in same plane.
Unit-IV Friction (14 Hrs, 20 Marks)	
4a. Illustrate types of brakes. 4b. Explain various parts of the given brakes and Dynamometers with their functions and constructional details. 4c. Describe needs, functions and applications of the given clutches.	4.1 Introduction to Brakes – Types, Functions and Applications. 4.2 No numerical on brakes and dynamometer. 4.3 Construction and principle of working of i) Shoe brake, ii) Band brake iii) Internal

4d. Explain various parts of the given clutch with their functions and constructional details.	expanding shoe break iv) Disc brake. v) Hydraulic Brake 4.4 Braking force, braking torque and power for shoe and band brake. 4.5 Dynamometer- construction and working of Rope Brake, Hydraulic, Belt transmission, epicyclic gear train dynamometer. 4.6 Clutches-Uniform pressure and Uniform Wear theories. Introduction to Clutch - Types, Functions and Applications, Construction and principle of working of i) Single-plate clutch, ii) Multi-plate clutch, iii) Centrifugal Clutch iv) Cone clutch 4.7 Bearings – Analytical treatment to determine power absorbed in friction for flat collar and pivot bearings (conical pivot excluded)
Unit-V Cams and Follower (10 Hrs, 12 Marks)	
5a. Draw dimensioned sketch of the given cam and follower arrangement. 5b. Identify the type of motion of follower in the given situation with justification. 5c. Draw cam profile for the given motion of knife-edge and roller follower with and without offset application using Graphical method.	5.1 Introduction to Cams and Followers. Cam and follower terminology. Classification of Cams and Followers. Applications of Cams and Followers. 5.2 Types of follower motions and their displacement diagrams - Uniform velocity, Simple harmonic motion, uniform acceleration and retardation. 5.3 Drawing of profile of a radial cam based on given motion of reciprocating knife-edge and roller follower with and without offset.
Unit-VI Power Transmission (12 Hrs, 12 Marks)	
6a. Calculate velocity ratio, belt tensions, slip and angle of contact in the given belt drive. 6b. Estimate power transmitted and condition for maximum power transmitted in the given belt drive through simple numerical problem. 6c. Calculate Train value & velocity ratio for the given simple, compound, reverted and epicyclic gear trains using spur and helical gears. 6d. Select suitable drives for the given	6.1 Belt Drives – Introduction to flat belt, V-belt & its applications, materials used for flat and V-belts. Angle of lap, length of belt, Slip and creep. Determination of velocity ratio, tight side and slack side tension for flat belt, V- belt, centrifugal tension and initial tension, condition for maximum power transmission. Merits, demerits and selection of belts for given applications. 6.2 Chain Drives – Introduction to chain drives, Types of chains and sprockets,

application with justification.	Methods of lubrication. Merits, demerits of chain drives. 6.3 Gear Drives – Introduction to gear drives, Classification of gears, gear terminology, Types of gear trains, Train value & velocity ratio for simple, compound gear trains using spur gears. Merits, demerits and selection of gear drives for given applications.

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	Kinematics of Machine	08	6	6	-	12
II	Velocity Acceleration in Mechanisms	12	2	4	6	12
III	Flywheel, Governor and Balancing	08	2	4	6	12
IV	Friction	14	4	8	8	20
V	Cams and Follower	10	2	4	6	12
VI	Power Transmission	12	2	4	6	12
Total		64	**14**	**26**	**40**	**80**

9. SUGGESTED STUDENT ACTIVITIES

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

Students should conduct the following activities in groups and prepare reports of about five pages for each activity, also collect/record physical evidence for their (student's) portfolio, which will be helpful in their placement interviews:

a. Prepare journals based on practicals performed in laboratory.
b. Prepare charts of different clutch, Brakes, Dynamometers and chain drive
c. Compile information from the internet related to various mechanisms/elements like piston, crank, connecting rod, cam, clutch, brake, flywheel, governor, or animation of mechanism etc., along with functions and areas of application of each.
d. List the mechanisms which you are using in your day to day life. Sketch any three from these.
e. List the different mechanisms used in a typical car.
f. Identify and measure the dimensions of Flywheel used in automobile engines, generators, punching and riveting machines.
g. Identify the type of clutches used in different automobiles and the type of brakes in automobiles and bicycles.

h. Visit the market and collect the data of items used in any mechanisms. Data includes specifications, cost, applications, etc. Also, name the mechanism/s in which such item/s is/are used.

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/sub topics.
b. 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 COs through classroom presentations (see implementation guideline for details).
c. Guide student(s) in undertaking micro-projects.
d. Use proper equivalent analogy to explain different concepts.
e. Use Flash/Animations to explain various components and 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 them. 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. The concerned faculty could add similar micro-projects:

a. Prepare a working model of any one mechanism using low cost materials.
b. Prepare animations of various mechanisms using free software's available on internet.
c. A market survey of Friction Clutches based upon types and function.
d. Field survey to collect information about applications of transmission systems (Gears, belts and chain)
e. Field survey to collect information about applications of flywheels and governors.

Field survey for identification of mechanisms in automobiles (2 Wheeler, 4 Wheeler)

12. SUGGESTED LEARNING RESOURCES

S.N.	Title	Author	Publisher, Edition and Year of publication ISBN Number
1	Theory of Machines	Rattan S. S.	Tata McGraw-Hill Education, 1986 ISBN 9780070591202
2	Theory of Machines	Khurmi R. S., Gupta J. K.	S. Chand Publications, New Delhi, 2015 ISBN 9788121925242
3	Theory of Machines	Bevan Thomas	Pearson Education India, 1986, 3/e ISBN 9788131729656
4	Theory Of Machines and Mechanisms	Ballaney P.L.	Publisher Khanna, 2003, Edition 23, ISBN 9788174091222
5	A Text Book of Theory of Machines	Bansal R.K., Brar J. S.	Laxmi Publication, New Delhi, 2004, ISBN 9788170084181
6	Theory of Machines and Mechanisms	Joseph E. Shigley	OXFORD UNIVERSITY PRESS, Fifth Edition, ISBN 9780190264482
7	Mechanics of machines elementary theory and examples	J. Hannah & R.C. Stephens	Hodde; International student edition edition, ISBN-13: 978-0713132328

13. SOFTWARE/LEARNING WEBSITES

1. http://nptel.iitm.ac.in/video.php?subjectId=112104121
2. http://www.technologystudent.com/gears1/gears7.htm
3. http://kmoddl.library.cornell.edu/model.php?m=20
4. http://www3.ul.ie/~kirwanp/whatisacamandfollowersyste.htm
5. http://nptel.iitm.ac.in/courses/Webcourse-contents/IIT-
6. Delhi/Kinematics%20of%20Machine/index.htm
7. http://elearning.vtu.ac.in/12/enotes/Des_Mac-Ele2/Unit6-RK.pdf
8. en.wikipedia.org/.../Canadian_Committee_for_the_Theory_of_Machines...
9. global.oup.com/.../theory-of-machines-and-mechanisms-978019537123...
10. www.tecquipment.com/Theory_of_Machines.aspx
11. www.researchgate.net/.../0094-114X_Mechanism_and_Machine_Theory
12. www.journals.elsevier.com/mechanism-and-machine-theory/
13. journalseek.net/cgi-bin/journalseek/journalsearch.cgi?field=issn...
14. site.iugaza.edu.ps/wp-content/.../IUGAZA%20TOM2012_CH1-2.pdf
15. www.iftomm.org/
16. www.wiziq.com/online-tests/44047-mechanical-theory-of-machine
17. www.cs.ubc.ca/~murphyk/Teaching/CS340-Fall07/infoTheory.pdf

14. PO - COMPETENCY- CO MAPPING

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

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

Sign: Name Mr. R.R.Godbole Mr. B. B. Dome (Course Experts)	Sign: Name: Dr. N. G. Kulkarni (Head of Department)
Sign: Name: Dr. N. G. Kulkarni. (Program Head) (Mechanical Engg Dept.)	Sign: Name: Shri. A. .S. Zanpure. (CDC In charge)

Government Polytechnic, Pune

'180 OB' – Scheme

Programme	**Diploma in Mechanical 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 of Mechatronics**
Course Code	**ME 3106**
Prerequisite course code and name	**NA**
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	
1	0	2	3	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

Rapid development in Technology and the competitive economy has led to the development of new trends in the manufacturing Industry such as CNC Machines, Automation, and FMS, which consists of a combination of mechanical, electrical, and electronic systems referred to as Mechatronics. Diploma engineer in professional life has to operate and maintain systems being developed in Mechatronics. Because of this, he needs to understand fundamental facts, concepts, principles, and applications of Mechatronics systems which enables him to work as a technician to adopt an interdisciplinary approach of engineering while working on the shop floor/industry.

3. COMPETENCY

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

- **Use mechatronics systems for relevant 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. Identify various instruments, sensors, actuators, microprocessor, software, and mechanical components in mechatronics based systems.
2. Prepare block diagrams for basic applications.
3. Use sensors and actuators for different mechatronics applications.
4. Programme PLC for simple applications.
5. Use microprocessor and microcontroller for simple mechatronics based applications

5. SUGGESTED PRACTICALS/ EXERCISES

Sr. No.	**Unit No.**	**Practical Exercises** (Outcomes in Psychomotor Domain)	**Relevant CO**	**Approx. Hours Required.**
1*	1	Conduct a survey of manufacturers of various building blocks of mechatronic system	1	02
2*	1	Identify various types of sensors and actuators used in mechatronics systems in lab	1	02
3	2	Prepare small circuits using open and closed-loop controls for interfacing servomotors.	2	04
4*	3	Select sensors and actuators for a given application with justification.	3	02
5*	3	Prepare small circuits using different sensors Proximity Sensor – NPN, NO, PNP, Limit Switch, Opto sensors, Pressure sensors, Motor- 24V DC, interfacing facility with PLC used in Mechatronics systems.	2	04
6	3	Prepare small circuits using different transducers like linear and rotary transducers with PLC	3	04
7*	4,5	Identify various types of PLC and microprocessors used in mechatronics systems in the lab	4	02
8*	3,4	Prepare small circuits for i) Door open and close application, ii) Stamping iii) Raw material rejection system (anyone) using different actuators with PLC and its use in Mechatronics Systems	3, 4	04
9	4	Develop ladder diagram for simple light ON-OFF switch	4	04
10	4	Develop ladder diagram for pedestrian traffic controller (Yellow, Red, Green)	4	04
11*	5	Write a simple program for microprocessor (8085)/ microcontroller based application.	5	04
12*	1-5	Complete a micro project based on guidelines provided in Sr. No. 11	1-5	04
		Total Hrs		**32**

Note
A judicial mix of a minimum of 10 practicals needs to be performed, out of which the practical marked as '*' are compulsory.

S.No.	Performance Indicators	Weightage in %
a.	Arrangement of available equipment or model	20
b.	Setting and operation	20
c.	Safety measures	10
d.	Observations and Recording	20
e.	Interpretation of result and Conclusion	10
f.	Answer to sample questions	10
g.	Submission of the 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	PLC Trainer Kit with 12 DI,12 DO,2AI, and 2AO with ladder and SCADA software.	1 to 12
2	Basic Pneumatic Trainer Kit with manual and electrical controls/ PLC Control	1 to 12
3	Electro-pneumatic Trainer kit	1 to 12
4	Basic Hydraulic Trainer Kit	1 to 12
5	Hydraulics and Pneumatics Systems Simulation Software /Automation studio	1 to 12
6	BLDC, stepper motor and drive circuit sets.	1 to 12
7	AC servo and VFD trainer kit	1 to 12
8	Real-Time Temperature Controller	1 to 12
9	DC Motor Speed controller	1 to 12
10	Servo controller using Open/Closed-loop control system	1 to 12
11	Pneumatic Power circuit system	1 to 12
12	SCADA software (2000 points) with Siemens TIA portal educational bundle or equivalent Free Software	1 to 12
13	Pneumatic Power circuit system for Door close and open application, stamping application and raw material rejection system	1 to 12

7. THEORY COMPONENTS

Unit Outcomes (UOs) (in cognitive domain)	**Topics and Sub-topics**
Unit-I Introduction to Mechatronics (Hrs-02)	
1a. Compare with block diagram the features of the traditional and Mechatronics system for the given example 1b. Identify sensor, actuators, microprocessor techniques, software, and mechanical components in the given diagram of the mechatronics-based system with justification.	1.1 Introduction, Need, Scope, objectives, and importance 1.2 Traditional V/s Mechatronics Approach, 1.3 Block diagram representation of General Mechatronics system (key elements of mechatronics system) showing various components with suitable examples.
Unit-II Block Diagram Representation (Hrs- 02)	
2a. Describe basic elements of the given closed loop system. 2b. Build Blocks of Mechatronics 2c. List applications of Mechatronics system	2.1 Control System - Open and Closed Loop Systems, Basic Elements of closed loop system, Concept of Transfer Function, Block Diagram & Reduction principles. 2.2 Building Blocks of Mechatronics - Electronics, Instrumentation, Sensor, Actuators, Microprocessor techniques, Software, Mechanical Components. 2.3 Applications of Mechatronic systems such as washing machine, microwave oven, Flexible Manufacturing System.
Unit-III Sensors & Actuators (Hrs- 04)	
3a. Explain the working of the given sensor with sketch and block diagrams. 3b. Write specifications and features of the given sensor. 3c. Select relevant sensors for the given situation with justification. 3d. Select the relevant actuator for the given situation with justification.	3.1 Introduction to Sensors, Transducers, and Actuators 3.2 Need, Classification of Sensors and Actuators. 3.3 Working and Application of- Potentiometer Sensors, Strain Gauge Elements, Capacitive Elements, Eddy Current, Proximity Sensors, Inductive Proximity Sensors, Light Sensors, Pressure Sensors, Pneumatic Sensors, Pyroelectric Sensors, Piezoelectric Sensors. 3.4 Electrical Actuation Systems - Electrical Systems Viz. Switching Devices, solenoid type Devices, Drive Systems, Mechanical Switches Viz. Debouncing, Keypads, Electro-Mechanical and Solid State Relays, Stepper Motors. 3.5 Selection of Sensor & Actuator.

Unit-IV Programmable Logic Controller (Hrs- 04)	
4a. Explain with sketches the working of the given PLC. 4b. Write specifications and features of the given PLC and power supply. 4c. Select the relevant PLC and power supply for the given situation with justification. 4d. Describe the procedure for installation, troubleshooting and maintenance of the given PLC.	4.1 Introduction, definition, Basic PLC functions, PLC block diagram, Difference between relay panel and PLC, 4.2 Power supply, input/output modules (analog, digital) concepts of sink/source, set/reset, latch/unlatch, 4.3 Advantages and disadvantages. 4.4 Installation, troubleshooting and maintenance. 4.5 Selection of a PLC, Programming equipment. 4.6 Introduction to Programming Formats, Ladder diagrams and sequence listing, PLC auxiliary commands and functions, Online, offline, stop/run modes of operations, uploading/ downloading between PLC and PC.
Unit-V Microprocessor and Mechatronics (Hrs- 04)	
5a. Explain the working of the microprocessor with sketches and block diagrams. 5b. Justify the use of D/A converters and A/D converters in the given application. 5c. Explain with sketches the working of the mechatronics devices in the given appliance.	5.1 Introduction, Architecture-Pin Configuration, Instruction set, 5.2 Interfacing input and output devices, Interfacing D/A converters and A/D converters, 5.3 Applications-Temperature control-Stepper motor control-Traffic light controller, 5.4 Introduction to ICs used for interfacing Comparison of microprocessor and microcontroller 5.5 Application of Mechatronics systems in Washing Machines, Desk Jet Printer, CNC Trainers, Pick and Place Robot, Automatic camera. 5.6 Introduction to IoT, general applications, the role of mechanical engineers in IoT.

8. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

NA

9. SUGGESTED STUDENT ACTIVITIES

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

a. Prepare journals based on practical performed in laboratory
b. Study of datasheets of electronic components.
c. Prepare charts of different sensors, actuators used in Mechatronics

d. Collect information of passive transducers and prepare charts of the same.
e. Collect information of different PLC's

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/sub topics.
b. 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 COs through classroom presentations (see implementation guideline for details).
c. For item No.8, teachers need 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, operations 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 them. 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 that 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 should submit a 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 ladder diagram for simple applications of PLC in Soft drink vending machine
b. Develop ladder diagram for simple applications of PLC in bottle filling plant.
c. Compare PLC of various brands based on applications.
d. Develop a digital display board.
e. Prepare a report on the use of mechatronics elements in the washing machine, lift, microwave oven, ATM, etc.

12. SUGGESTED LEARNING RESOURCES

S.N.	Title	Author	Publisher, Edition, and Year of publication, ISBN Number
1	Mechatronics Integrated Mechanical electronic system	K.P. Ramachandran G.K. Vijayraghavan M.S. Balsundaram	John Wiley & sons, 2013 ISBN- 9788126518371
2	Mechatronics	Bolton W.	Addison Wesley Longman Ltd., U.S.A. 1999, ISBN: 9780582357051
3	Mechatronics	H.M.T.	McGraw-Hill Education, New Delhi, 2000, ISBN: 0074636435
4	Mechatronics Electronics in Production and Process	Dawson D.A., Burd N.C., Loader A.J.	Chapman-Hall, 1993; Taylor & Francis, ISBN: 9780748757428
5	Introduction to mechatronics and Measuring Systems	Histand Michael B. Alciatore David G.	McGraw-Hill, New Delhi, 2003 ISBN: 9780072402414
6	Mechanical Measurements and Instrumentation	Sawhney Puneet, Sawhney A.K.	Dhanpat Rai and Sons, 2013, New Delhi. ISBN- 1234102781

13. SOFTWARE/LEARNING WEBSITES

1. www.cesim.com/simulations
2. www.scilab.org/scilab
3. www.ni.com/multisim
4. www.youtube.com /electric circuits
5. www.dreamtechpress.com /ebooks
6. www.nptelvideos.in/electrical engineering/ circuit theory
7. www.learnerstv.com/free-engineering
8. www.orcad.com/resources/orcad-downloads

14. PO - COMPETENCY- CO MAPPING

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

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

Sign: Name Dr. A AGadhikar (Course Experts) Sign: Mr. S.S.Harip (Course Experts)	Sign: Name: Dr. N. G. Kulkarni. (Head of Department)
Sign: Name: Dr. N.G.Kulkarni (Program Head) (Mechanical Engg Dept.)	Sign: Name: Shri. A.S.Zanpure (CDC In charge)

Government Polytechnic, Pune

'180 OB' – Scheme

Programme	**Diploma in Mechanical Engineering**
Programme code	01/02/03/**04**/05/06/07/08/15/16/17/**18**/19/21/22/23/**24**/26
Name of Course	**Computer Aided Drafting**
Course Code	**ME3107**
Prerequisite course code and name	**NA**
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">100</td></tr>
<tr><td rowspan="2">00</td><td rowspan="2">00</td><td rowspan="2">04</td><td rowspan="2">04</td><th>Marks</th><td>00</td><td>00</td><td>50</td><td>50</td></tr>
<tr><th>Exam Duration</th><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

The latest requirements in the Industry demand frequent changes in product design to suit the customer needs. With the introduction of computers, incorporating frequent changes as per requirement is becoming simpler. Moreover, the technology-driven competitive environment in today's market is compelling design. The main aim of this course is to provide the students with hand-on experience in drafting and editing an industrial production drawing using one of the commercial computer Aided Drafting software with particular emphasis on the application of CAD software.

3. COMPETENCY

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

- **Prepare digital drawing by using CAD 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 competency mentioned above**:**

1. Draw CAD drawing files in drafting setup.
2. Modify 2D and isometric drawing.
3. Integrate layers and blocks in the drawing.
4. Develop customized drawing template.
5. Print drawing.

5. SUGGESTED PRACTICALS/ EXERCISES

Sr. No.	**Unit No.**	**Practical Exercises** (Outcomes in Psychomotor Domain)	**Relevant CO**	**Approximate Hours Required.**
1	1	Identify and locate components of CAD classic screen by creating new drawings.	1	4
2	2	Draw a line diagram using the absolute coordinate method. Use LIMITS, UNITS, LINE, ARC Commands	1	6
3		Draw a line diagram using relative coordinate and relative polar coordinate method.	1	6
4	2 & 3	Draw a 2D figure using Draw and Modify commands. Use LINE, CIRCLE, OFFSET, TRIM, FILLET Commands.	2	6
5		Draw a 2D figure using Draw and Modify commands. Use LINE, ARC, POLYGON, ELLIPSE, COPY, MIRROR, TRIM, ROTATE, CHAMFER commands.		6
6.		Draw 2D drawing of the mechanical component using required commands. (anyone component like gear, pulley, bearing etc. may be selected)		6
7	4	Dimension the object. Open the previously saved file and dimension the lines, arc, circle, polygon etc.	5	6
8		Plot the drawing from the model space and print it.		6
9	5	Draw isometric drawing of mechanical components. Use LIMITS, UNITS, ZOOM, GRID, SNAP, LINE, COPY, ISOPLANE, ELLIPSE, TRIM, ERASE, PROPERTIES, SAVE Commands	2	6
10	6	Create the customized template, draw the title block using LAYER, RECTANGLE, EXPLODE, TEXT, AND COPY Commands.	3,4	6
11	All	Complete a micro project based on guidelines provided in Sr. No. 11	1 to 5	6
		Total Hrs		**64**

Sr. No.	Performance Indicators	Weightage in %
a.	Using drafting set up /aids	10
b.	Drawing diagrams of 2D or isometric given figure	15
c.	Dimensioning figure	10
d.	Answer the question	5
e.	Submission of drawing in time	10
	Total	**50**

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	CAD workstation with latest configuration for each student	1,2,3,4,5, and 6
2	LCD projector	1,2,3,4,5, and 6
3	Licensed latest version of computer aided software	1,2,3,4,5, and 6
4	Windows 7 operating system or latest operating system	1,2,3,4,5, and 6
5	Laser printer	1,2,3,4,5, and 6

7. THEORY COMPONENTS

Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
Unit-I CAD Basics	
1a. Identify components of CAD screen. 1b. Describe the procedure to Create new drawing 1c. Describe toolbar and commands. 1d. Describe the procedure to edit drawing	1.1 Getting acquainted with CAD, Starting CAD, CAD screen layout, drawing area, menu and toolbars, status bar 1.2 Creating a new drawing, working with toolbar and commands, changing drawing limits, creating rectangle etc. saving drawing for first time. 1.3 Opening and existing drawing file, CAD Cartesian workspace, working with drawing editor, closing a drawing and exiting from CAD
Unit-II Drawing in Two Dimensions	
2a. State drafting setup 2b. Describe the procedure to create 2D drawing with draw commands. 2c. Identify and select draw commands for particular drawing	2.1 **Drafting setup:** units, angle, area, coordinate system, limits, grid, object snap, line type and line weight 2.2 **Draw commands:** Drawing line, polyline, spline, rectangles, polygons creating construction lines, creating rays 2.3 Drawing circles, arcs, ellipses, Donuts, placing points, changing points style, text

Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
2d. Describe the procedure to use view options for drawing	2.4 Creating two dimensional drawings using draw commands, 2.5 Viewing your drawing- zoom, pan, window, aerial view, viewport, undoing and redoing action, save and exit
Unit-III Modifying the Drawing	
3a. Modify the 2D drawing with edit commands 3b. Identify and select proper edit command for particular editing 3c. Describe the procedure to Use edit commands 3d. Interpret draw and modify commands 3e. Describe the procedure to Change properties of drawing entities by Modify commands	3.1 Editing object, understanding object selection basic, erasing object, moving object, coping object, rotating object, scaling object, using change command. 3.2 Copying and moving object using MIRROR command, ARRAY command, offsetting object, resizing command, extending object, stretching object. 3.3 Modify the created object using copy, mirror, hatch, divide, explode, join, pedit, offset, array,
Unit-IV Dimensioning, Layout and Printing	
4a. Identify dimensioning techniques 4b. Describe the procedure to Use annotate menu for dimensioning drawing 4c. Describe the procedure to Create hatching 4d. Describe the procedure to Set up layout for printing 4e. Describe the procedure to Carry out printing of drawing	4.1 Dimensioning/annotating your drawing-Working with annotation, adding text in drawing, modifying and formatting multiline text 4.2 Hatching 4.3 Adding dimensions- dimensioning concept, adding linear, radial, angular dimensions, adding notes to your dimensions 4.4 Setting up layout- printing concept, creating view ports, setting up layouts, guideline for layouts 4.5 Printing your drawing: Preparing drawing for plotting or printing, creating layout in paper space, working with plot style, plotting a drawing- choosing a plotter/printer, preview/creating the plot
Unit-V Isometric Drawing	
5a. Create an isometric environment. 5b. Identify isometric setup 5c. Classify circle and iso-circle 5d. Select proper plane for isometric drawing 5e. Describe the procedure to draw isometric drawing	5.1 Isometric mode- grid, snap, standard/isometric 5.2 Isoplane-orientation of crosshairs, isotop, isoright and isoleft 5.3 Drawing isometric circles- set isoplane, use ellipse-isocircle 5.4 Isometric text- oblique angle, rotation angle, style, dynamic text 5.5 Creating isometric drawing

Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
Unit-VI Drawing Organization and information	
6a. Describe the procedure to create customized template 6b. Interpret components in different layers. 6c. Describe the procedure to collect information from drawing 6d. Describe the procedure to insert proper block 6e. Describe layers and block design center	6.1 Creating new drawing with template 6.2 Working in layers 6.3 Getting information from your drawing- measuring objects, working with properties 6.4 Inserting blocks- inserting blocks from tool pallets, inserting block using insert, inserting block with design center

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 teach various topics/subtopics.
b. About 15-20% of the topics/sub-topics which are relatively simpler or descriptive 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. For item No.8, teachers need to create opportunities and provisions for co-curricular activities.
d. Guide student(s) in undertaking micro-projects.
e. Correlate subtopics with power plant systems and equipment.
f. Use proper equivalent analogy to explain different concepts.
g. Use Flash/Animations to explain various components, operation
h. Teachers 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 them. 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 that integrate PrOs, UOs and ADOs (Affective Domain Outcomes). Each student will have to maintain a dated work diary of individual contributions to the project work and give a seminar presentation before submission. The student should submit a 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. Plot the drawing developed in Sr. no. 5 practical no. 6 & 7 using model space
b. Conduct survey of Commercial CAD software's-based Feature sets, Cost, Integration with other software learning resources & technical support basis
c. Prepare a 2D drawing of any one of the following machine components/devices using any CAD software for
   - Fasteners
   - Couplings
   - Bearings
d. Prepare an isometric drawing of any one of the following machine components/devices using any CAD software
   - Fasteners
   - Couplings
   - Bearings

12. SUGGESTED LEARNING RESOURCES:

NA

13. SOFTWARE/LEARNING WEBSITES:

1. www.nptel.com
2. http://www.mycadsite.com/tutorials/level_3/isometric-drawing-in-autocad-3-2.htm
3. http://www.cadlearning.com/courses/autocad-mechanical-training-tutorials/,
4. http://www.staff.city.ac.uk/~ra600/ME1105/Tutorials/CAD-1/Tutorial%20CAD-1a.pdf

14. PO - COMPETENCY- CO MAPPING

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

	PSO1	PSO2
CO1	3	1
CO2	3	1
CO3	3	1
CO4	3	1
CO5	3	1

Sign: Name: Mrs. V. G. Talkit (Course Experts) Sign: Name: Mrs. P. S. Sarode (Course Experts)	Sign: Name: Dr. N. G. Kulkarni (Head of Department)
Sign: Name: Dr. N. G. Kulkarni. (Program Head) (Mechanical Engg. Dept.)	Sign: Name: Shri A. S. Zanpure (CDC In charge)

Government Polytechnic, Pune

'180 O.B.' – Scheme

Programme	**Diploma in Mechanical Engineering**
Programme code	01/02/03/**04**/05/06/07/08/15/16/17/**18**/19/21/22/23/**24**/26
Name of Course	**Mechanical Engineering Materials**
Course Code	**MT 3108**
Prerequisite course code and name	**SC1106 Applied Chemistry**
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	125
02	00	02	04	Marks	80	20	00	25	
				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

This course in engineering materials is a part of acquiring basic and essential knowledge about materials used in engineering products and industry.

The course is useful for mechanical engineering to understand metallurgical aspects of materials, processes, and related problems encountered in industry. The course deals with classification, properties and application of materials with processes carried on them as well as testing of materials

3. COMPETENCY

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

- **Select appropriate materials for relevant Mechanical applications.**

4. COURSE OUTCOMES (C.O.s)

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 C.O.s associated with the competency mentioned above:

1. Identify properties of different materials.
2. Select proper ferrous alloy materials, nonferrous alloys, or Nonmetallic materials for various mechanical components.
3. Select relevant heat treatment processes to obtain desired structure and properties.
4. Perform destructive and non-destructive testing for the given material.

5. SUGGESTED PRACTICALS/ EXERCISES

Sr. No.	Unit No.	Practical Exercises (Outcomes in Psychomotor Domain)	Relevant CO	Approximate Hours Required.
1.	1	Measurement of mechanical properties such as the strength of any one ferrous alloy and nonferrous alloy using UTM.	1,4	04
2	2	Study of Iron carbon diagram of steel and cast iron	2,3	02
3		Assignment on Special Cutting Tool Materials – Diamond, Stelites & Tungsten Carbide tool steel of	2,3	02
4	3	Preparation and Examine the microstructure of steels and cast iron	2,3	04
5		Basic Heat treatment of steel and cast iron	2,3	04
6	4	Preparation and Examine the microstructure copper, aluminum alloys, bearing materials.	2	04
7	5	Assignment on other materials such as polymers, composites, Insulating, Ceramics etc.	2	02
8	6	Perform any one Non-Destructive Testing of given sample	5	04
9		Use relevant hardness tester to determine the hardness of given sample	5	02
10	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, Performing task, Following safety measures	50
b.	Observations, Interpretation and conclusion	30
c.	Answer to sample questions and submission in time	20
	Total	**100**

6. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

The major equipment with broad specifications 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	Fe-fe3c Phase diagram chart, Metallurgical Microscope and sample	2
2	Muffle Furnace. Sample, hardness tester and Metallurgical microscope, sample	3,4
3	Metallurgical microscope, microstructure set of nonferrous metals	5
4	NDT Setup level 1; UTM, Hardness tester	6

7. THEORY COMPONENTS

Unit Outcomes (U.O.s) (in the cognitive domain	**Topics and Sub-topics**
Unit-I Classification and Properties of Materials (04 Hrs, 10 Marks)	
1a. Compare /Classify the materials 1b. Understand Mechanical and Electrical properties 1c. Explain Metallic crystal structure 1d. Explain allotropy and advantages to be allotropic. 1e. Explain solid solution as strengthening mechanism.	1.1 **Classification of material:** Metals, non-metals, ceramics and glasses, polymers, composites and semiconductors (example and application) 1.2 **Mechanical properties:** Strength, elasticity, ductility, malleability, plasticity, toughness, hardness, hardenability, brittleness, fatigue, thermal conductivity, electrical conductivity, thermal coefficient of linear expansion 1.3 **Bonding in metals:** Metallic bond crystal structures (BCC, FCC and HCP) and allotropy of metals. 1.4 **Solid solution:** types and their condition.
Unit-II Ferrous Metal (10 Hrs, 24 Marks)	
2a. Draw, explain and compare Fe-Fe3c Phase diagram of steel and cast iron 2b. Explain and compare Alloy steel. 2c. Explain the effect of alloying element 2d. Explain properties and composition of tool steels 2e. Classify various cast iron 2f. Explain the properties of various grades of cast iron.	2.1 Characteristics and application of ferrous metals Phase equilibrium diagram for Iron and Iron Carbide 2.2 **Alloy Steels:** - Low alloy steel, high alloy steel, tools steel & stainless steel. Effect of various alloying elements such as – Chromium, nickel, manganese, molybdenum, tungsten, vanadium. 2.3 **Tool Steels:** - High-speed Steels (HSS), Hot & cold Working dies etc., properties & applications. 2.4 **Cast iron types:** White GCI, F.G., S.G., Malleable Alloy CI, Concept of castability & suitable production methods.

Unit Outcomes (U.O.s) (in the cognitive domain	**Topics and Sub-topics**
Unit-III Heat Treatment Process (04 Hrs, 12 Marks)	
3a. Explain the basic Heat treatments with advantages. 3b. Explain the advantages of tempering 3c. Explain surface hardening treatment with advantages. 3d. Compare nitriding with carburizing	3.1 **Heat treatment-**Introduction to Heat treatment processes such as Annealing, subcritical annealing, Normalizing, Hardening, Tempering (Austempering & Martempering) - Principle, Advantages, limitations and applications. 3.2 **Surface Hardening** - Methods of surface hardening, i) case hardening ii) Flame Hardening, iii) Induction Hardening, iv) Nitriding, v) Carburizing - Principle, advantages, limitations and applications, of Heat Treatments
Unit-IV Non-Ferrous Metals and Alloys (04 Hrs, 12 Marks)	
4a. Differentiate between properties, application and composition of various nonferrous alloys. 4b. Explain heat treatment of aluminum alloys	4.1 **Properties, applications & chemical compositions** Properties, applications & chemical compositions of Copper alloys (naval brass, muntz metal, Gun metal & bronzes), Aluminum alloys (Y-alloy & duralumin) & bearing materials like white metals, leaded bronzes & copper lead alloys. 4.2 Heat treatment of Aluminum alloys
Unit-V Other Engineering Materials (06 Hrs, 12 Marks)	
5a. Explain properties, advantages and uses of various polymeric materials, 5b. Explain types and properties of ceramic materials, 5c. Explain insulating materials. 5d. Explain composites	5.1 **Polymeric Materials** – Introduction to Polymers-types of polymer, Introduction, characteristics, properties and application of Thermoplastic, Thermosetting plastic, and Rubber. 5.2 **Properties and applications of following Engineering Materials** – Ceramics, Abrasive, Adhesive and Insulating materials such as Cork, Asbestos, Thermocole and Glass Wool 5.3 **Composites:** Fibre-reinforced plastics, Metal-Metrix composites, Nano-materials
Unit-VI Testing Inspection and Examination of Materials (04 Hrs, 10 Marks)	
6a. Compare NDT and D.T. 6b. Explain Dye Penetrant test principle, working and applications 6c. Explain any one D.T.	6.1 **Non Destructive Testing**: Advantages of NDT, Dye penetrant test (DPT), Magnetic particle test (MPT), eddy current test, Ultrasonic, X-ray. Inspection: Visual, optical. 6.2 **Destructive Testing:** On UTM, Hardness

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	Classification & properties of materials	04	2	4	4	10
II	Ferrous Metal	10	4	8	12	24
III	Heat Treatment Process	04	2	4	6	12
IV	Non Ferrous Metals and Alloys	04	2	4	6	12
V	Other Engineering Materials	06	2	4	6	12
VI	Testing, Inspection and Examination of materials	04	2	4	4	10
Total		**32**	**14**	**28**	**38**	**80**

9. SUGGESTED STUDENT ACTIVITIES

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

Students should conduct the following activities in groups and prepare reports of about five pages for each activity, also collect/record physical evidence for their (student's) portfolio, which will be helpful in their placement interviews:

a. Prepare a comparative chart of overall specifications of materials of the same class
b. Survey of materials used in automobiles/ mechanical machines.
c. Search information about ASTM specifications of NDT or D.T. test.
d. Prepare posters to illustrate the microstructure of steels or nonferrous alloys.

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/sub topics.
b. 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 C.O.s through classroom presentations (see implementation guideline for details).
c. For items No. 3 & 6, teachers need to create opportunities and provisions for ***co-curricular activities***.
d. Guide student(s) in undertaking micro-projects.
e. Use Flash/Animations to explain various components, operations and
f. Teachers 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 them. In the first four semesters, the micro-project is group-based. However, in the fifth and sixth semesters, it should preferably 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. 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 C.O.s that integrate PrOs, U.O.s and ADOs (Affective Domain Outcomes). Each student will have to maintain a dated work diary of individual contributions to the project work and give a seminar presentation before submission. The student should submit a micro-project by the end of the semester to develop the industry-oriented C.O.s.

A suggestive list of micro-projects is given here. The concerned faculty could add similar micro-projects:

a. Comparative study: Comparative study of various materials used in previous and current generation components of mechanical engineering equipment like I.C. Engine, Compressor, turbine, pumps, refrigerator, water cooler, Lathe Machine, Milling Machine, Drilling Machine grinding machine (anyone) with proper justifications.
b. Experimentation: Determine the hardness of different metallic components (min. five), compare hardness, and plot a bar chart indicating the hardest and soft material in the given group.
c. Experimentation: Determine the microstructure of different metallic components (min. five) using a Metallurgical microscope and compare their microstructure among the group.
d. Collection: Collect a sample of various types of plastics, ceramics, composites used in day to day applications and prepare a chart containing properties applications of the samples.
e. Collect information related to Types, Properties and applications of smart materials from websites. Present the information in the form of a Chart.

12. SUGGESTED LEARNING RESOURCES

S.N.	Title	Author	Publisher, Edition and Year of publication, ISBN Number
1	Material Science And Metallurgy	O.P. Khanna	Dhanpat Rai & Sons, Delhi ISBN-13:9789383182459 ISBN-10:9383182458
2	Material Science And Metallurgy	Dr. Kodgire	Everest Publishing House ISBN-13:9788186314008
3	Material Science And Engineering	R.K. Rajput	S.K. Kataria and Sons ISBN-13:9788185749686 ISBN-10:818574968X

4	Engineering Materials Properties And Selection	Kenneth G.	Budinski And Micheal K. Budinski Prentice Hall of India Pvt. Ltd. ISBN-13:9780137128426 ISBN-10:0137128428
5	Material Science And Processes	S.K. Hazra Chaudhary	Indian Book Distribution Company ISBN-9780906216002
6	Engineering Materials	C.P. Sharma	Prentice-Hall of India Pvt. Ltd. ISBN- 978-81-203-2448-0

13. SOFTWARE/LEARNING WEBSITES

1. www.nptel.com
2. http://www.capabiltydevelopment.org

14. PO - COMPETENCY- CO MAPPING

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

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

Sign: Name: Mr. P. B. Kamble (Course Experts) Sign: Name: Mrs V. G. Talkit (Course Experts)	Sign: Name: Prof. Namita S. Kadam (Head of Metallurgy Department)
Sign: Name: Dr. N. G. Kulkarni. (Program Head) (Mechanical Engg Dept.)	Sign: Name: Shri. A. .S. Zanpure. (CDC In charge)

Government Polytechnic, Pune

'180 OB' – Scheme

Programme	Diploma in Mechanical Engineering
Programme code	01/02/03/**04**/05/06/07/08/15/16/17/**18**/19/21/22/23/**24**/26
Name of Course	**Manufacturing Processes**
Course Code	**WS 3101**
Prerequisite course code and name	**NA**
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	04	06	**Marks**	80	20	25	25	150
				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

Diploma engineers require the knowledge of core principles of manufacturing processes to design and manufacture industrial equipment, machine parts, transport systems, and others. This subject helps the students perform various operations on Lathe, Shaper, Planner, Slotting machine and Press and perform metal cutting, Mechanical working of metal, Foundry technology and welding and related processes.

3. COMPETENCY

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

- **Produce components using manufacturing processes.**

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. Interpret various manufacturing processes, pattern making and molding principles for a given job.
2. Use lathe and shaping machine for given Job.
3. Select different press operations and dies for a given job.
4. Select Hot and cold working operations & foundry operations for a given job.
5. Use different welding machines for a given Job.

5. SUGGESTED PRACTICALS/ EXERCISES

Sr. No.	Unit No.	Practical Exercises (Outcomes in Psychomotor Domain)	Relevant CO	Approximate Hours Required.
1.	2	One job involving plain turning, step turning, taper turning and threading (v).	2	14
2.	3	Demonstration of simple job involving various operations on shaping machine	2	08
3.	6	One job of thermocol pattern or wooden pattern in group.	1	10
4.	6	Demonstration of simple job of casting / molding	4	08
5.	6	Demonstration of simple job of forging / smithy	4	08
6.	7	One job in welding involving different operations/- spot welding, TIG and MIG welding	5	12
7.	All	Complete a micro project based on guidelines provided in Sr. No. 11.	1 to 5	04
		Total Hrs.		**64**

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/ INSTRUMENT 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	Centre Lathe machine (Length between centers:2000)	1
2	Shaping machine (Maximum stroke length :up to 150mm)	2

3	TIG /MIG Welding set up with a suitable specification	6
4	Pattern making, molding and casting shop with the necessary equipment	3,4,5

7. THEORY COMPONENTS

Unit Outcomes (UOs) (in cognitive domain)	**Topics and Sub-topics**
Unit I: Basic Manufacturing Processes (04 Hrs, 06 Marks)	
1a Classify manufacturing processes. 1b Identify different types of manufacturing processes.	1.1 Manufacturing processes, Definition, Classification 1.2 Shaping processes, Metal forming Processes. 1.3 Joining processes, Surface finishing processes.
Unit II: Lathe and Lathe Work (06 Hrs, 14 Marks)	
2a. Explain the procedure of performing the given lathe machine operation on a job with sketches. 2b. Explain cutting speed, feed and depth of cut for the given job in different operations with sketches.	2.1 Introduction, classification, working principles, specifications of center lathe, basic parts and their functions, lathe accessories, attachments, operations. 2.2 Cutting parameters: speed, feed, depth of cut and estimation of machining time
Unit III: Shaper, Planer and Slotting Machine (06 Hrs, 14 Marks)	
3a. Explain working of shaper, planer and slotting machine with sketches. 3b. Explain the procedure of performing the given operation on a job with sketches.	3.1 Introduction, classification of shaper, planer and slotting machine 3.2 Construction, basic parts and their functions, working principle of Standard shaper, Standard double housing planer, Slotting machine (Puncher slotter and precision slotter). 3.3 Shaper operations: - Machining horizontal surface, machining vertical surface, Machining angular surface 3.4 Planer operations: -Planning flat horizontal surface, Planning vertical surface, Planning at an angular surface 3.5 Slotter operations:- Machining flat surface, Machining circular surface, Machining irregular surface or cams
Unit IV: Press and Press Work (03 Hrs, 10 Marks)	
4a. Explain different types of presses 4b. Explain functions of parts of the press with sketches. 4c. Explain types of dies in detail.	4.1 Introduction, types of presses. 4.2 Construction, basic parts of Fly press and Power press, Press Tools, Press operations. 4.3 Classification of dies, Die accessories: -

Unit Outcomes (UOs) (in cognitive domain)	**Topics and Sub-topics**
	Stop, Pilots, Strippers, Knockout and Press pad.
Unit V: Mechanical Working of Metal (03 Hrs, 08 Marks)	
5a. Differentiate between hot working and cold working. 5b. Explain with sketches hot working and cold working processes.	5.1 Introduction, Hot Working, Hot Rolling, Piercing or seamless tubing, Drawing, Deep Drawing, Hot Spinning, Extrusion. 5.2 Cold working, Cold rolling, Cold Drawing, Cold bending, Cold spinning, Cold Extrusion, Squeezing, Peening, Sizing, Coining, hobbing, Electro-hydraulic forming, Metallurgical aspects.
Unit VI: Foundry Technology (04 Hrs, 14 Marks)	
6a. Explain a pattern and mold for the given job. 6b. Explain casting process with sketches. 6c. Select a relevant furnace for the given raw material for with justification.	6.1 Introduction, Pattern-Materials, Tools, Types, Allowances, Core Prints, Core boxes, Color Code 6.2 Molding – Processes – Green Sand molding, molding machines. Casting – Die casting. 6.3 Furnaces- Classification of furnaces
Unit VII: Welding and Related Processes (06 Hrs, 14 Marks)	
7a. Explain joining processes with sketches. 7b. Select the relevant joining process for the given job with justification. 7c. Select the relevant soldering / brazing process for the given job with justification.	7.1 Introduction, Weldability, Types of welding, Metallurgy of welding, Gas Welding, Carbon arc welding, Oxy-acetylene welding, TIG welding, MIG welding, plasma arc welding, Oxy-hydrogen welding, Resistance welding, Solid state welding. 7.2 Related processes, Oxygen cutting, Hard facing, Bronze welding, Soldering, Brazing, Inspection and testing of welds, Welding joints and edge preparation, Welding of pipes, Representation of welds (Indian Standard), Safety in welding.

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	Basic manufacturing processes	04	02	02	02	06
II	Lathe and lathe work	06	04	04	06	14
III	Shaper, planner and slotting machine	06	04	04	06	14
IV	Press and press work	03	02	02	06	10
V	Mechanical working of metal	03	02	02	04	08
VI	Foundry technology	04	04	04	06	14
VII	Welding and related processes	06	04	04	06	14
Total		32	**22**	**22**	**36**	**80**

9. SUGGESTED STUDENT ACTIVITIES

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

Students should conduct the following activities in group and prepare reports of about five pages for each activity, also collect/record physical evidence for their (student's) portfolio, which will be helpful in their placement interviews:

a. Visit a Foundry shop, observe the Centrifugal / Die casting process, and identify the different defects on the component's surface.
b. Visit the plastic molding industry and collect information on types of molding machines, their specifications, and observe various activities performed in a molding process.
c. Visit an industry where the operations like drop forging, rolling and extrusion are carried out. Collect information on types of these machines and their specifications and observe various activities performed and output product characteristics.
d. Visit an industry /workshop to observe the process like seam, spot, TIG and MIG welding. Collect information on these machines' specifications and critically observe these processes to get information regarding various accessories (electrodes, current rating, etc.) used in these processes.
e. Collect information of recent advancements regarding manufacturing processes, machines /tools /equipment and their specifications/manufacturers and application in the industries.
f. Collect information on various forming processes used in industries. Observe the shape of input and output products and suggest suitable operations for various jobs.

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. About 15-20% of the topics/sub-topics, which is relatively simpler or descriptive, 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. For item No.9, teachers need 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 and operations.
g. The 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 them. 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, integration of PrOs, UOs and ADOs (Affective Domain Outcomes). Each student will have to maintain a dated work diary of individual contributions to the project work and give a seminar presentation before submission. The student should submit a 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. Prepare a cast product of different mechanical engineering drawing models with a wax material
b. Prepare various types of welding joints (with a metal component.) display them on the wallboard.
c. Fabricate types of keys like sunk key woodruff etc.
d. Prepare various pattern/ core/ core box etc., with suitable material.
e. Prepare a model of quick return mechanism using the wood material
f. Prepare a model of pulley and belt drive system used in the lathe.
g. Prepare a model of a direct extrusion process.

12. SUGGESTED LEARNING RESOURCES

S.N.	Title	Author	Publisher, Edition and Year of publication ISBN Number
1	Manufacturing Engineering Hand book	HwaiyuGeng	McGraw Hill, New York, 2000, ISBN: 9780071398251
2	Workshop Technology, Volume- I and II	Raghuvanshi B. S.	Dhanpat Rai Publications, New Delhi, 2009 ISBN: 100470534915
3	Production Technology (Manufacturing Processes)	Sharma P. C.	S.Chand and Company, New Delhi, 2013ISBN: 9788721911146
4	Textbook of Production Technology	Khanna O. P.	Dhanpat Rai Publications, New Delhi, 2010ISBN: 9788189928322
5	Textbook of Foundry Technology	Khanna O. P.	Dhanpat Rai Publications, New Delhi, 2010ISBN: 9788189928346
6	Elements of Workshop Technology- Volume- I and II	ChoudharyHajara	S.K., Media Promoters and Publishers Limited, Mumbai, 2005ISBN: 9788185099156
7	Workshop Technology, Volume- I and II	Bawa H. S.	McGraw Hill, New York, 2011ISBN: 13EBK0009651
8	Workshop Technology, Volume- I and II	Chapman W.	Taylor and Francis, New Delhi, 1995ISBN: 139780415503020
9	Material and Processing in Manufacturing	Black J. T.	Kosher Ronald A., Wiley India Pvt. Ltd., New Delhi, 1999ISBN: 9788126540464

13. SOFTWARE/LEARNING WEBSITES

1. http://nptel.ac.in
2. www.basicmechanicalengineering.com/lathe-machine-operations-basic-turning
3. www.makeengg.net/2016/operation-performed-on-shaping-machine.html
4. www.protolabs.com/injection-molding/plastic-injection-molding.html
5. www.thelibraryofmanufacturing.com/forming-basics.html
6. www.themetalcasting.com/casting-process.html

14. PO - COMPETENCY- CO MAPPING

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

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

Sign: Name: Smt. P. S. Sarode (Course Experts) Sign: Name: Shri. R. S. Solanke (Course Experts)	Sign: Name: Dr. N. G. Kulkarni (Head of Department)
Sign: Name: Dr. N. G. Kulkarni (Program Head) (Head of Department)	Sign: Name: Shri A. S. Zanpure (CDC In charge)

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	**NA**
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 (e.g., solar/wind)	4	04
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. N. G. Kulkarni. (Program Head) (Mechanical Engg Dept.)	Sign: Name: Shri. A. S. Zanpure. (CDC In charge)

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	**Nil**
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></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>00</td><td>00</td><td>50</td></tr>
<tr><td>Exam Duration</td><td>2Hrs</td><td>1/2Hr</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

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 I: Review of Conventional Sources of Energy 02 Hrs 04 Marks	
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 II:Solar Energy and its Applications 12 Hrs. 14 Marks	
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 III:Wind Energy and Energy from Biomass 12 Hrs. 14 Marks	
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 IV: Geothermal and Tidal Energy 06 Hrs. 08 Marks	
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 Expert /s)	Sign: Name: (Head of Department) (Electrical Engineering Dept.)
Sign: Name: Dr. N. G. Kulkarni. (Program Head) (Mechanical Engg Dept.)	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	**NA**
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	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

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 I. Introduction to Economics(06 Hrs, 08 Marks)	
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 II Demand Analysis (06 Hrs, 08 Marks)	
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 III Elements of Business/Managerial Economics(12 Hrs, 12 Marks)	
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 IV National Income, Finance and Banking (08 Hrs, 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 (Course-Expert) N.V.Gondane (Course-Expert)	Sign: Name: Smt. P.V. Toshniwal(Kalantri) (Head of Department)
Sign: Name: Dr. N. G. Kulkarni. (Program Head) (Mechanical Engg Dept.)	Sign: Name: Shri. A. S. Zanpure. (CDC In charge)

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	**NA**
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">50</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>00</td><td>00</td></tr>
<tr><td>Exam Duration</td><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 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 I ETHICAL SOURCING (06 Hrs 08 Marks)	
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 II SUSTAINABILITY (08 Hrs,10 Marks)	
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 III ETHICAL AND SUSTAINABLE SUPPLY CHAIN (10 Hrs,12 Marks)	
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 IV MATERIALS FOR SUSTAINABILITY (08 Hrs,10 Marks)	
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. N. G. Kulkarni. (Program Head) (Mechanical Engg Dept.)	Sign: Name: Shri. A. S. Zanpure. (CDC In charge)

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	**NA**
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	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

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	4
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	4
3		Study of Search Engine Optimization (SEO) using Digital marketing platform.	2	4
4		(A)Create the tracking id for web-site and track links (B) Analyze website traffic and leads using DM platform/tool	2	4
5		Read Analytics data. Read audience acquisition and behavior statistics	3	4
6		Generate different types of reports through Google Analytics	4	4
7		Study of any email marketing tool (Freeware)	5	4
8		Complete a micro project based on guidelines provided in Sr. No. 11	All Cos	4
		Total Hrs		**32**

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
S.No.	**Performance Indicators**	**Weightage in %**
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, 2nd Edition(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 Expert /s)	Sign: Name: Mr. U.V. Kokate Mr.Dr.S.B.Nikam (Head of Department) (Department of Computer Engineering)
Sign: Name: Dr. N. G. Kulkarni. (Program Head) (Mechanical Engg Dept.)	Sign: Name: Shri. A. S. Zanpure. (CDC In charge)

Level 4 - B Curriculum

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	**Entrepreneurship and Startup**
Course Code	**MA 4101**
Prerequisite course code and name	**NA**
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	00	00	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

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)	

Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
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], 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	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.

Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
justification. 4f. Describe role of the incubation centre for the given product/service.	

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. N. G. Kulkarni. (Program Head) (Mechanical Engg Dept.)	Sign: Name: Shri. A. .S. Zanpure. (CDC In charge)

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	**NA**
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">50</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>00</td><td>00</td></tr>
<tr><td>Exam Duration</td><td>2 Hrs</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

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 (06 Hrs, 08 Marks)	
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 (06 Hrs, 08 Marks)	
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
Unit-III Financial Management, Accounting and Material Management. (10 Hrs, 12 Marks)	
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. (10 Hrs, 12 Marks)	
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: G.W. Sonone (Course Expert)	Sign: Name: (Program Head) (Electronics &Telecommunication Dept.)
Sign: Name: Dr. N. G. Kulkarni. (Program Head) (Mechanical Engg Dept.)	Sign: Name: Shri. A. S. Zanpure. (CDC In charge)

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	**NA**
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	1/2 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

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) Lecturer in Metallurgical Engg.	Sign: Name: Smt. N. S. Kadam (Head of Department) Department of Metallurgical Engg.
Sign: Name: Dr. N. G. Kulkarni. (Program Head) (Mechanical Engg Dept.)	Sign: Name: Shri. A. S. Zanpure. (CDC In charge)

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	**NA**
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 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">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>00</td><td>00</td><td>50</td></tr>
<tr><td>Exam Duration</td><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

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 I 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 II 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 III 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 IV 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 Name: 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. N. G. Kulkarni. (Program Head) (Mechanical Engg Dept.)	Sign: Name: Shri. A. S. Zanpure. (CDC In charge)

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	**NA**
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	00	00	50
				Exam Duration	2Hrs	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

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 (04 Hrs, 06 Marks)	
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 (08 Hrs, 10 Marks)	
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 (08 Hrs, 10 Marks)	
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 (06 Hrs, 08 Marks)	
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 (06 Hrs, 06 Marks)	
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

1. https://blog.ipleaders.in/introduction-to-e-commerce-an-ultimate-guide/
2. https://noteslearning.com/what-is-e-commerce-introduction-types-and-importance/
3. https://www.techtarget.com/searchcio/definition/e-commerce
4. https://www.investopedia.com/terms/e/ecommerce.asp
5. https://www.rashminsanghvi.com/articles/taxation/electronic_commerce/chapter_1-introduction_to_Electronic_commerce.html
6. https://www.wix.com/blog/ecommerce/2021/05/what-is-ecommerce?utm_source=google&utm_medium=cpc&utm_campaign=9653627270^101840975426&experiment_id=^^440359935590^^_DSA&gclid=CjwKCAjwsJ6TBhAIEiwAfl4TWJGXfGvreFW VqzC9jOU7kEzUtBwc5pIGEPttv3t_woreXR1fP6KwPBoCFX4QAvD_BwE
7. https://ecommerceguide.com/guides/what-is-ecommerce/
8. https://www.bigcommerce.com/articles/ecommerce/#types-of-ecommerce
9. https://www.youtube.com/watch?v=nxSDHBdsWqA
10. https://www.youtube.com/watch?v=Zzs6kLlkAUQ

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. N. G. Kulkarni. (Program Head) (Mechanical Engg Dept.)	Sign: Name: Shri. A. S. Zanpure. (CDC In charge)

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	**NA**
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 (06 Hrs, 08 Marks)	
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 (06 Hrs, 08 Marks)	
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 (08 Hrs, 10 Marks)	
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 (06 Hrs, 08 Marks)	
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 (06 Hrs, 06 Marks)	
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 Expert)	Sign : Mrs.M. U. Kokate (Head of the Department) (Department of Information Technology)
Sign: Name: Dr. N. G. Kulkarni. (Program Head) (Mechanical Engg Dept.)	Sign: Name: Shri. A. S. Zanpure. (CDC In charge)

Level 4 - C Curriculum

Government Polytechnic, Pune

'180 OB' – Scheme

Programme	**Diploma in Mechanical Engineering**
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	**ME4101**
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**	
-	-	06	06	Marks	00	00	50	50	100
				Internship Duration	Six weeks 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

Note: Both ESE and PA part of the assessment will be carried out by institute faculty and industry training mentors as explained in Table 1, Table 2, and Table 3.

2. RATIONALE :

Employability competencies can be enhanced by exposing students to the actual real-time working environment in the industry . Industrial skills like soft skills, life skills, and hands-on skills will be inculcated among the students. Inplant training is the only way students learn to apply acquired knowledge to fulfill market demand and develop skills and competencies required to become employable.

3. COMPETENCY:

- **Develop soft skills and hands-on practices in the industrial environment**.

4. COURSE OUTCOMES:

Industry Inplant training is intended to acquire the competencies mentioned above to supplement those attained through several courses up to the fourth semester of the program:

1. Communicate effectively for executing assigned work.
2. Prepare a report of the executed work in the industry.
3. Exercise time management and safety in the work environment.
4. Work in teams for executing the given task.

5. GENERAL GUIDELINES FOR INDUSTRIAL TRAINING

a) **Period of Industrial Training:** Between 4^{th} and 5^{th} 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 industries / Organizations. However, despite the best efforts by the institute, if large and medium scale Industries / Organizations are not available to all students then, students can also be placed in small scale industries / Organizations.

Industry/ Organization 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, ordnance factories, textile factories, automobile manufacturers, or major automobile workshops

6. ROLE OF PARENT DEPARTMENT & THE INSTITUTE:

- **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	Finalize and prepare letter of	12^{th} – 16^{th} week of	Allocated faculty /

	placements	4^{th} Semester	Mentor
6	Organize 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 the training phase after the third week for assessment in coordination with industry personnel and feedback. Weekly assessment can be done through online mode.

7. FORMAT FOR TRAINING REPORT

Following is the suggestive format for the training report; the actual format may differ slightly depending upon the nature of the 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 used in industry with specifications, approximate cost and specific use, and their routine maintenance.

Chapter 4. Manufacturing Processes/Models along with planning , handling and control methods.

Chapter 5. Testing methods for raw materials, components and finished products along with quality assurance procedures.

Chapter 6. Safety and Maintenance procedures followed by Industry.

Chapter 7. Particulars of Hands on experiences in Industry / Organisation if any in Production/ Assembly/ Testing/Maintenance.

Chapter 8. Detailed report of the given Task . (if any done during the training)

Chapter 9. Special/challenging experiences encountered during training if any (may include students liking & disliking of workplaces)

Chapter 10. Conclusion

Chapter 11. References /Bibliography

8. SUGGESTED LEARNING & EVALUATION STRATEGIES/GUIDELINES

- Students should visit the industry website where they are undergoing training to collect information about products, processes, capacity, number of employees, turnover, etc.
- They should also refer to the handbooks of the major machinery and technical 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 for assessing the students' performance and soft skills.
- The scoring rubric, scoring schemes, and rating scales are developed to assess the students. 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 requires students to produce a substantial report to explain the organization's background, the overall training that has been performed, the specific projects they have conducted, and specific conclusions /solutions.
- The students must apply the skills of communicating using written language, outlining, organizing, and planning a report, using reference materials and sources, and following the above format.
- The student plays an important role in deciding what should be included in the logbook and learning to understand and evaluate their progress.
- In exceptional cases, online training can also be considered an option, provided the contents and the concerned authorities approve the assessment schemes.
- Student performance evaluation focuses on a student's work performance and personality. The scoring rubric forms are used that relate the assessment item to the learning outcome. 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 / Organization selection will depend upon the nature of the program and its related industry. The training activity may vary according to the nature and size of the Industry / Organization. The following table details a 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 jobs.	04
2	Week No. 2	Study the 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 the first week as per job assigned and nature of the industry)	04
4	Week No. 4	Study of QA/QC/Testing procedures.	04
5	Week No. 5	Study Safety and maintenance procedures 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: <u>Suggested Rubric for PA Assessment of Internships/Implant Training</u>

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 the 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 is not identified	Moderate Explanation of existing systems & Objectives of the proposed work is 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 is well defined	
Week No. 3: Execution of task	Execute/study Task. (Execution may start from the first week as per job assigned and nature of industry)	Minimal efforts and participation and poor understanding	Moderate efforts and participation and preliminary understanding	Good efforts and participation, and fair understanding	Extensive efforts and participation and well understanding	

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 Students cannot apply their knowledge on top of assessing what he/she knows	Applications are appropriate and well delivered Students can apply their knowledge on top of assessing what he/she knows.	
Week 5 : Study Safety & Maintenan ce Procedure	Study safety and maintenance procedures in an industry/organization .	Not very appropriate	Appropriate but not well delivered	Appropriate and well delivered Students cannot apply their knowledge on top of assessing what they know	Appropriate and well delivered Students can apply their knowledge on top of assessing what they know.	
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 a good manner Project work is not well summarized and concluded Future extensions in the project are not properly specified	Results are presented in a 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 the industry supervisor.

Signature of mentor
Name of mentor:

Table 3 Assessment Scheme ESE

		Contents (20 marks)	Presentation (30 marks)			Total Out of (50)
Enrollment No.	Title of Industrial project	Report writing	Presentation Skill (15)	Slide preparation (05)	Defence (10)	Total Out of (50)

10. PO - COMPETENCY- CO MAPPING

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

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

Sign: Name: Mr. Sanjay Sudhakar Harip (Course Expert)	Sign: Name: Dr. N. G. Kulkarni (Head of Department)
Sign: Name: Dr. N. G. Kulkarni (Program Head) (Mechanical Engg Dept.)	Sign: Name: Shri A. S. Zanpure (CDC In charge)

Government Polytechnic, Pune

'180 O.B.' – Scheme

Programme	**Diploma in Mechanical Engineering**
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	**ME4102**
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	00	00	50	50	100
				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

A diploma technician has to face a number of problem solving situations in his professional life while working in changing industrial environments. A scientific approach is necessary to plan and execute a given engineering task. Interacting with people, obtaining information from different sources and presenting the same in the form of a project report are some of the skill sets that a diploma engineer should possess. This course aims to inculcate these attributes in the students and encourages the process of independent thinking.

3. COMPETENCY

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

- **Execute an engineering task by systematic planning, organizing, and managing the available resources.**

4. COURSE OUTCOMES (COs)

1. Analyze the real life problem from a project development point of view.
2. Apply appropriate design methodology by using different design tools.
3. Select the appropriate production tool/ process.
4. Prepare a technical project report (including production drawings, process charts, costing and estimation, etc.).
5. Communicate effectively as a member /and leader of the project team.

5. GUIDELINES FOR UNDERTAKING A PROJECT :

I. During the guidance and supervision of the project work, faculty should ensure that students acquire the 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 financial implications. ,
d) Collect relevant data from different sources (books / internet/ market/ suppliers/ experts etc. through surveys/interviews).
e) Prepare required drawings and a detailed plan for the execution of the work.
f) Present the findings/features of the project.

II. In the industry-sponsored/guided project, implementation stages may vary as per industry requirements. Still, the same format of project report, diary, demonstration, and Rubrics will be required to be fulfilled.

Sr. No.	General Guidelines
1.	The project can be industry sponsored, maintenance based, or design and fabrication type, involving multidisciplinary technologies.
2.	The project has to be completed in a group of 3-4 students under the guidance of the allotted faculty
3.	Faculty/ students may form groups for the completion of the project work. Each group is assigned a guiding faculty, and project titles must be decided in coordination with the faculty.
4.	Students are required to present their project work in the form of a working model/simulation work, if any.
5.	Students must submit one hard copy and one soft copy of the project report in the prescribed format.
6.	Generally, the Project Report should be as per the guidelines mentioned in Annexure 1

7.	Students 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 and impart proper guidance. This will assist in the proper evaluation of students. The format of the cover page of the diary should be as Annexure-II. The project diary may contain no more than 5-10 pages.

Course Implementation Stages:

1. **Orientation Session:** The portfolio in-charge faculty has to coordinate Project orientation sessions during the last week of the fourth semester.
2. **Problem Selection and problem definition:** Different project ideas should be discussed and a synopsis of not more than two pages describing the project's scope to be submitted to the guide This activity may be completed during the first week of the **fifth semester.**
3. **Data Collection:** The reference material for the project should be collected through various sources such as books, the internet, industry, manuals etc. One week is to be utilized for this activity, and the same should be presented to the faculty.
4. **System Design:** The following week must be utilised for system design. The system design comprises the mechanism's development so that the given concept can perform the desired operation. The system design also determines the system components, shapes, and overall dimensions.
5. **Mechanical Design:** Classify the components of the project as standard and nonstandard parts. Decide the dimension of the nonstandard parts based on their function and the different loads it is subjected to.
6. **Production drawing preparation:** Production drawings with appropriate dimensional and geometric tolerances of the parts using any CAD software should be prepared under the guidance of the project guide.
7. **Material procurement and process planning:** Procure the raw material and prepare process charts for the parts to be manufactured.
8. **Manufacturing:** Parts should be produced as per the drawings. The parts produced should confirm the designed specifications to obtain the optimum performance of that produced product.
9. **Assembly and Testing:** After all the parts are manufactured and procured, various components should be assembled, and trials should be carried out to evaluate the performance. The project would have to go through a minimum of two demonstrations :
    a. Preliminary demonstration (Given to faculty guide)
    b. Final Demonstration: During ESE final demonstration of the working model is to be presented.

Note:

i. Students must maintain a project diary and prepare a project report, which should be periodically monitored and assessed by the faculty guide as provided by RUBRICS.

6. ASSESSMENT OF PROJECT WORK :

The progressive assessment and end semester examination assessment should be as per the Rubrics given in Annexure III

7. THEORY COMPONENTS

NA

8. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

NA

9. SUGGESTED STUDENT ACTIVITIES

NA

10. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

As per the guidelines mentioned in Annexure-I or any other guidelines given by faculty.

11. SUGGESTED MICRO-PROJECTS

As all the components of a micro project are covered in the project work, no separate micro project is required.

12. SUGGESTED LEARNING RESOURCES

As per the guidelines mentioned in Annexure-I or any other guidelines given by faculty.

13. SOFTWARE/LEARNING WEBSITES

NA

14. P.O. - COMPETENCY- CO MAPPING

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

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

Sign: Name: V.S.Sonawane C. S Ghadage (Course Experts)	Sign: Name: Dr. N. G. Kulkarni. (Head of Department)
Sign: Name: Dr. N. G. Kulkarni. (Program Head) (Mechanical Engg Dept.)	Sign: Name: Shri. A. S. Zanpure. (CDC In charge)

Annexure I

Guidelines for the preparation of Project Report

1. **The project report shall be computer typed (English- British) and printed on A4 size paper.**
2. **Text Font -Times New Roman, Size-12 point**
3. **Subsection heading TNR- 12 points bold normal**
4. **Section heading TNR- 12 capital bold**
5. **Chapter Name/ Topic Name – TNR- 14 Capital**
6. **All text should be justified. (Settings in the Paragraph)**
7. **The project report shall be hardbound with a cover page in black colour. The name of the candidate, diploma (department), year of submission, name of the institute shall be printed on the cover [Refer sample sheet (outer cover)]**
8. **The project report shall be typed on one side only with double space with a margin of 3.5 cm on the left, 2.5 cm on the top, and 1.25 cm on the right and bottom.**
9. **In the project report, the title page [Refer sample sheet (inner cover)] should be given first, then the Certificate, the acknowledgement and contents with page numbers. This should be followed by an abstract of the project report (not exceeding 1000 words)**
10. **The reference should be given at the end of the Project report in alphabetical order, indicating:**

    i) **The author's name and his initials**

    ii) **The title of the paper and name of the journal**

    iii) **The name of the book and the publisher**

    iv) **The number of the volume, page numbers, and the year of publication**

    v) **standard abbreviation may be used in the names of the journals**

    vi) **For book, Title should be italicized (See Ref [3] below) whereas, for journal/conference papers, Journal/Conference name should be italicized (See Ref [1] and [2] below). While referencing websites, specify the exact web link followed by the date on which it is referred to. Avoid mentioning search engines like www.google.com, etc., but mention the actual web page referred to. See Ref [4] below.**

For Example:

[1] **Singh, S. and Shan, H. S, "Development of Magneto Abrasive Flow Machining Process",** ***International Journal of Machine Tools & Manufacturing*****, vol. 42, 2, pp. 953-959,20**

[2] **Laroiya, S.C. and Adithan, M, "Precision Machining of Advanced Ceramics"** ***Proceeding of the International Conference on Advanced Manufacturing Technology*** **(ICMAT - 94), University Teknologi Malaysia, Johor Bahru, Malaysia, pp 203-210, 29-30 August1994.**

[3] **Adithan, M. and Gupta, A.B.,** ***"Manufacturing Technology"*****, New Age, International Publishers, New Delhi, 1996.**

[4] **http://www.datasheetarchive.com/IC%20566%20vco-datasheet.html [1 Feb2012]**

11. **The diagrams should be printed on a light/white background, and Tabular matter should be clearly arranged. The decimal point may be indicated by a full stop (.). The caption for Figure must be given at the BOTTOM of the Fig. (11 point Times New Roman), and Caption for the Table must be given at the TOP of the Table (11 point Times New Roman).**

12. **The project report shall consist of the following content along with given chapters**

– **FrontPage**

– **Certificate**

– **Declaration**

– **Acknowledgement**

– **Content**

- **List of abbreviation**
- **List of figures**
- **List of tables**
- **List of symbols etc.**

1- **Introduction**

– **Objectives of the study**

– **Relevance**

2- **Present Status of Technology**

3- **Proposed Work**

4- **Principle of Working / Construction / Drawing (as Applicable)**

5- **Production Processes Used on Production Sheets / Costing (as Applicable)**

6- **Performance Analysis**

7- **Future Scope for Work**

8- **Conclusion**

9- **References**

– **Bibliography**

– **Webliography**

10- **Appendix**

- **Bill of material**
- **Datasheets**
- **Annexure-I, II, III (if any)**

13. **These are indicative titles of chapters. The students may revise/ modify as per the need of the report in consultation with the guide.**
14. **Prepare a log-book and write the weekly activities carried out towards the project work in it. Get it duly signed by your guide weekly.**
15. **Before the final print of the project report, a draft copy of it should be approved by the guide.**
16. **Please note that the report may be viewed by the academic auditors / examiners / members of the monitoring committee visiting the institute. Hence, utmost care and precision is required while drafting.**
17. **Prepare copies of the project report equal to TWO more than the number of students. (One for guide, one for department and rest for the students).**
18. **All project reports shall be prepared in the golden embossed format of the Black Book.**

Sample sheet (outer cover)

" (Title)" (24pt.)

PROJECT REPORT (14pt.)

SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENT FOR THE AWARD OF DIPLOMA IN

MECHANICAL ENGINEERING(12pt.)

SUBMITTED BY

STUDENT NAME 1: ExamNo(14pt) STUDENT NAME 2 : ExamNo.(14pt)

STUDENT NAME 3: ExamNo(14pt) STUDENT NAME 4: ExamNo.(14pt)

GUIDE

NAME (14pt)

DEPARTMENT OF MECHANICAL ENGINEERING

GOVERNMENT POLYTECHNIC PUNE

(2020-21)

Sample sheet (inner cover)

" (Title)" (24pt.)

PROJECT REPORT (14pt.)

SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENT FOR THE AWARD OF DIPLOMA IN

MECHANICAL ENGINEERING(12pt.)

SUBMITTED BY

STUDENT NAME 1: ExamNo(14pt) STUDENT NAME 2 : ExamNo.(14pt)

STUDENT NAME 3: ExamNo(14pt) STUDENT NAME 4: ExamNo.(14pt)

GUIDE

NAME (14pt)

DEPARTMENT OF MECHANICAL ENGINEERING

GOVERNMENT POLYTECHNIC PUNE

(2020-21)

GOVERNMENT POLYTECHNIC, PUNE

CERTIFICATE

This is to certify that,

(Name of student 1) (Exam number)

(Name of student2) (Exam number)

(Name of student3) (Exam number)

(Name of student4) (Exam number)

of final year Mechanical Engineering students have submitted their project report on

"(-- Project Title --)"

during academic session 20- 20 as a part of project work described by Government Polytechnic, Pune for partial fulfilment for the Diploma in Mechanical Engineering in the sixth semester.

The project work is the record of students' own work under my guidance and to my satisfaction.

(-- Name of Guide--)	(-- Name of Head--)
Guide	Head

Department of Mechanical Engineering

Principal

Government Polytechnic, Pune

Sample sheet -declaration

GOVERNMENT POLYTECHNIC, PUNE

CANDIDATE'S DECLARATION

I hereby certify that the work which is being presented in the project report entitled "TITLE" by us in partial fulfillment of requirements for the award of diploma in Mechanical Engineering submitted in the Department of Mechanical Engineering is an authentic record of our own work carried out during (20 -) guided by Mr._____.

Signature and Name of the Students

STUDENT NAME 1: Exam No(14pt) STUDENT NAME 2 : Exam No.(14pt)
STUDENT NAME 3: Exam No(14pt) STUDENT NAME 4: Exam No.(14pt)

This is to certify that the above statement made by the candidate is correct to the best of my/our knowledge

Signature of the GUIDE

SAMPLE SHEET-ACKNOWLEDGEMENT

ACKNOWLEDGEMENT

I would like to place on record my deep sense of gratitude to Prof. , Dept. of-
------------ for his generous guidance, help and useful suggestions.

I express my sincere gratitude to Prof. --------, Dept. of -------------, for his stimulating guidance, continuous encouragement and supervision throughout the course of present work.

I am extremely thankful to Prof. , Principal, for providing me infrastructural facilities to work in, without which this work would not have been possible.

(Students Name and Signature)

(Note: This is just the specimen, students have the flexibility to express/ acknowledge in his words)

SAMPLE SHEET – content

CONTENTS Page No.

Annexure-II

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-III

Rubrics

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 the following criteria.

Sr. No.	Criteria	Marks
1	Topic Selection & Problem definition	10
2	Data collection and system design	10
3	Stage wise progress as per discussion	10
4	Involvement in project activities	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 by the guide based on the following criteria.

Sr. No.	Criteria	Marks
1	Project selection process	5
2	Project content	10
3	Project Execution	10
4	Quality of project report	10
5	Question Answer	15

Government Polytechnic, Pune

'180OB' – Scheme

Programme	**Diploma in Mechanical Engineering**
Programme Code	01/02/03/**04**/05/06/07/08/15/16/17/**18**/19/21/22/23/**24**/26
Name of the Course	**Seminar**
Course Code	**ME4103**
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	50
--	--	02	02	Marks	00	00	25	25	
				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 course tends to mould students towards integrating the knowledge acquired throughout and applying it, to understand and interpret evolving technologies to strengthen the confidence over acquired Engineering skills and thus fulfill the objective of the Diploma Programme. The seminar mainly serves 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 the 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 new technologies/tools.
2. Apply technical knowledge.
3. Write a Seminar Report
4. Work independently, prepare and deliver presentations.

5. GUIDELINES FOR UNDERTAKING A SEMINAR :

1. Department must organize a Seminar Orientation session for all the registered students.
2. The process of conducting a Seminar includes allocating a topic to the individual student who should perform the required search, deciding on the topic objectives, designing and preparing an appropriate method of presentation, and presenting the topic to their fellow students and teachers with all of the necessary explanation and discussion. Faculty assigned to the 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. The respective guide shall approve the seminar topic.
5. The student will maintain a dated Seminar Diary for the whole semester. This diary should be assessed by the respective guide timely. The format of a diary is as given in **Annexure IV.**

Suggested Seminar Activities to be performed:-

- Collection of **at least three Seminar topics** on recent technologies and presentation of their abstract to faculty guide.
- Finalization of Seminar topic.
- Submission of final abstract on selected topic.
- Weekly interaction of students in group with seminar guide.
- Weekly assessment of seminar and work is labelled as Progressive Assessment.
- Group of Students should prepare and submit Report writing and presentation slides of Seminar in consultation with Seminar guide.
- Presentation of Seminar in well-defined manner within specified time.
- Submission of Seminar report with the permission of faculty and Head of the Department.

6. ASSESSMENT OF SEMINAR WORK

- Like other courses, assessment of Seminar work also has two components, first is a progressive assessment, while another is the end of the term assessment.
- The faculty will undertake the progressive assessment to develop the COs in the students. They can give informal oral feedback about their performance and interpersonal behavior while guiding them on their seminar work every week.
- There will also be a regular progressive assessment by the teacher.

A. **Progressive 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 the 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 efforts displayed (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 given below. The faculty shall do this assessment.

Sr. No.	Criteria	Marks
1	**Seminar Topic and Contents**	5
2	**Seminar Delivery (Speech clarity and body language)**	5
3	**Overall understanding capability**	5
4	**Quality of presentation (Slides and Time management)**	5
5	**Interactions with Q & A**	5

7. THEORY COMPONENTS

NA

8. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

NA

9. SUGGESTED STUDENT ACTIVITIES

NA

10. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

As per the guidelines mentioned in Annexure-I or any other guidelines given by faculty.

11. SUGGESTED MICRO-PROJECTS

NA

12. SUGGESTED LEARNING RESOURCES

As per the guidelines mentioned in Annexure-I or any other guidelines given by faculty.

13. SOFTWARE/LEARNING WEBSITES

NA

14. PO - COMPETENCY- CO MAPPING

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

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

Sign: Name: 1.M. W. Giridhar. 2.Dr A.A.Gadhikar. (Course Expert/s)	Sign: Name: Dr.N.G.Kulkarni. (Head of Department)
Sign: Name: Dr.N.G.Kulkarni. (Program Head) (Mechanical Dept.)	Sign: Name: Mr. A.S.Zanpure (CDC In-charge)

Annexure-I

Seminar Report Guideline

1. **All students should submit their seminar report to their respective guide on or before the scheduled date**
2. **Seminar report must include**
   i) **Cover Page**
   ii) **Certificate**
   iii) **Acknowledgement**
   iv) **Index**
   v) **Abstract**
   vi) **Chapters (as per discussion with guide)**
   vii) **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**

Annexure-II

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 MECHNICAL ENGINEERING
(Academic Year: -)

Government Polytechnic, Pune-16
(An Autonomous Institute of Government of Maharashtra)
Department Mechanical Engineering

CERTIFICATE

This is to certify that Ms/Mr.______________with Enrollment No.__________, of Third Year Diploma in Mechanical Engineering has successfully completed the seminar titled "_________________________________" as part of his/her diploma curriculum in academic year ________.

Seminar Guide	H.O.D	Principal
(Shri/Smt.)	(Dr . N.G.Kulkarni)	(Dr. V. S. Bandal)

ACKNOWLEDGEMENT

Acknowledgement should be prepared by the students in their wordings expressing their gratitude towards department.

Annexure-III

Department of Mechanical engineering
GENERAL SEMINAR GUIDELINES

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.
- Every student must report to respective guide 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**

Government Polytechnic, Pune

'180 OB' – Scheme

Programme	**Diploma in Mechanical Engineering**
Programme code	01/02/03/**04**/05/06/07/08/15/16/17/**18**/19/21/22/23/**24**/26
Name of Course	**Quality Techniques**
Course Code	**ME4104**
Prerequisite course code and name	**NA**
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, 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:

Quality is another name for universal acceptance for products and services in today's international market. Hence, Mechanical engineers must have consciousness about various quality aspects required for the manufacturing /service sector. This subject about various factors and philosophies in quality development is introduced to fulfil this need. So, the students will have most of the essential inputs before entering their profession.

3. COMPETENCY:

- Apply Quality control techniques for assuring the Quality of products and services.

4. COURSE OUTCOMES:

1. Apply Quality Standards to products as per consumer needs.
2. Interpret data from different processes and quality charts for variable and attribute data.
3. Implement Quality circle and Kaizen for continuous improvement in the work.
4. Apply various statistical tools for data interpretation in graphical format.
5. Use different ISO standards in practice.

5. SUGGESTED PRACTICALS/ EXERCISES:

NA

6. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED:

NA

7. THEORY COMPONENTS:

Unit outcomes (UOs) (In cognitive domain)	**Topics and subtopics**
Unit – I Quality (06 Hrs, 08 Marks)	
1a. Prepare a quality characteristics chart to decide the fitness of a product. 1b. List parameters for service quality of a product. 1c. Differentiate cost and value of Quality. 1d. Select type and stages of inspection for a process for quality control. 1e. Imbibe quality mindedness in supporting staff.	1.1 Meaning of Quality of product and services, Various definitions of Quality, Quality of design and Quality of conformance, cost of Quality and value of Quality, Service quality Vs product quality. 1.2 Quality policy: definition and objectives 1.3 Quality assurance: - definition, meaning, its various forms and advantages. 1.4 Quality audit, quality mindedness 1.5 Inspection and quality control.
Unit - II Statistical Process Control (12 Hrs, 16 Marks)	
2a. Prepare a list of parameters to reduce variation in Quality. 2b. Calculate mean, mode, median, range, standard deviation from given data. 2c. Draw and interpret X, R and P, C charts from given data. 2d. Determine Process capability. 2e. Represent the given data through a normal distribution curve.	2.1 Meaning and importance of SQC, Variable and attribute Measurement. 2.2 Variation in Quality, Reasons of variation, inherent and assignable sources of variation, central tendency, Dispersion, universe, Normal distribution curve. 2.3 Control charts – control charts for variables – X & R charts, defect and defective, control charts for attributes - P & C charts, Trend of control charts (Numerical on control charts), Process capability. 2.4 Acceptance sampling- Need of sampling, types of sampling plans, operating characteristics (OC) curve).
Unit – III Total Quality Management (08 Hrs, 16 Marks)	
3a. Apply an eight-dimensional model of total Quality for the task. 3b. Prepare vision and mission statements for the organization. 3c. Identify key six sigma roles and black belt coaches for the given industrial situation. 3d. Prepare elementary list of parameters of PDCA cycle for a product to be manufactured.	3.1 Total Quality: - Concept, definition, objectives, eight-dimensional model of total Quality. 3.2 Strategic quality management (Hoshin Kanri), vision, mission, QCDF (Quality Cost Delivery Flexibility), Juran trilogy. 3.3 Principles of total quantity management. TQM implementation – PDCA cycle. 3.4 Six sigma: Definition and Statistical meaning, advantages, implementation,

Unit outcomes (UOs) (In cognitive domain)	Topics and subtopics
	methodology of system Improvement-DMAIC and DMADV. 3.5 Belts used in six sigma.
Unit - IV Quality Management Processes (06 Hrs, 16 Marks)	
4a. Prepare a list of steps to solve the given problem in the industry using the quality circle concept with justification. 4b. Identify wastes in the organization and suggest measures to reduce them. 4c. Decide steps to implement 5S in the organization.	4.1 Quality Circle (QC): - concept, objective, structure, steps in formation of quality Circle, Roles of people involved in quality Circle, advantages of quality Circle. 4.2 Kaizen - concept, meaning and definition, areas for Kaizen, 10 ground rules for change, Traditional methods Vs Kaizen, Kaizen Vs innovation. 4.3 Types of waste and Waste elimination, hidden waste and obvious waste, Identification of wastes. 4.4 5S in housekeeping and their meaning.
Unit - V Quality Improvement Tools (08 Hrs, 12 Marks)	
5a. Prepare cause and effect diagram/ pareto chart for solving the given problem for root cause analysis. 5b. Conduct a brainstorming session of a team for generation of new ideas. 5c. Prepare flow charts for explaining a process. 5d. Apply '5 Whys' technique to solve a problem.	5.1 Various statistical tools in quality improvement: Cause and effect diagram (Fishbone or Ishikawa diagram), check sheet, histogram, pareto chart, scatter diagram. 5.2 Additional tools of quality improvement: Brainstorming, Flow charts, 5W & 1H, 5 Whys technique for problem solving.
Unit – VI Quality Management Standards (08 Hrs, 12 Marks)	
6a. Identify suitable ISO standards to be implemented in the industry. 6b. Prepare a list of steps in implementing suitable ISO standards in the organization. 6c. Prepare documentation for implementation of ISO.	6.1 History of evolution of ISO 9000 standards. European economic community (EEC), need for quality system standards, International Organization for Standardization (ISO) adopted by Bureau of Indian Standards (BIS) 6.2 ISO 9000: 2000 -Quality system ISO 9000 series standards, ISO 9000 elements understanding requirement, Documentation and implementation, quality manual, structure, internal quality audit, external audit and certification. 6.3 Various Quality Systems Vocabulary and features – ISO 9001:2008 Requirements for a quality management system ISO 9004: 2009 Guidelines for the

Unit outcomes (UOs) (In cognitive domain)	Topics and subtopics
	effectiveness and efficiency of the quality management system IS 14000: Significance ISO 19011: guidance on auditing and environmental management systems 6.4 Introduction to Toyota way: Toyota production system (TPS), lean production, '4' P model of Toyota way. 6.5 Toyota way: principles and their meaning.

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.	Quality	06	08	--	--	08
2.	Statistical Process control	12	08	04	04	16
3.	Total Quality Management	08	08	08	--	16
4.	Quality Management process	06	08	08	--	16
5.	Quality improvement	08	08	04	--	12
6.	Quality management standards	08	08	04	--	12
	Total	**48**	**48**	**28**	**04**	**80**

9. SUGGESTED STUDENT ACTIVITIES:

Other than classroom learning, the following are the suggested student-related co-curricular activities that can be undertaken to accelerate the attainment of the various outcomes in this course. Students should conduct the following activities in a group, prepare reports of about five pages for each activity, and collect/record physical evidence for their (students') portfolio, which will be helpful in their placement interviews.

a. Prepare wall charts of 3 sigma and six sigma curves.
b. Search information about various ISO standards of quality control.
c. Prepare a list of national and international industries working on the principle of the six sigma technique.

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. About 15-20% of the topics/subtopics are relatively simpler or descriptive to be given to the students for self-directed learning and assess the development of the COs through classroom presentations.
c. Teachers need to ensure to create opportunities and provisions for co-curricular activities.
d. Teachers 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	Total Quality Management	Dr K. C. Arora	S.K. Kataria and sons
2	Total Quality Management Text and cases	B. Janakiraman and R.K. Gopal	Prentice-Hall of India Pvt. Ltd. New Delhi.
3	Total Quality Management	Subburaj	Tata Mc - Graw Hill Co., New Delhi.
4	Total Quality Management	Gupta, Srinivas N & B Valarmathi	Tata Mc - Graw Hill Co., New Delhi.
5	Total Quality Management	Paul, Arasu	Prentice-Hall of India Pvt. Ltd. New Delhi.

13. SOFTWARES/ LEARNING WEBSITES: The students should refer to the following videos from the internet.

1. Quality: https://youtu.be/ZpFqnefTGA8
2. Quality control vs quality assurance: https://youtu.be/zSyICkGZ6iM
3. TQM: https://youtu.be/fKvEkOFzhjQ
4. Six sigma: https://youtu.be/wEBPVQ7W2wg
5. Quality improvement tools: https://youtu.be/7Kc1reo8NU0
6. http://www.slideshare.net/var93/seven-tools-of-tqm?from_m_app=android
7. Variable charts: https://youtu.be/ccReTaolqHo
8. Attribute charts: https://youtu.be/66rtASiAnbA
9. Acceptance sampling: https://youtu.be/xJ3czkvNxpk
10. kaizen and 5S: https://youtu.be/DFsFODnb-Iw
11. ISO: http://www.slideshare.net/kumudajayaram/iso-9000-87352949?from_m_app=android
12. http://www.slideshare.net/parvikasinghal/iso-14000-41162373?from_m_app=android

14. PO - CO MAPPING:

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

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

Sign: Name: Mr N. B. Hirlekar Dr R. R. Saraf (Course Experts)	Sign: Name: Dr N. G. Kulkarni (Head of Department)
Sign: Name: Dr N. G.Kulkarni (Program Head) (Mechanical Engg. Dept.)	Sign: Name: Mr A. S. Zanpure (CDC in Charge)

Government Polytechnic, Pune

'180 OB' – Scheme

Programme	**Diploma in Mechanical Engineering**
Programme code	01/02/03/**04**/05/06/07/08/15/16/17/**18**/19/21/22/23/**24**/26
Name of Course	**Power Engineering**
Course Code	**ME 4105**
Prerequisite course code and name	**Thermal Engineering ME 3102, L1**
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 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

In today's automobile sector internal combustion engine is one of the essential thermal prime movers. In the present twin crisis of fossil fuel depletion and environmental pollution, much technological advancement are taking place, and alternate fuels are also emerging. This course has been designed to develop skills to identify, select, maintain & test internal combustion engines, air compressors, Electric vehicles, Refrigeration and air conditioning devices and Power plants.

3. COMPETENCY

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

- **Maintain IC engine, Air compressor and Refrigeration and air conditioning systems.**

4. COURSE OUTCOMES (COs)

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

1. Identify different components of I.C.Engine and Gas Turbine.
2. Test performance of a given IC engine and air compressor.
3. Select alternate fuels in the IC engine.
4. Identify different components of Refrigeration and air conditioning systems.
5. Illustrate working of different power plants.

5. SUGGESTED PRACTICALS/ EXERCISES

Pr. No.	**Unit No.**	**Practical Exercises** (Outcomes in Psychomotor Domain)	**Relevant CO**	**Approximate Hours Required.**
1		Dismantle and assemble .of diesel or petrol engine	1	04
2		Dismantle and Assemble of solex Carburetor.	1	02
3	2	Dismantle and Assemble of fuel injection pump	1	02
4		Demonstrate working of CNG Station	3	02
5		Demonstrate working of Electric vehicle	3	02
6	3	Trial on the four-stroke engine with the heat balance sheet.	1,2	04
7	3	Use exhaust gas analyzer to measurement and analyze pollutants in the given IC engine	2	02
8	2	Perform diagnosis test on given MPFI engine using OBD Analyser	2	02
9	3	Demonstrate any one Gas turbine application	1	02
10	5	Trial on reciprocating air compressor system.	2	02
11	6	Demonstration of working of domestic refrigerator	4	02
12	6	Calculate COP of Vapour compression refrigeration system	4	02
13	7	Measure air properties using Psychrometer	4	02
14.	7	Demonstration of working of Window Air Conditioner and Split Air Conditioner	4	02
15	8	Demonstrate any one power plant	5	02
16.	All	Complete a micro project based on guidelines provided in Sr. No. 11	1 to 5	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 the 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	Four stroke Diesel engine/Petrol engine	1
2	Cut section/Models, charts of carburetor, Injector, FIP	2,3
3	Diesel engine/Petrol engine test rig	6
4	Exhaust Gas Analyser	7
5	OBD Analyser	8
6	Air compressor test rig.	10
7	Model/Actual domestic refrigerator, Ice plant	11
8	VCC Test Rig	12
9	Model/Actual window AC, split AC	14

7. THEORY COMPONENTS

Unit Outcomes (UOs) (in the cognitive domain)	Topics and Sub-topics
Section I	
Unit- I Air Standard Cycles (6 Hrs, 8 Marks)	
1a. Define air standard efficiency and air standard cycle. 1b. Draw PV and TS diagrams of Air standard Cycle. 1c. Calculate Air standard efficiency of Otto and Diesel cycle.	1.1 Carnot cycle Definition of Air standard cycles, Definition of air standard efficiency, Carnot cycle, representation on P-V and T-S diagram, Air standard efficiency derivation. 1.2 Otto cycle, Diesel cycle, representation on P-V and T-S diagram. Air standard efficiency. (Numerical to be solved) 1.3 Duel combustion and Brayton cycles, representation on P-V and T-S diagram (No Numerical)

Unit Outcomes (UOs) (in the cognitive domain)	Topics and Sub-topics
Unit -II IC Engines (7 Hrs, 12 Marks)	
2a. Classify IC engines and state applications of IC engines. 2b. Explain working and construction of four-stroke cycle petrol and diesel engine with neat sketch 2c. Explain with a neat sketch of ignition systems and combustion processes in petrol engines. 2d. Define carburetion 2e. Explain MPFI system and DI technology 2f. Name different alternate fuels, Explain with sketch engine modification systems for LPG and CNG operation	2.1 Classification and application of IC engines. 2.2 Construction and working four-stroke petrol and diesel engines, 2.3 Combustion process in SI engine with sample chemical reactions. Ignition systems in Petrol engines-Electronic ignition system, Distributorless ignition system. 2.4 Concept of carburetion, air fuel ratio, Types of mixtures. 2.5 MPFI system, Gasoline direct injection technology, Concept of bifuel and dual fuel engine 2.6 Introduction to alternate fuels LPG, CNG, Ethanol. Engine modification system for LPG and CNG. Introduction to hybrid and electric vehicle
Unit -III IC Engine Testing (7 Hrs, 12 Marks)	
3a. State purpose of engine testing. 3b. Define different engine parameters 3c.Calculate different parameters of I.C. engine 3d. Draw heat balance sheet 3e.Explain BS-VI emission norms, IS testing methods and concept of engine simulation.	3.1 Purpose of engine testing, Methods of determining indicated & brake power of the engine. 3.2 Morse Test—Procedure and numerical examples. 3.3 Definition, Formulae and units of Engine parameters like Brake Power, Indicated Power, frictional power, Brake thermal and Indicated thermal efficiencies, Relative Efficiency, BSFC and ISFC (Numerical examples to be solved). 3.4 Heat balance sheet—Method and numerical examples. 3.5 BS VI Emission norms, CO, HC and NOx emissions. IS testing of engines and introduction to engine simulation.
Unit- IV Gas Turbines and Jet Propulsion (4 Hrs, 8 Marks)	
4a. Name different components of gas turbines. 4b. Compare open cycle and closed cycle gas turbine. 4c. Name applications of gas turbine. 4d. Explain the working principle of Ramjet Turbojet, Turboprop and Rocket engine.	4.1 Introduction to a gas turbine, working cycle, Elements of a gas turbine. (Descriptive treatment only) 4.2 Open cycle and closed cycle gas turbine. Their comparison (Descriptive treatment only) 4.3 Applications of a gas turbine (Descriptive treatment only). 4.4 Working principle of Turbojet, Rocket, Rocket fuels. (Descriptive treatment only)

Unit Outcomes (UOs) (in the cognitive domain)	**Topics and Sub-topics**
Section II	
Unit -V Air Compressor (8 Hrs, 12 Marks)	
5a. List uses of compressed air 5b. Explain construction and working of single acting single stage reciprocating air compressor. 5c. Solve numerical examples to evaluate different compressor parameters. 5d. Illustrate the effect of clearance and pressure ratio on volumetric efficiency of compressor. 5e. State necessity of multi staging and advantages of multi staging. 5f .Illustrate working principle of rotary compressors.	5.1 Uses of compressed air, classification of air compressor 5.2 Construction and working of single stage, single acting, reciprocating air compressor. Calculation of power required, isothermal, mechanical and volumetric efficiencies, (Numericals) 5.3 Effect of clearance and pressure ratio on volumetric efficiency, 5.4 Necessity of multi-staging, inter-cooling (perfect and imperfect), advantages of multi-staging, after coolers (use of formulae only, no derivation). 5.5 Rotary compressors –Working principle of Roots Blower, Vane, screw compressor. Factors to be considered for energy saving in air compressors.
Unit - VI Refrigeration (6 Hrs, 10 Marks)	
6a. Sketch VCC on PH and TS diagrams. 6b. Calculate COP of VCC with given enthalpy values. 6c. Select appropriate refrigerant based on properties with justification. 6d. Explain construction and working of various components of vapor compression systems. 6e. Select a suitable type of components of VCC refrigeration systems.	6.1 Refrigeration: Definition, Unit of Refrigeration, 6.2 Vapor compression cycle, subcooling and superheating, components of vapor compression systems . Calculation of COP (only for Vapour is Dry and saturated at the inlet to the compressor) 6.3 Desirable properties of Refrigerant, Ozon friendly Refrigerant, the concept of GWP, AMP and ODP 6.4 Applications: Components and working of Domestic refrigerator, water cooler, Ice plant and cold storage. 6.5 Selection of components like compressor expansion valve for the given application by referring manufacturers specification charts/table and by referring ASHRAE/ISHRAE handbook
Unit - VII Air Conditioning (5 Hrs, 10 Marks)	
7a. Define Airconditioning 7b. Determine properties of air using a psychrometric chart. 7b. Select air-conditioner based on capacity requirement with justification. 7c. Explain the construction and working of the given air conditioner.	7.1 Air-conditioning: Definition, Classification, Applications 7.2 Psychrometry: properties of air, psychrometric processes, psychrometric chart. 7.3 Components and working of Window air conditioner, split air-conditioner; Central air-conditioning system.

Unit -VIII Power Plant Engineering (5 Hrs, 8 Marks)	
8a. Classify different power plants. 8b. Draw layout and state working principle of all mentioned power plants. 8c. List factors affecting site selection for power plants. 8d. Name different power plants in India.	8.1 Introduction. 8.2 Layout and working principle of Hydroelectric Steam, Nuclear and Gas turbine Power plant. 8.3 Site selection criteria for power plants. 8.4 Different power plants in 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**
	Section - I					
I	Air Standard Cycles	6	02	02	04	08
II	I.C. Engines	7	02	04	06	12
III	IC Engine Testing	7	02	02	08	12
IV	Gas turbines and jet propulsion	4	02	02	04	08
	Total	**24**	**08**	**10**	**22**	**40**
	Section II					
V	Air – Compressor	8	02	04	06	12
VI	Refrigeration	6	02	02	06	10
VII	Air-conditioning	5	02	02	06	10
VIII	Power plant engineering	5	02	02	04	08
	Total	**24**	**08**	**10**	**22**	**40**

9. SUGGESTED STUDENT ACTIVITIES

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

a. Prepare journals based on practicals performed in the laboratory.
b. Preparation of charts.
c. Literature survey from the internet.
d. Collection of information about the latest trends in the subject.

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. 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 COs through classroom presentations (see implementation guideline for details).
c. For item No.9, teachers need 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 working.
f. The teacher should ask the students to go through instructional 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 them. 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 and integrate PrOs, UOs and ADOs (Affective Domain Outcomes). Each student will have to maintain a dated work diary of individual contributions to the project work and give a seminar presentation before submission. The student should submit a 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. Models of four stroke engine and engine parts/systems.
b. Preparation of different charts.
c. Any other suitable as decided by the teacher and the industry expert.
d. Prepare a simulation model of the working of micro-hybrid/hybrid E vehicles.
e. Prepare a chart showing the Classification of E- vehicles.
f. Demonstration of the working of the battery charging station by preparing the models.

12. SUGGESTED LEARNING RESOURCES

SN.	Title	Author	Publisher, Edition and Year of publication, ISBN Number
1.	A Course in IC Engine.	Mathur & Sharma	Dhanpat Rai Publications, Delhi. ISBN-9788189928469
2.	Heat engineering	V.P. Vasudani and DS. Kumar	Metropolitan Book Co., New Delhi. ISBN-9788120003507
3.	Thermal Engineering	P.L. Ballaney	Khanna Publishers, Delhi. ISBN-9788174090312
4.	Basic Refrigeration and air conditioning	Anant Narayan	Tata Mcgraw Hills, New Delhi. ISBN-9781259062704

5.	Heat engine – Vol I – III	Patel Karamchandani	Acharya Publication, Vadodara ISBN-1234567145375
6.	Internal Combustion Engines	V. Ganeshan	Tata Mcgraw Hills, New Delhi. ISBN-9781259006197
7.	Thermodynamics and Heat Engines	PK Nag	Tata Mcgraw Hills, New Delhi. ISBN-9780070591141

13. SOFTWARE/LEARNING WEBSITES

1. www.nptel.com
2. https://en.wikipedia.org
3. www.howstuffworks.com
4. www.slideshare.net

14. PO - COMPETENCY- CO MAPPING

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

	PSO1	PSO2
CO1	--	3
CO2	–	3
CO3	--	3
CO4	--	-
CO5	–	-

Sign: Name: A.S.Zanpure Dr.V.B. Jaware (Course Experts)	Sign: Name: Dr N.G.Kulkarni (Head of Department)
Sign: Name: Dr N. G. Kulkarni. (Program Head) (Mechanical Engg Dept.)	Sign: Name: Shri. A. S. Zanpure. (CDC In charge)

Government Polytechnic, Pune

'180 O.B.' – Scheme

Programme	**Diploma in Mechanical Engineering**
Programme code	01/02/03/**04**/05/06/07/08/15/16/17/**18**/19/21/22/23/**24**/26
Name of Course	**Industrial Hydraulics and Pneumatics**
Course Code	**ME4106**
Prerequisite course code and name	**N.A.**
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></th></tr>
<tr><td rowspan="2">04</td><td rowspan="2">00</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><td>150</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, 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

In any mechanical industry-hydraulic and pneumatic control systems are widely used due to their versatility and adaptability to automation.

Understanding fundamental principles, construction, and working of hydraulic and pneumatic control systems help a Diploma technician in operation, maintenance and erection of modern machine tools. Practical circuits and PLC ladder diagrams are also dealt with so that student is familiar with the industrial automation

3. COMPETENCY

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

- **Use different types of hydraulic and pneumatic 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. Illustrate the working principle of various components used for hydraulic and pneumatic systems.
2. Select appropriate working medium, components and accessories required in the fluid system wherever necessary.
3. Connect simple hydraulic and pneumatic circuits as per the drawings.
4. Use hydro pneumatic and electro-pneumatic systems appropriately.
5. Develop hydraulic and pneumatic circuits for given applications.

5. SUGGESTED PRACTICALS/ EXERCISES

Sr. No.	Unit No.	Practical Exercises (Outcomes in Psychomotor Domain)	Relevant CO	Approx. Hours Required.
1.	1	Identify the components of hydraulic and pneumatic trainers.	1	02
2.		Draw ISO symbols of all components and their types used in fluid systems.	1	02
3.	2	Use of Pumps and compressors mounted on hydraulic and Pneumatic trainers.	1, 2	02
4.	3	Use of actuators mounted on hydraulic and Pneumatic trainer	1, 2	02
5.	4	Construct & demonstrate Hydraulic and Pneumatic Circuits for actuation of linear and rotary actuators by the direct and indirect method using suitable D.C. valves.	1, 2, 3	04
6.		Construct & demonstrate Pneumatic circuits involving Quick exhaust valve, logic OR, AND, NOT functions.	1, 2, 3	02
7.	5	Study pressure control valves based on selection criteria	1, 2	02
8.		Construct & demonstrate circuits using pressure relief and sequence valve	1, 2, 3	02
9.	6	Construct & demonstrate speed control circuit for hydraulic and pneumatic actuators (Meter in and Meter out circuits)	1, 2, 3	02
10.	7	Demonstrate Electro-Pneumatic circuits for direct and indirect control of pneumatic actuators	1, 2, 3, 4	02
11.		Develop ladder diagram for simple circuits	4	02
12.	8	Develop Advance Hydraulic & Pneumatic circuits for a given application (To and fro, Time Delay, Two-step speed control of actuator, circuits for Milling machine, Shaper machine and surface grinding machine, Accumulator circuits)	5	04
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 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	Cut sections of pumps, valves, cylinders, motors, accumulators, filters, etc.	1, 2, 3
2	Hydraulic trainer with transparent /actual working components.	1, 4, 7, 8, 9
3	Pneumatic trainer with transparent/ actual working components.	4, 5, 11, 12, 13, 14
4	Working / actual models of pumps, cylinders, valves, other components	1, 2, 3
5	Single /Multistage Reciprocating Compressor (pressure 0-10 bar)	4, 5, 11, 12, 13, 14

7. THEORY COMPONENTS

Unit Outcomes (U.O.s) (in cognitive domain)	Topics and Sub-topics
Section I	
Unit– I Introduction to Hydraulic & Pneumatic Systems (6 Hrs, 8 Marks)	
1a. List various applications of fluid system 1b. Draw a general layout of Hydraulic & Pneumatic Systems. 1c. Identify components from their symbols. 1d. Select hydraulic fluid based on its properties 1e. Draw cross-sectional diagrams	1.1 Fluid power system: Meaning, Principles and Applications, Future of fluid power in India. 1.2 Oil hydraulic & pneumatic system: basic components and general layout, advantages and disadvantages, comparison between electric, hydraulic & pneumatic systems. 1.3 ISO Symbols used in hydraulic & pneumatic system 1.4 Hydraulic Fluid: Functions, Types, properties like viscosity, viscosity index and demulsibility, Selection of fluids, the effect of temperature &

Unit Outcomes (U.O.s) (in cognitive domain)	Topics and Sub-topics
of accessories.	Pressure on Hydraulic fluid system 1.5 Oil filters: Degree of filtration, filtration material, Types, construction and working of Depth, surface, full flow and proportional filter. Construction and working of FRL unit used in pneumatics.
Unit-II Pumps and Compressors (8 Hrs, 8 Marks)	
2a. Classify various types of pumps. 2b. Compare various types of pumps based on given factors. 2c. Select pump for the given application 2d. Classify compressors 2e. Draw constructional details of Pneumatic Compressors, Actuators and control valves	2.1 Hydraulic pumps: Classification, Construction and working of Gear pump (external and Internal), Lobe Pumps, Gerotor Pumps, Vane pump (imbalanced and balanced), Screw pump, Piston pump (axial and radial). Comparison, Selection of Pump for Power Transmission, Pump performance. 2.2 Compressors: Types, construction, working principle of Reciprocating & Rotary compressors.
Unit– III Hydraulic & Pneumatic Actuators (8 Hrs, 12 Marks)	
3a. Classify various types of actuators with justification. 3b. Draw constructional details of hydraulic actuators 3c. Select actuator for the given application with justification. 3d. Draw performance curves of Actuators	3.1 Hydraulic and Pneumatic Actuators: classification, function and applications 3.2 Construction and Working of Linear Actuators: - single acting (spring and gravity return), double acting (single and double piston rod end) Cylinders. 3.3 Construction and Working of Rotary Actuators: Gear, Gerotor, Vane, Piston motors. Motor performance. 3.4 Construction and Working of special designs: Telescopic, Tandem and Rodless cylinder.
Unit –IV Direction Control Valves in Hydraulic & Pneumatic Systems (10 Hrs, 12 Marks)	
4a. Classify various types of D.C. valves 4b. Draw constructional details of D.C. valves 4c. Select the appropriate type of D.C. valves for a given application 4d. Select actuation methods of D.C. valves as per the type of application. 4e. Draw Hydraulic and	4.1 Direction control valves: Classification, construction, working and applications of Poppet valve, spool valve, 2/2, 3/2, 4/2, 4/3, 5/2, 5/3, D.C valves simple and pilot operated check valves (pilot to open, pilot to close) methods of actuation of DCV, Comparison of D.C. valves, Selection of standard center position in 3 positions DCV. 4.2 Construction and working of Rotary spool D.C. valve, Dual pressure valve, Shuttle valve and Quick exhaust valve. 4.3 Hydraulic and Pneumatic Circuits actuate linear and

Unit Outcomes (U.O.s) (in cognitive domain)	**Topics and Sub-topics**
Pneumatic Circuits using D.C. valve for a given application 4f. Compare DC valves on various grounds	rotary actuators by direct and indirect (with pilot valve) methods-practical circuits involving Quick exhaust valve, logic OR, AND, NOT functions.
Section II	
Unit –V Pressure Control valves in Hydraulic & Pneumatic Systems (8 Hrs, 8 Marks)	
5a. Draw constructional details of pressure control valves 5b. Draw Hydraulic and Pneumatic Circuits using P.C. valve for a given application 5c. Illustrate the use of pressure control valves in hydraulic and pneumatic circuits 5d. Compare various pressure control valves 5e. Select the appropriate type of P.C. valves for a given application	5.1 Pressure Control Valve: Classification, Construction, working and applications of Relief valve (direct and pilot operated), pressure reducing valve (direct and pilot operated), sequence, unloading and counter balance valves. Comparison on various grounds. 5.2 Hydraulic and pneumatic Circuits using pressure control valve, Single and double sequence circuit, Two pump unloading circuit, Counterbalance circuit, circuit for reduced pressure in part of the system .
Unit –VI Flow Control valves and Accessories in Hydraulic & Pneumatic Systems (10 Hrs, 12 Marks)	
6a. Classify various types of F.C. valves 6b. Draw constructional details of flow control valves 6c. Compare various methods of flow control 6d. Select appropriate flow control valves and method of flow control for the given application 6e. Illustrate the use of various accessories in hydraulic/pneumatic system. 6f. Select appropriate accessories in hydraulic and pneumatic system	6.1 Flow control valves: Classification, Construction, working and applications of non-compensated, Pressure compensated, Pressure & temperature compensated flow control valve. 6.2 Meter in, Meter out and bleed off circuits. Comparison between them. Speed control circuit for pneumatic actuators 6.3 Types, construction and functions of Accessories: Pipes, hoses, fittings, Seals and gaskets, accumulators. 6.4 Hydraulic circuits using Accumulator as an auxiliary power source, leakage compensator, emergency power source, hydraulic shock absorber and thermal expansion compensator
Unit –VII Hydro- Pneumatics and Electro- Pneumatics (6 Hrs, 8 Marks)	
7a. List and Illustrate the use of, various components of Hydro-	1.1 Introduction to Hydro- Pneumatics, need, types, Air-Oil reservoir, Hydraulic check unit and air

Unit Outcomes (U.O.s) (in cognitive domain)	Topics and Sub-topics
Pneumatic and Electro Pneumatic system 7b. Draw and Analyze pneumatic circuits for different applications 7c. Develop ladder diagram for simple hydraulic & pneumatic circuits	hydraulic intensifier, comparison with hydraulic and pneumatic system 1.2 Introduction to Electro Pneumatics, important steps, Function of commonly used devices (manually actuated push button switches, Limit switches, Pressure switches, Solenoids, Relays, Timers, Temperature switches, Proximity sensors, Electric counters), Advantages, Electro Pneumatic circuits for direct and indirect control of pneumatic actuators 1.3 PLC programming methods, Development of Ladder Diagram of simple hydraulic & pneumatic circuit s. a. OR, AND, Time delay, sequencing, NOR, NAND. (Basics of PLC are already covered elsewhere)
Unit –VIII Industrial Hydraulic and Pneumatic Circuits (8 Hrs, 12 Marks)	
8a. Develop hydraulic circuits for specified applications 8b. Develop pneumatic circuit for specified applications	8.1 Position dependent automatic reversal of piston 8.2 Pressure dependent automatic reversal of piston 8.3 Time dependent automatic reversal of piston 8.4 Continuous to and fro motion of D/A cylinder with roller operated valves and solenoid operated valves & limit switches. 8.5 Locked cylinders with pilot check valves 8.6 Regenerative circuit 8.7 Two hand safety circuit 8.8 Rapid Feed Return circuit 8.9 Cylinder Synchronizing Circuits (Series and parallel) 8.10 Hydraulic circuits for Milling machine, Shaper machine and surface grinding machine

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
Section - I						
I	Introduction to hydraulic & Pneumatic systems	06	04	04	--	08
II	Pumps and Compressors	08	02	04	02	08
III	Hydraulic & Pneumatic Actuators	08	04	04	04	12

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
IV	Direction Control Valves in Hydraulic & Pneumatic Systems	10	04	04	04	12
	Total	32	14	16	10	40
	Section - II					
V	Pressure Control valves in Hydraulic & Pneumatic Systems	08	02	04	02	08
VI	Flow Control valves and Accessories in Hydraulic & Pneumatic Systems	10	02	04	06	12
VII	Hydro- Pneumatics and Electro-Pneumatics	06	04	04	--	08
VIII	Industrial Hydraulic and Pneumatic Circuits	08	--	06	06	12
	Total	32	08	18	14	40
	Total	**64**	**22**	**34**	**24**	**80**

9. SUGGESTED STUDENT ACTIVITIES

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

a. Prepare a journal based on practical performance in an Industrial fluid power laboratory. Journal consists of drawing, observations, essential measuring tools, equipment, and date of performance with teacher signature.
b. PowerPoint Presentation on hydraulic and Pneumatic brakes by a group of two/three students. (Duration:10 minutes)
c. PowerPoint Presentation on accessories used in hydraulics and pneumatics by a group of two/three students. (Duration:10 minutes)
d. Prepare a report of market survey of suppliers for fluid-powered Earth moving equipments like JCB, Mahindra Earth master by a group of four students.
e. Prepare chart on full imperial drawing sheet for ISO Symbols used in hydraulic & pneumatic systems by a group of two students.
f. Prepare a chart on a full imperial drawing sheet for the classification of pumps and actuators by a group of two students.
g. Prepare a Seminar/presentation on types of oil filters by a group of two/three students. (Duration:10 minutes)
h. Prepare display charts on types of seals and gaskets (actual samples) used in hydraulics.
i. Prepare a visit report of any automobile service station to observe the use of pneumatic hand tools.
j. Prepare a report of construction sites to observe JCB/Other hydraulic /pneumatic equipment for automation.

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. 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 C.O.s through classroom presentations (see implementation guideline for details).
c. For item No.9, teachers need 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
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 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. Conduct an industrial survey of oil used in hydraulic systems (types, desirable properties, manufacturers, specifications, trade names, selection of oil, cost, packing size, sample collection)
b. Conduct an industrial survey of oil filters and FRL unit (types, filtration material, constructional details, selection of filter, manufacturers, cost, sample collection)
c. Prepare a working model of a hydraulic crane using waste injections used by Doctors.
d. Prepare a report of agriculture equipment working on hydraulics and pneumatics. (field-based)
e. Prepare report of specifications of Hydraulic power pack and Pneumatic service unit(FRL Unit)
f. Collect technical specifications of Gear pumps, Vane pumps/other pumps (Internet based).
g. Prepare a visit report on the Pneumatic system used by Dentists.
h. Prepare a visit report on automobile vehicle cleaning service stations to observe the hydraulic actuator and system used.

i. Prepare display board by collecting sample of pipes and pipe fittings with specifications of different manufactures.(New/Worn out)
j. Prepare a tabulated summary for types of pipes available in the market. (Summary includes type, specification, size range, material, rate and applications).
k. Prepare a report on specifications, sketches of linear actuators and mounting methods.
l. Prepare a report on the working of the hydraulic jack and its system.
m. Prepare prototype working model of hydraulically operated hospital bed.
n. Prepare a demonstration model of a telescopic cylinder using PVC pipes.
o. Develop a working model of automation of bench vice used in carpentry/fitting shops.
p. Prepare a report of various pneumatic hand tools and its attachments.
q. Prepare cut section model of any hydraulic/pneumatic component.
r. Prepare report of hydraulic system used in Universal testing machine available in Strength of material laboratory.
s. Prepare report of construction and working of hydraulic press used in nearby machine/fabrication shop.
t. Prepare a report of the service center for common faults and remedies of hydraulic equipment.

12. SUGGESTED LEARNING RESOURCES

S.N.	Title	Author	Publisher, Edition and Year of publication, ISBN Number
1	Oil Hydraulic system- Principles and maintenance	Majumdar S.R	Tata McGraw Hill, ISBN: 9780074637487
2	Pneumatics Systems Principles and Maintenance	Majumdar S.R	Tata McGraw Hill,ISBN-978-0-07-460231-7
3	Fluid Power with applications	Anthony Esposito	Pearson Education, Inc 2000,ISBN 81-7758-580-0
4	Hydraulics and Pneumatics	Harry Stewart	Taraporewala Publication, ISBN:978-0672234125
5	Pneumatic Controls	Joji B.	Wiley India Pub. ISBN:978-8126515424
6	Hydraulics & Pneumatics A Technicians & Engineers Guide	Andrew Parr	Butterworth-Heinemann Publisher, ISBN: 9780080966755
7	Industrial Hydraulics Manual	-----	Vickers Systems International(Company Manual)
8	Product Catalogue of FESTO	-----	Company catalogue
9	Hydraulic And Pneumatic Power For Production Industrial Hydraulics	D. Stewart	Industrial Press INC. 200, Madison Avenue, New-York 10016.
10	Animation software for hydraulics and pneumatics	Any version available	-----

13. SOFTWARE/LEARNING WEBSITES

1. Hydrulic Pumps:https://en.wikipedia.org/wiki/Hydraulic_pump
2. Hydrulic Pumps:www.hydraulicspneumatics.com/.../HydraulicPumpsM/.../TechZone-HydraulicPumps.
3. Animation of Hydraulic pumps:https://www.youtube.com/watch?v=Qy1iV6EzNHg
4. Animation of Hydraulic pumps:https://www.youtube.com/watch?v=pWuxYnqYDnk
5. Eaton Pump assembly :https://www.youtube.com/watch?v=sEVTIRYHoGg
6. Video lectures of IIT Faculty :http://nptel.ac.in/courses/112105047/
7. Lecture series and notes by IIT faculty :http://nptel.ac.in/courses/112106175/
8. Pneumatic control valves animation:https://www.youtube.com/watch?v=XAItnsUcES0
9. Control valve symbol generation:https://www.youtube.com/watch?v=yIot4shcOkE
10. Animation of D.C. Valve:https://www.youtube.com/watch?v=jsMJbJQkGTs
11. Animation of 4/2,4/3 D.C Valves:https://www.youtube.com/watch?v=CQPwvWXbV3w
12. Animation of Hydraulic cylinder:https://www.youtube.com/watch?v=bovfDsAYSbc
13. Telescopic cylinder animation: https://www.youtube.com/watch?v=icaqvfAtccY

14. P.O. - COMPETENCY- CO MAPPING

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

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

Sign: Name: Dr. A. A. Gadhikar Mr. S. B. Kulkarni (Course Experts)	Sign: Name: Dr. N. G. Kulkarni. (Head of Department)
Sign: Name: Dr. N. G. Kulkarni. (Program Head) (Mechanical Engg Dept.)	Sign: Name: Shri. A. S. Zanpure. (CDC In charge)

Government Polytechnic, Pune

'180 OB' – Scheme

Programme	**Diploma in Mechanical Engineering**
Programme code	01/02/03/**04**/05/06/07/08/15/16/17/**18**/19/21/22/23/**24**/26
Name of Course	**Machine Design**
Course Code	**ME 4107**
Prerequisite course code and name	**AM 3104 Strength of Materials**
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	T/W	
04	00	02	06	Marks	80	20	25	25	150
				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

The design office of Industry is one of the significant job areas for Diploma Technicians. To enable a student to work there, he should know how to design simple machine elements, apply the knowledge of materials' strength, manufacturing processes, computer-aided drawing, etc. He should also be aware of economic considerations, usual design procedures, selection of appropriate material and use of standards.

3. COMPETENCY

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

- **Design simple machine elements**

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. Select suitable materials for designing machine elements.
2. Design joint, levers for various applications.
3. Design power transmission elements like shafts, keys and couplings.
4. Design fasteners, power screws and springs for various applications.
5. Select standard components from the design data book/manufacturer's catalogue.

5. SUGGESTED PRACTICALS/ EXERCISES

Sr. No.	Unit No.	Practical Exercises (Outcomes in Psychomotor Domain)	Relevant CO	Approximate Hours Required.
1.	1	1. Identify the material if IS designation is given or designate the material if the description is provided using a Databook. 2. Explain Fatigue failure, Theories of elastic failure. 3. Identify areas of stress concentration in a component and suggest a remedy (an assignment of question and answers type may be planned by the teacher based on Unit I).	1	02
2.	2	Design C frame/offset link, Levers.	2	02
3.	2	Design and draw joints.		04
4.	3	Design Shaft subjected to bending and twisting.	3	02
5	3	Design and draw couplings.		04
6.	4	Design eccentrically loaded bolts of wall or roof bracket.	4	02
7.	5	*Design and draw Screw clamps.	4	04
8	5	*Design and draw Screw jack.		04
9.	6	Design Helical coiled springs & Sketch of Leaf Spring.		04
10.	7	Sketch various types of Bearings. Select a Ball bearing from the Manufacturer's catalogue or Design Databook.	5	02
11	8	Complete a micro project based on guidelines provided in Sr. No. 11	1,2,3,4,5	02
Total Hrs.				**32**

***Students will draw assembly & details drawing for anyone from assignments from numbers 7 & 8.**

Sr.No.	Performance Indicators	Weightage in %
a.	Use of design data handbook for material selection.	10
b.	Calculation and result.	30
c.	Use of standards and finalizing the dimensions.	10
d.	Preparation of production drawing.	30
e.	Answer to sample questions.	10
f.	Submission of a 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 and aid to procure equipment by authorities concerned.

Sr.No.	Major Equipment/ Instruments Required	Experiment Sr. No.
1	Drawing hall equipped with a sufficient number of drawing boards.	all
2	Mini drafter and other drawing instruments.	all
3	Computer lab with CAD software (optional).	all

7. THEORY COMPONENTS

Unit Outcomes (UOs) (in the cognitive domain)	**Topics and Sub-topics**
Section I	
Unit - I Design Considerations (10 Hrs., 12 Marks)	
1a. Write steps in the Design 1b. Draw and explain Stress-strain and S-N curves 1c. Explain two theories of elastic failure. 1d. Use design data book 1e. Identify areas of stress concentration in a component and suggest remedies.	1.1 Machine design philosophy, Steps and procedure followed in Design, Aesthetic and Ergonomic consideration in Design. Design aspects for Manufacturing, Maintainability, Environment and Cost. 1.2 Types of loads and stresses, eccentric loading, Crushing and bearing stresses, strain, yield point, strength consideration, stress strain diagram, proof stress. 1.3 Reversed bending cycle, endurance limit S-N curve, fluctuating stresses concept and Fatigue failure. 1.4 Use of principal stress equations, maximum principal stress theory, maximum shear stress theory. 1.5 Use of design data books, Designation and selection of material, standardization. 1.6 Factors of safety, criteria for selection of F.S. 1.7 Stress concentration, meaning, causes and remedies.
Unit - II Design of Joints and Offset Link (10 Hrs., 10 Marks)	
2a. Design simple components and joints. 2b. Design C-frame/ Offset link. 2c. Design levers.	2.1 Forces resulting in direct tension, compression and shear. 2.2 Forces resulting in combined, direct and bending. Design of C- frame, offset link. 2.3 Design simple machine parts such as knuckle

	joint, turnbuckle, cotter joint. 2.4 Forces resulting in bending, designing lever of lever loaded safety valve, bell crank lever.
Unit - III Design of Shaft and Couplings (12 Hrs., 18 Marks)	
3a. Design shafts under Torsion, Bending and torsion. 3b. Design keys and couplings.	3.1 Design of hollow and solid shaft for combined loading. ASME code equations for shafts. Line shaft supported on two bearings with one or two pulleys (between the bearings) and overhung. Design of shaft based on rigidity. 3.2 Design of keys. 3.3 Types of couplings, Design of muff coupling, flange coupling, bushed pin type flexible coupling.
Section II	
Unit - IV Design of Fasteners (08 Hrs., 08 Marks)	
4a. Illustrate Bolt of uniform strength. 4b. Design eccentrically loaded bolted joints 4c. Design welded joints	4.1 Bolts of uniform strength. Design of bolted joints arranged symmetrically and subjected to eccentric loading (about one axis only). 4.2 Design of transverse and parallel fillet welded joints.
Unit - V Power Screw (12 Hrs., 12 Marks)	
5a. Sketch thread profiles 5b. Derive an equation for torque to overcome thread friction 5c. Design Screw jack, screw clamp.	5.1 Thread profiles used for power screws. 5.2 The torque is required for raising and lowering the load, Efficiency, self-locking and overhauling conditions. Stresses in power screws. 5.3 Design of screw jack, screw clamp. (Numerical problems limited to square threads only, exclude check for buckling of screw).
Unit - VI Design of Springs (08 Hrs., 12 Marks)	
6a. Classify and state functions of springs. 6b. Define Wahl's correction factor and explain its significance 6c. Design helical compression and tension springs. 6d. Sketch a leaf spring.	6.1 Classification, application and functions of springs. 6.2 Material for springs and specifications of spring. 6.3 Wahl's correction factor and its significance. 6.4 Design of helical springs with circular cross section wire only. 6.5 Leaf spring sketch, construction and application. (Numerical problem not expected).
Unit - VII Bearings (04 Hrs., 08 Marks)	
7a. Sketch various Bearings 7b. Define terms related to Bearings 7c. Select proper bearing for given application with prescribed procedure.	7.1 Types of bearings, common bearings used in practice, Types of ball and roller bearings. 7.2 Static capacity, Dynamic capacity, limiting speed, bearing life. 7.3 Selection of bearings from Manufacturer's catalogue causes of bearing failures, Mountings.

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
Section I						
I	**Design consideration**	10	00	06	06	12
II	**Design of joints and offset link**	10	00	04	06	10
III	**Design of Shaft and couplings**	12	06	00	12	18
Total		32	06	10	24	40
Section II						
IV	**Design of Fasteners**	08	00	04	04	08
V	**Power screw**	12	04	00	08	12
VI	**Design of springs**	08	04	02	06	12
VII	**Bearings**	04	04	04	00	08
Total		32	12	10	18	40
Total		**64**	**18**	**20**	**42**	**80**

9. SUGGESTED STUDENT ACTIVITIES

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

Students should conduct the following activities in groups and prepare reports of about five pages for each activity, also collect/record physical evidence for their (student's) portfolio, which will be helpful in their placement interviews:

a. Prepare a journal for the conducted practicals.
b. Undertake micro-projects.
c. Make a chart indicating different thread profiles and sizes required for different types of loads in case of screw jack, toggle jack, C-clamps and lead screw of machines.
d. Collect different types of springs and write applications of the same.
e. Collect different types of used bearings and make display models and their applications.

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. About ***15-20% of the topics/subtopics*** that are relatively simpler or descriptive in nature are 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. For item No.9, teachers need 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 operations.
g. Teachers should ask the students to go through instruction and technical manuals.

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

Only one micro-project is planned to be undertaken by a student that needs to be assigned to them. 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 that 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 should submit a 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. Take any day-to-day life component, find load and stresses, and prepare charts/models for the same.
b. Make models of various joints and levers highlight resisting sections of different elements.
c. Make models of various shafts, keys and pulleys highlight resisting sections.
d. Make models of various couplings highlight resisting sections of different elements.
e. Make a chart indicating different thread profiles and sizes required for different loads in case of screw jack, toggle jack, C-clamps and lead screw of machines.
f. Prepare a model of eccentrically loaded bolted and welded joints and highlight the maximum loaded section.
g. Prepare a list of different types of bearings used in a bike and write their specifications and basis for selection.
h. Prepare a list of different types of levers and springs used in a bike, bicycle, Auto Rickshaw, Moped and write their specifications and basis for selection.

12. SUGGESTED LEARNING RESOURCES

S. N.	Title of Book	Author	Publisher, Edition and Year of publication, ISBN Number
1	Design of Machine Elements	Bhandari V. B.	McGraw-hill education India Pvt. limited, New Delhi, 2017, ISBN-13:978-9339221126
2	Machine Design	Khurmi R. S. and Gupta J. K.	S. ChandNew Delhi, 2005, ISBN 10:8121925371 ISBN13:9788121925372
3	Machine Design	Jindal U. C.	Pearson Education India New Delhi, 2010, ISBN13: 9788131716595

4	Machine Design	Pandya and Shah	Charotar Publishing house Pvt. Ltd. Anand, Gujarat, 2015, ISBN-13:9789385039102
5	Mechanical Engineering Design	Shigley	McGraw-hill education India Pvt. limited, New Delhi, 2017, ISBN-13:978-9339221638
6	Design Data Book	PSG	PSG College of Technology Coimbatore, 2012, ISBN-10: 8192735508
7	Westermann Tables	Hermann Jutz & Eduard Scharkus	New Age International (P) Limited, ISBN:81-224-1730-2
8	IS Codes: IS 4218: 1967 ISO Metric Threads IS 2693: 1964 Cast Iron Flexible Couplings IS 2292: 1963 Taper keys and Keyways IS 2293: 1963 Gib Head Keys and Keyways IS 2389: 1963 Bolts, Screws, Nuts and Lock Nuts IS 4694: 1968 Square threads IS 808: 1967 Structural Steel SKF/NBC Catalogue for Bearings	ISO	Indian Standard Bureau New Delhi
9	Schaum's outline of theory and problems of machine design	A.S. Hall, A.R. Holowenko, H.G. Laughlin	Mcgraw-hill book company, ISBN-13: 9780070255951

13. SOFTWARE/LEARNING WEBSITES

1. http://nptel.ac.in/courses/112105124/
2. https://www.youtube.com/watch?v=CLeLFUrvO2g
3. www.machinedesignonline.com
4. www.engineeringtoolbox.com
5. https://www.youtube.com/watch?v=N5SckoiTDxA
6. https://www.youtube.com/watch?v=GfbcxJmjn9s
7. http://www.ignou.ac.in/upload/Unit-5-60
8. https://sizes.com/numbers/preferred_numbers.htm
9. www.robot-and-machines-design.com/en/articles/mech
10. http://www.youtube.com/flangedcoupling
11. http://www.youtube.com/screwjack

14. PO - COMPETENCY- CO MAPPING

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

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

Sign: Name: Mr. C. S. Ghadage Mr. B. B. Dome (Course Experts)	Sign: Name: Shri. N. G. Kulkarni (Head of Department)
Sign: Name: Dr. N. G. Kulkarni (Program Head) (Mechanical Engg. Dept.)	Sign: Name: Shri A. S. Zanpure (CDC In charge)

Government Polytechnic, Pune

'180 OB' – Scheme

Programme	**Diploma in Mechanical Engineering**
Programme code	01/02/03/**04**/05/06/07/08/15/16/17/**18**/19/21/22/23/**24**/26
Name of Course	**Production Technology**
Course Code	**WS 4101**
Prerequisite course code and name	**NA**
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	04	07	Marks	80	20	25	25	150
				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

Students should be trained about the wide range of production processes involved in the mass production of engineering components that need to be employed with due consideration of functional and economic aspects.

3. COMPETENCY

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

- **Operate various machines in a workshop to produce different 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 competency mentioned above**:**

1. Illustrate Drilling, boring, milling and broaching machines with their attachments.
2. Justify Finishing and superfinishing processes for given components.
3. Select the appropriate machine for gear manufacturing.
4. Suggest types of Jigs and fixtures and their elements for a given component.
5. Justify the importance and functions of PPC for manufacturing organization.

5. SUGGESTED PRACTICALS/ EXERCISES

Sr. No.	Unit No.	Practical Exercises (Outcomes in Psychomotor Domain)	Relevant CO	Approximate Hours Required.
1.	1	Two composite jobs and Journal / Report writing.	1,2,3,4,5	24
2.	2	Gear Milling using module cutter and Polygon milling.	1,3	20
3.	3	A job on center less Grinder / Demonstration.	2	16
4.	All	Complete a micro project based on guidelines provided in Sr. No. 11	1 to 3	04
		Total Hrs		**64**

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	Column and knee type milling machine along with dividing head (Length X width of the working table 800 mm X 300 mm)	2
2	Centerless Grinder	3

7. THEORY COMPONENTS

Unit Outcomes (UOs) (in cognitive domain)	**Topics and Sub-topics**
Section I	
Unit - I Drilling Machine And Boring Machines (04 Hrs, 12 Marks)	
1a. Describe construction and working of the given Drilling and boring machine with sketches. 1b. List the different types of operations to be performed by drilling and boring machines on a given job. 1c. Explain the nomenclature of a twist drill.	1.1 Classification of drilling machines, diagram, construction and working of sensitive drilling machine, Upright drilling machine, Radial drilling machine. 1.2 Twist drill nomenclature, Size of drilling machine, Accessories, Attachments. 1.3 Classification of boring machines, diagram construction and working of horizontal boring machine, vertical boring machine. 1.4 Drilling machine operations:- Drilling, Reaming, Boring, Counterboring, Countersinking and its applications. 1.5 Boring operations:- Face milling, Drilling, Machining flat surface, Turning cylindrical surface, Boring by tool head, Boring by a boring bar, Cutting off, Forming and its applications.
Unit - II Milling Machines (08 Hrs, 12 Marks)	
2a. Describe the construction and working of the given milling machine with sketches. 2b. Select the relevant milling cutter for the specific operation on the given job with justification. 2c. Name and draw different types of milling cutters.	2.1Classification of milling machine, diagram construction and working principles of column and knee type milling machine. 2.2 Milling processes, Up milling and Down milling, Milling operations and its applications. 2.3 Milling cutters- material, types of standard milling cutters, universal dividing head, different types of indexing methods.
Unit - III Broaching Machine (02 Hrs, 06 Marks)	
3a. Describe the construction and specification of the given broaching machine with sketches. 3b. Name the nomenclature of the given type of broach. 3c. Name and describe different applications.	3.1 Introduction to broaching, classification of broaching, broaching methods. 3.2 Diagram construction working of internal pull broach 3.3 Broaching machines0 - horizontal broaching machine, vertical broaching machine, continuous broaching machine, applications.

Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
Unit - IV Finishing And Superfinishing Processes (10 Hrs, 10 Marks)	
4a. Describe the construction and specification of the grinding machine with sketches. 4b. Select the grinding process for the given job with justification. 4c. Choose the relevant grinding wheel for the given job with justification. 4d. Describe superfinishing operations with sketches.	4.1 Types of grinding, grinding machines, all types of rough grinders, plain center-type grinders, centreless grinders, all surface grinders. 4.2 Grinding wheels, abrasive materials, bonding, selection of grinding wheels, dressing, types of dressing. 4.3 Super Finishing, honing, lapping.
Section II	
Unit – V Gear Production Machines (10 Hrs, 18 Marks)	
5a. Select relevant indexing and generating methods for the given gear. 5b. Choose a gear finishing method for the given job. 5c. Explain gear finishing method with a sketch. 5d. Explain gear generating method with sketch.	5.1 Gear tooth elements, introduction to gear shaping. 5.2 Working principle of gear shaping machine, gear shaping cutter. 5.3 Introduction to gear hobbing, cutters, working principle of gear hobbing machine, Gear finishing.
Unit - VI Jigs And Fixtures (08 Hrs, 14 Marks)	
6a. Explain the difference between jigs and fixtures. 6b. Explain types of jigs and fixtures with sketches. 6c. Explain job holding devices with sketches.	6.1 Definition, Utility in production, Comparison, Principles of Locations, Fool proofing. 6.2 Types of Jigs and fixtures. 6.3 Job holding devices.
Unit - VII Introduction of Production Planning And Control (06 Hrs, 08 Marks)	
7a. Explain meaning, scope, need of PPC. 7b. Explain functions of PPC. 7c. Identify PPC organization for given example	7.1 Meaning, scope and need of production planning and control. 7.2 Outcomes and functions of production planning and control. 7.3 Types of PPC organizations.

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
Section - I						
I	Drilling machine and boring machine	04	04	04	04	12
II	Milling machine	08	04	04	04	12
III	Broaching machine	02	02	02	02	06
IV	Finishing and superfinishing processes	10	02	02	06	10
Total		24	12	12	16	40
Section - II						
V	Gear production machines	10	04	04	10	18
VI	Jigs and Fixtures	08	04	04	06	14
VII	Introduction of production planning and control	06	02	02	04	08
Total		24	10	10	20	40
Total		**48**	**22**	**22**	**36**	**80**

9. SUGGESTED STUDENT ACTIVITIES

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

a. Prepare journals based on practical performance in the laboratory.
b. Visit manufacturing industries.
c. Write specifications of different machine tools observed during industrial visits.
d. 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 teach various topics/subtopics.
b. About ***15-20% of the topics/sub-topics*** which are relatively simpler or descriptive 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. For item No.9, teachers need 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, operations
g. Teachers should ask the students to go through instruction and Technical manuals

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

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 suggestive list of micro-projects is given here. The concerned faculty could add similar micro-projects:

a. Take any five components/ machine parts, identify machining processes required to manufacture it, and plan the sequence of operations.
   Prepare a display board to demonstrate types of gears.
b. Prepare a report with detailed specifications of machines available in the institute workshop.

12. SUGGESTED LEARNING RESOURCES

S.N.	Title	Author	Publisher, Edition and Year of publication, ISBN Number
1	Workshop Technology Vol- II	Choudhary Hajara S.K.	Media Promoters and Publishers Limited, Mumbai, 2005, ISBN: 9788185099156
2	Manufacturing Technology Vol - II	Rao P.N.	McGraw Hill, New York, 2005, ISBN: 9781259029561
3	Production Technology Vol-II	Khanna O.P.	Dhanpat Rai Publication, New Delhi, 2012 ISBN:10: 9383182032
4	Industrial Engineering and Production Management	Martand Telsang.	S.Chand & Company Ltd. New Delhi 2004 ISBN:10: 8121917735

13. SOFTWARE/LEARNING WEBSITES

1. http://nptel.ac.in
2. Simulation of machining processes from YouTube and educational websites.

14. PO - COMPETENCY- CO MAPPING

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

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

Sign: Name: Shri. V. J. Deshpande Smt. P. S. Sarode (Course Experts)	Sign: Name: Dr. N. G. Kulkarni (Head of Department)
Sign: Name: Dr. N. G. Kulkarni (Program Head) (Mechanical Engg. Dept.)	Sign: Name: Shri A. S. Zanpure (CDC In Charge)

Level 5 Curriculum

Government Polytechnic, Pune

'180OB' – Scheme

Programme	**Diploma in Mechanical Engineering**
Programme code	01/02/03/**04**/05/06/07/08/15/16/17/**18**/19/21/22/23/**24**/26
Name of Course	**Computer Aided 3D Modeling**
Course Code	**ME5101**
Prerequisite course code and name	**NA.**
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><th></th></tr>
<tr><td rowspan="2">01</td><td rowspan="2">00</td><td rowspan="2">04</td><td rowspan="2">05</td><td>Marks</td><td>00</td><td>50</td><td>50</td><td>50</td><td>150</td></tr>
<tr><td>Exam Duration</td><td>--</td><td>1 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

The market-driven economy demands frequent changes in product design, data collection, analysis & retrieval at much faster rates. Computers play a significant role in this diversified field, such as CAD, CAM, CIM simulation etc. It is essential for a Diploma Technician to know the latest Solid Modeling software used in the industries and acquire skills in operating different software's available such as Pro-E/ Creo, Catia, Solid Works, Unigraphics etc. This course deals with solid modeling concepts to enhance the modeling skills of diploma students.

3. COMPETENCY

This course aims to help the student to attain the following industry identified competency through various teaching-learning experiences:

- **Develop 'Solid Models' of given machine components using any parametric CAD 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 related to the competency mentioned above**:**

1. Prepare 2D Drawing using a sketcher workbench of any parametric CAD software.
2. Generate 3D Solid Models from the 2D sketch using Part workbench of any parametric CAD software.
3. Prepare assembly of part models using the Assembly workbench of any parametric CAD software.
4. Generate orthographic views of 3D solid models/assemblies using any parametric CAD software drafting workbench.

5. Plot/Print a drawing for a given part model/assembly.

5. SUGGESTED PRACTICALS/ EXERCISES

Sr. No.	**Unit No.**	**Practical Exercises** (Outcomes in Psychomotor Domain)	**Relevant CO**	**Approximate Hours Required.**
1	1,2	Introduction to Modeling software & its environments. Draw 2D sketches of the machine parts using 3-D modeling software (Minimum 05)	1,5	08
2	3	Create simple parts using features like extrude, revolve, ribs, chamfer, fillet, hole, pattern etc., from the given orthographic views. (Minimum 5)	2,5	08
3	5	Prepare a drawing template consisting of Nameplate, boundary lines and projection symbol.	4,5	04
4	5,6	Generate drawing views of Parts created in Ex. No.-2 on the drawing template giving all dimensions and Print on A4 size paper.	4,5	04
5	3	Create complex 3D parts using features extrude, revolve, sweep, ribs, chamfer, fillet, hole, pattern, draft, shell etc., from the given pictorial view (Minimum 5) and print anyone with a 3D printer in a group of 5 students.	2,5	08
6	5,6	Generate drawing views of Parts created in Ex. No.-5 on the drawing template giving all dimensions and Print on A4 size paper.	4,5	04
7	3,5,6	Create 3D part models of individual components of any TWO assemblies consisting of at least five parts. (e.g. assembly of Bench Vice, Drill Jig, Joints, Couplings, Bearings, Valves, Screw Jack, Lathe Tool	2,4,5	16

		Post, I.C.Engine piston and connecting rod etc). Generate drawing views of the parts on the drawing template with dimensions and Print on A4 size paper.		
8	4,5,6	Assemble parts created in Ex. No. 7. Generate and print orthographic views of assembly using the drawing template with one of the views is a sectional view along with a Bill of material on A4 size paper.	3,4,5	04
9	4,5,6	Create an exploded view of assemblies created in Ex. No. 7. Generate view and print on A4 size paper.	3,4,5	04
10	1,2,3,4,5, 6	Complete a micro project based on guidelines provided in Sr. No. 11	1,2,3,4,5	04
Total				**64**

Sr.No.	Performance Indicators	Weightage in %
a.	Use and selection of proper commands, Presentation and printing of drawings	40
b.	Able to answer oral questions	20
c.	Timely submission	20
d.	Attendance and punctuality.	20
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	Hardware: Desktop P.C. IntelCore i3 has Windows10 Pro 64 Bit OS with 8 GB RAM and a 1 TB hard disk.	All
2	Software: Any parametric solid modeling software.	All
3	Printer/ Plotter	10

7. THEORY COMPONENTS

Unit Outcomes (UOs) (in the cognitive domain)	**Topics and Sub-topics**
Unit – I Introduction To Modeling Software (2 Hrs, NA Marks)	
1a. Use the 3D Modeling software. 1b. Explain the use of all toolbars. 1c. Explain the use of various working environments in Modeling software.	1.1 Introduction to CAD, CAM and CAE. Various available CAD software. Parametric, associative and feature-based nature of CAD modeling software. 1.2 Tool bars:-Standard Toolbar, Sketch Toolbar,

Unit Outcomes (UOs) (in the cognitive domain)	**Topics and Sub-topics**
	Relationship Toolbar, View Toolbar, Drawing Toolbar, Feature Toolbar, Annotation Toolbar. 1.3 Feature Manager Design Tree: Design Manager, Property Manager, Configuration Manager. 1.4 Selection Method: Selection from Design Tree, Graphic Area.
Unit - II Sketching With Modeling Software (4 Hrs, NA Marks)	
2a. Describe the given sketcher commands. 2b. Demonstrate the given modify Commands. 2c. Apply dimensioning and Geometrical Constraints	2.1 Drawing tools include Line, Rectangle, Circle, Arc, Ellipse, Spline, etc. 2.2 Editing tools include Trim, Extend, Erase, Mirror, etc. 2.3 Modify tools: Chamfer, Fillet, Copy, Move, etc. 2.4 Linear, angular dimensions. 2.5 Dimensioning constraint and Geometrical constraint. 2.6 Drawing template: prepare a drawing template consisting of nameplate, boundary lines and projection symbol.
Unit - III Part Modeling (4 Hrs , NA Marks)	
3a. Prepare 3D Model of the part using different commands 3b. Use various editing and modifying commands 3c. Describe the intersection of a given solid.	3.1 Working in a 3D environment: Creating 3D Solid Models of simple machine parts. 3.2 Reference Geometry: Creating axis, Creating reference planes 3.3 Part tool: Extrude, Revolve, Sweep, Swept blend, Pattern, Hole and Rib etc. 3.4 Part Editing tool: Trim, Extend, Erase, Mirror, 3.5 Part Modify tool: Chamfer, Round, Copy, Move, Draft, Shell etc. 3.6 Intersect two solid components by inserting a new body option. Boolean operations: Union, subtract, intersection.
Unit - IV Assembly Of Parts(3 Hrs , NA Marks)	
4a. Use assembly tools to create an assembly of parts. 4b. Use explodes command to get the exploded view of the assembly.	4.1 Assembly toolbar, Feature manager design tree conventions. 4.2 Assembly constraints. 4.3 Exploded view. Generating Exploded view. View manager tools.

Unit Outcomes (UOs) (in the cognitive domain)	**Topics and Sub-topics**
Unit - V Drawing Environment (2 Hrs, NA Marks)	
5a. Use a drawing module to create orthographic views of part models. 5b. Use a drawing module to create orthographic views of a given assembly. 5c. Prepare a bill of material for assembly drawing.	5.1 Drawing environment. Using templates in Drawing. 5.2 Add Model/assembly in drawing module. 5.3 Generating orthographic views , isometric views. Creating sectional views, auxiliary view, detailed view, exploded view. 5.4 Add dimensions, notes, tolerances, surface roughness symbol, bill of material.
Unit - VI Printing And Additive Manufacturing (1 Hrs , NA Marks)	
6a. Plot / Print the Drawing on a sheet. 6b. Print the 3D Model using a 3D printer.	6.1 Plotters- Types of plotters and Printers. 6.2 Sheet setup. Page setup. Print selection, Print Preview and print document. 6.1 Additive manufacturing: 3D printing, Rapid prototyping. 6.2 Construction and working of 3D printer and Rapid prototyping machine. 6.3 Type and properties of the material for 3D printer and Rapid prototyping machine. 6.4 File format: STL (Stereo Lithography). 6.5 3D printer software: part import, orientation, processing and printing.

8. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

NA.

9. SUGGESTED STUDENT ACTIVITIES

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

a. Prepare journals based on practical performance in the laboratory.
b. Collect information about various CAD, CAM and CAE software used in industry, their applications and use.

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/subtopics*** that are relatively simpler or descriptive are 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. For 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. Use proper equivalent analogy to explain different concepts.
f. Use LCD projector to explain all topics and experiments.
g. The 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 them. 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 that integrate PrOs, UOs and ADOs (Affective Domain Outcomes). Each student will have to maintain a dated work diary 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 representative list of micro-projects is given here. The concerned faculty could add similar micro-projects:

a. 2D drawing: Each student will collect one or two drawings from the nearby industry/workshop, develop a model, and generate 2D drawing production drawings from it.
b. 3D Model: Each student will identify a minor assembly from the institute workshop/laboratory. Measure the dimensions of each part and prepare sketches. Using sketches, develop 3D models of parts and assembly. Plot the assembly and detail drawings. (e.g. Bench vice, Machine vice, Tool post, Couplings, Joints, Bearings etc.)
c. Create 3D models for parts to be manufactured for their manufacturing type of project and generate assembly and detail drawings.

12. SUGGESTED LEARNING RESOURCES

SN.	Title	Author	Publisher, Edition and Year of publication, ISBN Number
1	CATIA for Designers.	Sham Tickoo	18th Edition, Softcover, Cadcim Technologies, ISBN 978-1-64057-108-2
2	Pro/Engineer Wildfire 5.0 for Designers	Sham Tickoo	2012 edition, Dream Tech Publications, New Delhi, ISBN 978-93-5004-044-7
3	Solid Works for Designers	Sham Tickoo	Softcover, Cadcim Technologies
4	CREO Parametric 6.0 for engineers and designers	Sham Tickoo	2019 edition, BPB Publications, ISBN 978-93-89423-13-6

13. SOFTWARE/LEARNING WEBSITES

1. www.nptel.com
2. https://en.wikipedia.org/
3. www.slideshare.net/
4. http://www.solidworks.inlsw/products/3d-cad/3d-solid-modeling.htm
5. https:llwww.youtube.com/watch?v=vjX4PDJcFOI
6. https://www.youtube.com/watch?v=5BDHS4FN2-
7. https:llwww.youtube.com/watch?v=JjKs-lePlPY
8. https://www.youtube.com/watch?v=LaPp6DiYdOY&list=PLbjkHL0f0OsgqYNDDMhk4EOh_pbNRinc6
9. https://www.youtube.com/watch?v=MoHbGBb5_HE&list=PLbjkHL0f0OsgqYNDDMhk4EOh_pbNRinc6&index=2
10. https://www.youtube.com/watch?v=EfBVhLoWCqc&list=PLbjkHL0f0OsgqYNDDMhk4EOh_pbNRinc6&index=3
11. https://www.youtube.com/watch?v=2ahR_9M9DVs&list=PLbjkHL0f0OsgqYNDDMhk4EOh_pbNRinc6&index=4
12. https://www.youtube.com/watch?v=Z5ALvJf3sn0&list=PLbjkHL0f0OsgqYNDDMhk4EOh_pbNRinc6&index=5
13. https://www.youtube.com/watch?v=ku3u6jcaJtY&list=PLbjkHL0f0OsgqYNDDMhk4EOh_pbNRinc6&index=6
14. https://www.youtube.com/watch?v=R00W6bstVe4&list=PLbjkHL0f0OsgqYNDDMhk4EOh_pbNRinc6&index=9
15. https://www.youtube.com/watch?v=vSBp4ZXntSU&list=PLbjkHL0f0OsgqYNDDMhk4EOh_pbNRinc6&index=10
16. https://www.youtube.com/watch?v=UH_6-JigVcY&list=PLbjkHL0f0OsgqYNDDMhk4EOh_pbNRinc6&index=20
17. https://www.youtube.com/watch?v=6glpCzXvCbw
18. https://www.youtube.com/watch?v=Xf953H-WHqg
19. https://www.youtube.com/watch?v=xCR6wK1avyc
20. https://www.youtube.com/watch?v=OooD3Qib_q0
21. https://www.youtube.com/watch?v=5u4-xMnl2aQ
22. https://www.youtube.com/watch?v=hA27dgnjI9Y

23. https://www.youtube.com/watch?v=hpMFQnyqfg8
24. https://www.youtube.com/watch?v=IyJMksXemsA
25. https://www.youtube.com/watch?v=UH_6-JigVcY&list=PLbjkHL0f0OsgqYNDDMhk4EOh_pbNRinc6&index=20
26. https://www.youtube.com/watch?v=1DSJ795_3i0
27. https://www.youtube.com/watch?v=rK-4O0E6pCA
28. https://www.youtube.com/watch?v=JPJ2WXOCvyM
29. https://www.youtube.com/watch?v=CeK17bZo2k4
30. https://www.youtube.com/watch?v=QvWGAMLFxTY&list=PLbjkHL0f0OsgqYNDDMhk4EOh_pbNRinc6&index=18
31. https://www.youtube.com/watch?v=_qo7wUJbHf4
32. https://www.youtube.com/watch?v=Gsdy5cK5V8E

14. PO - COMPETENCY- CO MAPPING

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

	PSO1	PSO2
CO1	3	-
CO2	3	-
CO3	3	-
CO4	3	-
CO5	3	-

Sign: Name:Mr. M. W. Giridhar Mr. C. S. Ghadge (Course Experts)	Sign: Name: Dr.N.G.Kulkarni (Head of Department)
Sign: Name: Dr.N.G.Kulkarni (Program Head) (Mechanical EnggDept.)	Sign: Name: Shri A.S.Zanpure (CDC In Charge)

Government Polytechnic, Pune

'180 OB' – Scheme

Programme	**Diploma in Mechanical Engineering**
Programme code	01/02/03/**04**/05/06/07/08/15/16/17/**18**/19/21/22/23/**24**/26
Name of Course	**Refrigeration and Air Conditioning**
Course Code	**ME 5102**
Prerequisite course code and name	**Thermal Engineering (ME 3102), L1**
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 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">3</td><td rowspan="2">0</td><td rowspan="2">2</td><td rowspan="2">5</td><td>Marks</td><td>80</td><td>20</td><td>25</td><td>25</td><td>150</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, 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 21st century predicts revolutionary developments in Heating, Ventilation and Air Conditioning. Considering the extensive and increasing use of Heating, Ventilation and Air Conditioning for domestic, commercial and industrial applications and its challenges, Diploma Engineers must learn these systems. They should know the processes, equipment, methods of Heating, Ventilation and Air Conditioning with their functioning, maintenance, repairs and measures to meet the current demand

3. COMPETENCY

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

- **Maintain Refrigeration and air-conditioning 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 competency as mentioned above**:**

1 Calculate COP of the given refrigeration system.
2 Select different systems of refrigeration and air conditioning for the given application.
3 Select various refrigeration components and refrigerants for given refrigeration and air conditioning applications.
4 Calculate psychrometric properties using a psychrometric chart.
5 Determine cooling loads for Air-conditioning systems.

5. SUGGESTED PRACTICALS/ EXERCISES

Sr. No.	**Unit No.**	**Practical Exercises** (Outcomes in Psychomotor Domain)	**Relevant CO**	**Approximate Hours Required.**
1	1	Identify different components of Vapor compression cycle with their specification	1	2
2	1	Determine COP of given Vapor compression system	1	2
3	1	Demonstrate construction of Vapor absorption refrigeration System	1	2
4	2	Identify refrigerant for given applications	3	2
5	2	Demonstrate Leak Testing, Evacuation and Refrigerant charging process of any refrigeration system.	2	2
6	3	Dismantle and assemble hermitically Sealed compressor	3	2
7	3	Trial on Ice plant	3	2
8	3	Identify different components of Household refrigerator	2	2
9	4	Determine air properties using Psychrometer	4	2
10	5	Calculate cooling load of given laboratory	4,5	2
11	6	Determine the refrigeration capacity of unitary air conditioner	1,4,5	2
12	6	Identify different components of window/split air conditioner	2	2
13	6	Identify different components and control systems of Car air conditioner	2	2
14	3, 6	Hands-on practice on fault detection & repair of the given 1)refrigeration unit 2)air conditioning unit.	3	2
15	All	Complete a micro project based on guidelines provided in Sr. No. 11	1 to 5	4
Total Hrs				**32**

Sr. No.	Performance Indicators	Weightage in %
a.	Arrangement of available equipment or model	20
b.	Setting and operation	20
c.	Safety measures	10
d.	Observations and Recording	20
e.	Interpretation of result and Conclusion	10
f.	Answer to sample questions	10
g.	Submission of 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	Vapour compression Test rig consisting of Hermetically sealed compressor 1TR capacity, Air-cooled condenser, Expansion devices like TEV and capillary tube, Evaporator coils, with arrangements for measurement of COP of VCC and Heat Pump	1,2
2	Water cooler test rig up to 100 litres capacity- consisting of Hermetically sealed compressor 1.5 TR capacity, Forced Air-cooled condenser, Expansion devices like TEV and capillary tube, Evaporator coils	1,2
3	Aqua- Ammonia Vapour Absorption Refrigeration Test rig	3
4	Ice plant test Rig- consisting of Hermetically sealed compressor 1.5 TR capacity, Forced Air-cooled condenser, Expansion devices like TEV and capillary tube, Evaporator coils, brine tank, Stirrer	8
5	Household refrigerator cut section model	7
6	Hermetically sealed compressor cut section model	6,7
7	Psychrometer digital	10,11
8	Anemometer	11,12
9	Window air conditioner cut section Model with an arrangement of fault detection	13
10	Split / Window air conditioner test rig r- consisting of Hermetically sealed compressor 1.5 TR capacity, Forced Air cooled condenser, Expansion devices like TEV and capillary tube, Evaporator coils	12,13
11	Refrigerant Cylindersr12,R 22, R 134a, R 60` a, R602a9Qty one each)	5
12	Charging kit with a vacuum pump, Brazing Tool, Halide torch, flaring tools, swaging Tools, bending tool	5,15
13	Working model of Car air conditioner	14

7. THEORY COMPONENTS

Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
SECTION 1 (Refrigeration)	
UNIT I: Refrigeration Cycles (10 Hrs, 16 Marks)	
1a. Define basic terminologies of Refrigeration 1b. Represent Bell- Coleman cycle on P-v and T-s diagram 1c. Calculate Actual and theoretical COP of the given Vapour compression cycle. 1d. Represent VCC on P-H and T-S diagrams for different conditions. 1e. Calculate the refrigeration capacity for the given system 1f. State functions of different components used in Vapour Absorption refrigeration system 1g. Explain the working of the different vapour absorption system	1.1 The necessity of Refrigeration, Unit of Refrigeration, the concept of COP (actual and Theoretical) 1.2 Bell-Coleman cycle and its representation on P-V and T-S diagram with simple numerical. 1.3 Principle of Vapor Compression Cycle, Main components, Representation on P-H and T-S diagram, conditions- dry compression, the effect of superheating, effect of undercooling, Calculation of Refrigeration capacity and Power required 1.4 Vapour Absorption Cycle -- principle, its component, working of Aqua – Ammonia Vapour absorption system, working of Li-Br absorption system, Electrolux refrigerator- working, principal components, applications. Comparison between Vapour Compression system. and Vapour absorption system
UNIT II: Refrigerants (04 Hrs, 08 Marks)	
2a. List desirable properties of refrigerant 2b. Classify refrigerants 2c. Designate refrigerant 2d. Explain the effect of Refrigerant on Environment 2e. State the legislation imposed for controlling environment degradation by refrigerant.	2.1 Refrigerants, desirable properties, classification, designation of refrigerant, selection of refrigerant for relevant applications, 2.2 System vacuumization Charging processes, leak testing methods and processes. 2.3 Montreal protocol, Kyoto protocol. Concept of Ozone Layer Depletion, Green House effect, Global warming, Eco-friendly Refrigerants.
UNIT III: Vapor Compression Refrigeration Components and Systems (10 Hrs, 16 Marks)	
3a. Explain the working of the Refrigeration compressor for a given refrigeration system. 3b. Select condenser for a given refrigeration system with justification.	3.1 Refrigeration compressors - classification, construction and working of hermetically sealed compressor, open type compressor, rotary compressors-centrifugal, Screw and Scroll compressors and their applications. 3.2 Condensers- classification, working of air

Unit Outcomes (UOs) (in cognitive domain)	**Topics and Sub-topics**
3c. Explain construction and working of evaporator for given refrigeration system 3d. Select relevant Expansion device for a given refrigeration system with justification. 3e. Explain the working of specified auxiliary devices used in the refrigeration system 3f. Describe the working of different applications of vapour compression refrigeration system.	and water-cooled condensers, evaporative condensers, comparison and applications. 3.3 Evaporators- Classification- working of finned type, bared tube, plate type, flooded, shell and tube type evaporators, their applications. Chillers- Direct expansion and flooded type chillers, working and applications. 3.4 Expansion devices- classification, capillary tube, automatic expansion valve, thermostatic expansion valve, selection, working and application. 3.5 Other components- Drier, Solenoid valve, Thermostatic switch, defrosting devices, working and applications 3.6 Applications of Refrigeration, Household refrigerators, Water coolers, name of manufacturers and their products with capacity.
SECTION II (Air Conditioning)	
UNIT IV: Psychrometry (06 Hrs, 10 Marks)	
4a. Represent the given psychrometric processes in the Psychrometric chart 4b. Select relevant auxiliary components for a given air conditioning system. 4c. Describe the procedure to maintain the given air conditioning component	4.1 Air conditioning- necessity, types of air conditioning- comfort air conditioning, industrial air conditioning, applications. 4.2 Principle of Psychrometry, DBT,WBT DPT,RH etc Dalton's law of partial pressure, air properties referring to ASHRAE Handbook. 4.3 Psychrometric processes, Representation of processes on Psychrometric. chart. Types and construction of Psychrometers. 4.4 Components used for air conditioning- Humidifiers, dehumidifiers, filters, heating and cooling coils.
UNIT V: Cooling Load Calculation (06 Hrs, 10 Marks)	
5a. List human comfort conditions 5b. Identify the relevant sources of heat gain for the given situation with justification. 5c. Calculate the cooling load for the given situation	5.1 Comfort condition, heat exchange by the human body with the environment, factors affecting human comfort. 5.2 Calculation of Sensible and Latent heat gain sources. 5.3 Cooling load calculation for CAD LAB, HMED Cabin, Auditorium, Metrology laboratory, Classroom. 5.4

Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
UNIT VI: Air Conditioning Systems (12 Hrs, 20 Marks)	
6a. Classify Air conditioning system 6b. Explain the working of Unitary air conditioning system 6c. Explain the constructional features of central air conditioning 6d. Select relevant components for given air distribution system 6e. Select the insulating material for the given air conditioning system. 6f. Describe the procedure to maintain the given type of air conditioning system 6g. Explain the working of Automobile Air conditioning System	6.1 Classification of air conditioning system- Summer, winter, year-round air conditioning, construction, application, comparison. 6.2 Construction and working of window, split, package type air conditioners. 6.3 Central air conditioning- types, direct and indirect central air conditioning construction, capacity, application. 6.4 Concept of air handling unit, air distribution system- closed perimeter system, extended perimeter system, radial duct system, losses in ducts, construction and application of supply, return and make up ducts, grills, diffusers, types of fans and blowers. 6.5 Insulation- purpose, types of insulation, material and their properties. 6.6 Automobile Air conditioning system- working, different sensors and components. Climatic 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
Section – I						
I	Refrigeration Cycle	10	4	4	8	16
II	Refrigerants	04	2	2	4	08
III	Vapor Compression Refrigeration Components and Systems	10	4	4	8	16
	Total	24	10	10	20	40
Section – II						
IV	Psychrometry	06	2	2	6	10
V	Cooling Load Calculation	06	2	2	6	10
VI	Air Conditioning Systems	12	4	4	12	20
		24	8	8	24	40
	Total	**48**	**18**	**18**	**44**	**80**

9. SUGGESTED STUDENT ACTIVITIES

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

ii.

a) Prepare journals based on practical performed in the laboratory.
b) Follow the safety precautions.
c) Use various mechanical measuring instruments and equipment related to Heating, Ventilation and air conditioning
d) Read and use specifications of the Refrigeration and air conditioning equipment.
e) Library / Internet survey of HVAC systems
f) Prepare PowerPoint presentation or animation for understanding constructional details and working of different Centralized air conditioning systems.
g) Visit nearby malls/auditoriums/commercial complex/Dairy/Cold storages/Ice cream factory/Ice plant/Cinema Theaters to identify different components of Refrigeration and air conditioning 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/subtopics that are relatively simpler or descriptive are 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. For item No.9, teachers need to create opportunities and provisions for co-curricular activities.
d. Guide student(s) in undertaking micro-projects.
e. Correlate subtopics with actual domestic and industrial Refrigeration and air conditioning systems.
f. Use proper equivalent analogy to explain different concepts related to Psychrometry.
g. Use Flash/Animations to explain various applications of Refrigeration and air conditioning.

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) Prepare a duct layout of your institute building from AHU
b) Prepare a chart showing all the components of a household refrigerator.
c) Prepare a demonstration model of cold storage.
d) Measure Refrigeration capacity of split air conditioner.
e) Collect different air outlet devices used in Central air conditioning system
f) Download Manufacturer's catalogue of Refrigeration compressors.
g) Prepare display charts of types of refrigerant used in commercial and Industrial applications.
h) Visit to nearby Central air conditioning plant/Malls/Showrooms and collect information regarding air conditioning
i) Conduct market survey of household refrigerators, make, capacity, arrangement, features, commercial terms etc.
j) Conduct market survey of window air conditioner make, capacity, arrangement, features, commercial terms etc.
k) Collect information about automobile air conditioning of different vehicles.
l) Comparative study of various types of compressors with detailed specification & market survey.
m) Comparative study of various types of condensers with detailed specification & market survey.
n) Comparative study of various types of evaporators with detailed specification & market survey.
o) Comparative study of various types of expansion devices with detailed specification & market survey.
p) Study of different types of refrigerants with properties, designation, selection & applications.
q) Comparative study of different types of central air-conditioning system with detailed specification and visit analysis report. (viz. AHU,FCU,VAV)
r) To prepare bills of materials for the maintenance of the given Refrigeration and air conditioning equipment.

12. SUGGESTED LEARNING RESOURCES

S.N.	Title	Author	Publisher, Edition and Year of publication ,ISBN Number
1	Refrigeration and Air conditioning	Khurmi R. S.	S Chand publication, New Delhi, (2008), ISBN-10: 8121927811
2	Refrigeration and Air conditioning	Arora C. P.	Tata McGrawHill Publication, New Delhi, (2009), ISBN-13-978-07-008390-5
3	Basic Refrigeration and Air conditioning	Ananthnarayan P. M.	Tata McGrawHill Publication, New Delhi, (2013), ISBN- 9781259062704
4	Refrigeration and Air conditioning	Sapali S. N.	PHI publication, New Delhi, (2013) ISBN - 9788120348721
5	Refrigeration and Air conditioning	Prasad Manohar	New Age International, New Delhi, (2011), ISBN- 9788122414295
6	Refrigeration and Air conditioning	Ameen Ahmdul	PHI Publication, New Delhi, ISBN - 9788120326712
7	Principles of Refrigeration	Dossat R. J.	John Wiley and Sons Ltd, UK, (2009) ISBN 978-0130272706
8	ASHRAE Handbook	American Society of Heating, Refrigerating and Air-Conditioning Engineers	Amer Society of Heating; Har/Cdr edition (30 June 2016)

13. SOFTWARE/LEARNING WEBSITES

1. www.youtube.com/watch?v=52P0KbTNvok
2. www.youtube.com/watch?v=OXIZhqypNUI
3. www.youtube.com/watch?v=cobFAMZDS0o&start_radio=1&list=RDcobFAMZDS0o
4. www.youtube.com/watch?v=cobFAMZDS0o&list=RDcobFAMZDS0o&index=1
5. www.youtube.com/watch?v=Ll8Ku-mFQxE
6. www.youtube.com/watch?v=yQGFmBBvw1g&t=134s
7. www.youtube.com/watch?v=GSWt0zjLgIY
8. www.youtube.com/watch?v=PL0vU02QC4w
9. www.youtube.com/watch?v=lMqoKLli0Y4
10. www.youtube.com/watch?v=oSLOHCOw3yg
11. www.youtube.com/watch?v=6UMqdD6ejZQ
12. www.youtube.com/watch?v=7FxltQ41bZc

14. PO - COMPETENCY- CO MAPPING

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

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

Sign: Name Mr. A. S. Zanpure Mr. V. J. Deshpande (Course Expert /s)	Sign: Name: Dr. N.G.Kulkarni (Head of Department)
Sign: Name: Dr. N. G. Kulkarni (Program Head) (Mechanical Engg. Dept.)	Sign: Name: Shri A. S. Zanpure (CDC In charge)

Government Polytechnic Pune

'180OB' – Scheme

Programme	**Diploma in Mechanical Engineering**
Programme code	01/02/03/**04**/05/06/07/08/15/16/17/**18**/19/21/22/23/**24**/26
Name of Course	**Automobile Engineering**
Course Code	**ME 5103**
Prerequisite course code and name	**NA**
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 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

Due to the ever-increasing population in the developing cities in India, the need for transportation facilities is increasing. There is a tremendous rise in the number of automobiles. To meet the demand of the service industry, a Mechanical Engineer should have an overall view of automobiles before entering the automobile manufacturing and service industry.

This course aims to:

- Make the student capable of working in various shops of the automobile industry.
- Create awareness about the problems and their remedies of automobiles during their use.
- Create awareness about new standards used in the modern automobile industry.
- Create awareness about new technologies used in the modern automobile industry.

3. COMPETENCY

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

- **Carry out PDI and Maintenance of an automobile**.

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 as mentioned above**:**

1. Use general purpose and special tools required in automobile workshops.
2. Inspect different parts of various systems of the automobile.
3. Inspect different elements of starting and charging circuit of an automobile.
4. Carry out oiling and greasing of different components.
5. Identify different components of Automobile Control Units.

+

5. SUGGESTED PRACTICALS/ EXERCISES

Sr. No.	**Unit No.**	**Practical Exercises** (Outcomes in Psychomotor Domain)	**Relevant CO**	**Approximate Hours Required.**
1.	1	Identify the various components/systems of the automobile for carry out PDI.	1	02
2.	2	Dismantle / Assemble a Manual Transmission and calculate the gear ratios.	1,2	04
3.		Observe components of a Torque Converter	2	02
4.		Dismantle/ assemble an Automatic transmission for understanding the power flow.	1,2	04
5.	3	Dismantle / Assemble a Differential.	1,2	02
6.	4	Inspect the starting and charging system of an automobile	3,4	02
7.	5	Identify links of a steering system.	2	02
8.	6	Perform maintenance of brakes in a car.	1,2	04
9.	7	Identify different parts of independent & conventional suspensions system.	2	02
10.	8	Trace the locations of different control units in a car and state their functions.	5	04
11.	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, performing task, Following safety measures	50
b.	Observations, Interpretation and conclusion	30
c.	Answer to sample questions and submission in time	20
Total		**100**

6. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

The major equipment with broad specifications 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	Working car	All
2	Tool box containing general-purpose tools, and special tools for the car	All
3	Coolant tester and hygrometer	1
4	Multimeter, amp clamp, battery charger	4
5	Manual Transmission, Automatic transmission, Torque convertor, Differential, Steering gears,	2,3,4 and 5

7. THEORY COMPONENTS

Unit Outcomes (UOs) (in the cognitive domain)	**Topics and Sub-topics**
Section I	
Unit – I Introduction (02 Hrs, 04 Marks)	
1a. Compare the salient features of the automobile 1b. State resistance to motion 1c. Compare different chassis	1.1 Classification of Automobile. 1.2 Resistance to vehicle motion – rolling resistance, wind resistance, gradient resistance, inertia resistance. 1.3 Types of Chassis and their functions
Unit - II Transmission Systems I (10 Hrs, 16 Marks)	
2a. Explain construction and working of clutches with sketch 2b. Explain construction and working of gearboxes with neat sketch	2.1 Automobile clutches – construction and working of a single plate, multi-plate, cone clutch, centrifugal clutch. Faults and remedies/repairs of clutches. (Brief description) 2.2 Gear Box – Construction and working of sliding mesh, constant mesh, synchromesh and epicyclic gearbox, torque converter, Faults and remedies/repairs of gear box.

Unit Outcomes (UOs) (in the cognitive domain)	**Topics and Sub-topics**
Unit - III Transmission Systems II (08 Hrs, 12 Marks)	
3a. Explain the function of different joints. 3b. Explain the working of different axles 3c. Compare different types of wheels and tyres 3d. Write specification of tyres	3.1 Propeller shaft and U joint – construction and working of Universal joint, Rzeppa joint, C.V. joint. 3.2 Differential - function, construction, working principal, Transfer case. 3.3 Rear axle and bearing – types, semi-floating, full floating bearing, three quarter floating axle. 3.4 Wheels and tires – requirements of automobile wheels, disk wheel, wire wheel. Functions and desirable properties of tires. Conventional tube and tubeless tires, car-case types, cross ply, radial ply, belted bias. Considerations in tread design. 3.5 Tire specification, tire rotation, tire wear patterns and remedies, tire life.
Unit - IV Electric Systems (04 Hrs, 08 Marks)	
4a. Differentiate between dynamo and alternator. 4b. Define battery capacity ratings 4c. Explain the working of starting system and starting drives.	4.1 Construction and working of dynamo and alternator, specifications of alternator cutouts, relay and regulator. 4.2 Automotive battery capacity rating, charging. 4.3 Starting system, Bendix drive, role of over running clutch drive.
Section II	
Unit - V Steering System (08 Hrs, 12 Marks)	
5a. Explain construction of steering linkages for rigid axle and independent Suspension with neat sketch 5b. Explain construction and working of steering gearboxes. 5c. Interpret the steering geometry for wheel alignment.	5.1 Front axle, types of stub axle, steering geometry, Ackerman's mechanism, under steer, oversteer, steering linkage for rigid and independent Suspension. 5.2 Type of steering gears – worm and wheel, re-circulating ball type, rack and pinion. Power steering: Hydraulic and electric/electronic. Faults and remedies of steering, wheel alignment, wheel balancing
Unit - VI Braking Systems (04 Hrs, 08 Marks)	
6a. Classify brakes used in automobiles, 6b. Explain the working of various elements of braking systems.	6.1 Types: drum brakes, disk brakes, hand brake/ parking, hydraulic, and air brakes. 6.2 ABS.

Unit Outcomes (UOs) (in the cognitive domain)	Topics and Sub-topics
	6.3 Brake troubleshooting,
Unit - VII Suspenssion Systems (08 Hrs, 12 Marks)	
7a. State the need and requirements of Suspension. 7b. Classify different springs as per application. 7c. Explain shock absorbers, and independent suspensions	7.1 The necessity of Suspension, Types of Suspension- the concept of passive and active Suspension. 7.2 Types of suspension springs: leaf spring, coil spring, torsion bar, rubber, anti-roll bar, air suspension. Introduction to active and passive suspensions. 7.3 Shock absorbers. 7.4 Independent Suspension: Wishbone and Mac-Pherson strut type. 7.5 Concept of pitching, rolling, bouncing.
Unit - VIII Automotive Control Units (04 Hrs, 08 Marks)	
8a. State the need of control unit. 8b. Explain the construction of a control unit. 8c. Explain the necessity of interlinking the control units. 8d. State different types of networking in a car	8.1 Necessity of control units in a car. 8.2 Components of a control unit. 8.3 Block diagram of different control units and their functions 8.4 Interlinking of control units: Necessity, specifications of types of networking in the car and their applications.(CAN, LIN, Flex ray, MOST)

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
Section I						
I	Introduction	2	4	0	0	4
II	Transmission System I	10	4	4	8	16
III	Transmission System II	8	4	4	4	12
IV	Electric Systems	4	0	4	4	8
Total		24	12	12	16	40
Section II						
I	Steering Systems	8	4	4	4	12
II	Braking Systems	4	4	4	0	8
III	Suspension Systems	8	2	4	6	12
IV	Automotive Control Units	4	0	4	4	8
Total		24	10	16	14	40
Total		**48**	**22**	**28**	**30**	**80**

9. SUGGESTED STUDENT ACTIVITIES

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

a. Prepare a comparative chart overall specifications of automobiles of same class
b. Survey of brake oil and engine oil used in automobiles.
c. Search information about ratings and specifications of batteries, alternators, starters,
d. Prepare posters to illustrate the organization chart in the automobile workshop.

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*** that are relatively simpler or descriptive are 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. For item No.9, teachers need to create opportunities and provisions for ***co-curricular activities***.
d. Guide students in undertaking micro-projects.
e. Correlate subtopics with power plant systems and equipment.
f. Use proper equivalent analogy to explain different concepts.
g. Use flash/animations to explain various components, operation.
h. Teachers 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 them. 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 that integrate PrOs, UOs and ADOs (Affective Domain Outcomes). Each student will have to maintain a dated work diary 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 representative list of micro-projects is given here. The concerned faculty could add similar micro-projects:

a. Prepare a chart of symbolic representation of different electrical-electronic components used in automobiles. (e.g. earthing, fuse, circuit breaker, capacitor, resistor, coil, switch, diode, motor, semiconductor etc.)

b. Collect information on chassis specifications of different vehicles.
c. Visit a modem service station and prepare a layout indicating various sections, specialized equipment, machines and basic amenities.
d. Prepare a case study on the following topics related to transport management through group discussion:
   i. Current public transport scenario in India
   ii. RTO policies for enhancing road safety
   iii. Importance of metro rail in the rapid transition system
   iv. Review of worldwide effective rapid transition systems (E.g. BRT System in Bogota, Singapore, Japan, Malaysia)
   v. Traffic crisis in metro cities: causes and cures
   vi. Role of motor vehicle department in transport management
e. Information search and market survey through magazines like Overdrive, Autocar, Auto India, internet surfing and site visits on following topics:
   i. Automobile manufacturers in India.
   ii. Aerodynamic optimization in automobiles.
   iii. Current (Indian/Worldwide) automobile market of 2/4 wheeler industry.
   iv. Upcoming vehicles on alternative fuels in the Indian auto industry.
   v. Adaptive suspension system
f. Prepare a chart of road traffic signs in mandatory, cautionary, and informatory categories. Display it in your department/institute.
g. Prepare a simple automobile lighting circuit display with wiring color codes.
h. Information search and market review on "Different types of automobile service tools and specialized equipment and machines" used in Modem Service Stations
i. Prepare a report on electric and hybrid vehicles.

12. SUGGESTED LEARNING RESOURCES

S.N.	Title	Author	Publisher, Edition and Year of publication, ISBN Number
1	Automobile Engg. Vol I	Dr. Kirpal Singh	Standard Publishers Distributors, Delhi, Edition 14 , ISBN- 9788180142420
2	Automobile Engg. Vol II	Dr. Kirpal Singh	Standard Publishers Distributors, Delhi, Edition 14 , ISBN- 9788180142512
3	Automotive Mechanics	Willam Crouse, Donald Anglin	Tata Mc-Graw Hill International, New Delhi, Edition 2007, ISBN - 9780070634351
4	Automotive Technology	H.M. Sethi	Tata McGraw Hill, Edition 1-1998, ISBN - 978-00746033-06
5	Automobile Engineering	K. K. Jain, R. B. Asthana	Tata McGraw Hill ,Edition 1 -2002, ISBN - 007044529X
6	Automotive Electrical Equipment	P. L. Kohli	Tata McGraw Hill, Edition 1- 1995 ISBN - 9780074602160
7	Automotive Mechanics	S. Shrinivasan	Tata McGraw Hill, Edition 1 – 1998 ISBN - 9780070966303

13. SOFTWARE/ LEARNING WEBSITES

1. http://nptel.ac.in/courses. (NPTEL)
2. http://www.cirtindia.com/testing_universalTyreTestingMachine.html. (CIRT, Pune)
3. https://www.saeindia.org/. (SAE India)
4. https://transport.maharashtra.gov.in/1161/Road-Signs. (RTO, M V Department, MS.)
5. https://www.youtube.com/watch?v=Y1 zbE21 PzlO. (Automatic Transmission)
6. https://www.youtube.com/watch?v=vOo3TLgLOkM. (Manual Transmission)
7. https://www.youtube.com/watch?v=aNGA5Ejq8A4. (Differential)
8. https:l/www.youtube.com/watch?v=VFu-6tckyc8. (Rear Axle)
9. https://www.youtube.com/watch?v=IrBE8k9rlr8. (Radial and Tubeless Tyre)
10. https:l/www.youtube.com/watch?v=hnsvkpOP8_g. (Alloy and Cast Wheel)

14. PO - COMPETENCY- CO MAPPING

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

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

Sign: Name: Mr. V. S. Sonawane Mr. R. R. Godbole (Course Experts)	Sign: Name: Dr. N. G. Kulkarni (Head of Department)
Sign: Name: Dr. N. G. Kulkarni (Program Head) (Mechanical Engg Dept.)	Sign: Name: Shri A. S. Zanpure (CDC In charge)

Government Polytechnic, Pune

'180 OB' – Scheme

Programme	**Diploma in Mechanical Engineering**
Programme code	01/02/03/**04**/05/06/07/08/15/16/17/**18**/19/21/22/23/**24**/26
Name of Course	**CIM and Robotics**
Course Code	**ME5104**
Prerequisite course code and name	**NA**
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
03	00	02	05	Marks	80	20	25	25	
				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

Diploma Engineers need to acquire the knowledge of Computer integrated Manufacturing (CIM) after getting conversant with conventional manufacturing methods. This subject encompasses the entire range of product development and manufacturing activities with the help of different software packages. The course intends to help the students to work on Group Technology, Material Requirement Planning and collection of factory data system

3. COMPETENCY

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

- **Use of Computer integrated manufacturing (CIM) technology in the current manufacturing 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 competency as mentioned above**:**

1. Prepare Computer Aided Design (CAD)/ Computer Aided Manufacturing (CAM)/(CIM) product cycle different products cycle.
2. Apply CAM and CIM practices.
3. Apply business function software in CIM.
4. Apply networking in CIM.
5. Use of Flexible Manufacturing System (FMS) and Automation concepts in industries.
6. Use of Robotics technology in industries.

5. SUGGESTED PRACTICALS/ EXERCISES

Sr. No.	**Unit No.**	**Practical Exercises** (Outcomes in Psychomotor Domain)	**Relevant CO**	**Approximate Hours Required.**
1.	1	Prepare a traditional product cycle for any one of the assemblies.	1	02
2	2	Use of CRM (Customer Relation Management) software for maintaining customer relationships.	2	02
3	2	Prepare a computer aided process plan for the selected part using variant CAPP (Computer Aided Process Planning) software.	2	02
4	2	Generate sample program for any part and verify tool path by simulation using CAM software.	2	02
5	2	Generate tool path movement by Interfacing part program or manual part program to CNC machine.	2	02
6	2	Use MRP (Material Resource Planning) software for CIM of and assembly.	2	02
7	3	Prepare the network topology and network hardware/ network software layout at your institute place.	2,3	02
8	3	Establish networking between two CNC machines, computers and supported peripherals of your institute to exchange manufacturing data and produce a simple component.	2,3	02
9	4	Observe actual/video film of FMS system and identify various elements of FMS and its nature of controlling by Computer.	4	02
10	4	Generate part family code for a machine component using Opitz/MICLASS methods.	4	02
11	4	Use FMS simulation software to generate a Flexible Manufacturing System simulated environment to control and program Automatic storage and Retrieval system (ASRS), linear shuttle conveyor, Interfacing of CNC lathe/milling, and loading unloading.	2,5	02

12	5	Observe actual / video film of robotics system and identify the various element, type of robot, its configurations and its nature of controlling by Computer	2,5	02
13	6	Observe the actual / video film of the autonomous robotics system and identify various elements and types of robot. its configurations and its nature of controlling by Computer	6	02
14	6	Use Teach Pendent/Offline programming/simulation software to program a robotic arm to perform tasks of pick and place and stacking of objects (2 programs)	6	02
15	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 and aid to procure equipment by authorities concerned.

Sr. No.	Major Equipment/ Instruments Required	Experiment Sr. No.
1	Computers minimum 4GB RAM and above	1 to 14
2	MRP/ ERP/ CRM/SCM and PLM software (1 + 10 user)	2,3,12,
3	Database Management system Software (1 + 10)	2,3,12,
4	Educational networking licensed CAD software (1 + 20 user)	2 & 4 To 7
5	Educational networking licensed CAM software (1 + 20 user)	2 & 4 To 7
6	CNC Milling Machine	9,10,
7	CNC lathe machine	9,10,
8	Educational networking licensed CAQC software (Computer Aided Quality Control) or CMM/other systems	11
9	Flexible Manufacturing System (FMS) model	2,3,12,13,14
10	Educational networking licensed FMS simulation software	11,12
11	Previous final year students sample projects containing low cost automation systems.	11,12
12	Educational programmable robotics arm to manipulate objects.	13,14
13	Educational networking licensed Robotic system simulation software	13,14

7. THEORY COMPONENTS

Outcomes (UOs) (in cognitive domain)	**Topics and Sub-topics**
Section I	
Unit – I Introduction to CIM (4 Hrs, 10 Marks)	
1a. Explain the traditional product cycle with a diagram and show all its elements. 1b. Explain the advantages and benefits of the given CIM system. 1c. Explain the given CAD/CAM/CIM product cycle with a diagram and show all its elements. 1d. Compare the given traditional product cycle with its counter CAD/CAM /CIM product cycle	1.1 **Traditional product cycle diagram-**role of marketing, R&D, design, PPC, quality control and sales departments. Disadvantages and limitations of a traditional product cycle. 1.2 **Current production needs-** production rate, quality, accuracy, repeatability, Flexibility, survival. 1.3 **CIM-**concept, advantages and benefits of CIM. 1.4 **Elements of CIM-** Computer aided design (CAD), computer process planning (CAPP), Computer aided manufacturing control (CAMC), and Computer aided business function (CABF). 1.5 **CAD/CAM/CIM product cycle diagram-** customer, marketing, Computer aided design (CAD), Computer aided process planning (CAPP), Computer aided manufacturing control (CAMC), Computer aided business function (CABF).
Unit-II - Product Cycle Development through CIM (12 Hrs, 18 Marks)	
2a. Explain part modeling procedure in CAD for the given component. 2b. Explain analysis, optimization and evaluation for the given part using any CAE software. 2c. Explain automated drafting procedure for the given component using any CAD software. 2d. Differentiate given two methods of CAPP justifying with suitable examples 2e. Explain the computerized part program generation procedure for the given part using any CAM software. 2f. Explain the procedure of part program interfacing to the given CNC machine. 2g. Justify the benefits of ERP, MRP, CRM, PLM, SCM using the corresponding software.	2.1 **Computer aided design (CAD)-**geometric modeling, finite element analysis and optimization, evaluation and design review (CAE), the concept of concurrent engineering, list of software for CAE, simulation, automated drafting and generation of report. 2.2 **Computer aided process planning (CAPP)-** concept of CAPP, structure of processes planning software, methods of CAPP-variant, generative. Computerized material resource planning (CMRP), computerized work scheduling. 2.3 C**omputer aided manufacturing control (CAMC)** – to generate computer program in machining. Interfacing part program to CNC. Computerized control monitoring and control, Computer aided quality control (CAQC). Programmable logic control (PLC), software list like SCADA etc. 2.4 **Computer aided business functions (CABF)-** Enterprise Resource Planning (ERP)-role of ERP in business, advantage and applications of ERP software. Material Resource Planning (MRP) **-** role of MRP in business, advantage and benefit. MRP software. Customer Relationship Management (CRM) - the role of CRM in business, advantage

	and applications. CRM software. 2.5 Product Lifecycle Management (PLM) - the role of PLM in business, advantage and applications. PLM software. 2.6. Supply Chain Management (SCM)- the role of SCM in business, advantage and applications. SCM software.
Unit– III CIM Hardware, Software, Networking & Data Base Management System(DBMS) (8 Hrs, 12 Marks)	
3a. Classify various types of actuators with justification. 3b. Draw constructional details of hydraulic actuators 3c. Select actuator for the given application with justification. 3d. Draw performance curves of Actuators	3.1 Hydraulic and Pneumatic Actuators: classification, function and applications 3.2 Construction and Working of Linear Actuators: - single acting (spring and gravity return), double acting (single and double piston rod end) Cylinders. 3.3 Construction and Working of Rotary Actuators: Gear, Gerotor, Vane, Piston motors. Motor performance. 3.4 Construction and Working of special designs: Telescopic, Tandem and Rod less cylinder.
Section II	
Unit –IV Group Technology and Flexible Manufacturing System (6 Hrs, 12 Marks)	
4a. Justify the concept of Group Technology and its benefits for the given situation. 4b. Classify the FMS based on Flexibility for the given types of layouts. 4c. Compare the given two manufacturing systems based on the given criteria with examples. 4d. Justify the use of FMS for the given situation with an examples	4.1 **Group Technology-**concept, basis for developing part families, part classification and coding with example, concept of cellular manufacturing. Advantages and limitations. 4.2 **Flexible Manufacturing System-** Introduction, concept, definition and need, sub systems of FMS, comparing with other manufacturing approaches. 4.3 **Major elements of FMS-**workstations, material handling and storage system, computer control system and human resource. 4.4 **Classification based on flexibility**-dedicated FMS, random order. 4.5 **Classification based on types of layouts**-inline layout type, rotary layout, rectangular layout, loop layout type , ladder layout type. Applications and benefits of FMS, advantages and disadvantages of FMS.
Unit –V Basics of Robotics (10 Hrs, 16 Marks)	
5a. Explain with sketches the function of the specified actuators used in a robot 5b List different types of grippers used in robots with diagrams 5c. Explain with sketches the	5.1 **Introduction to robotics-** definition of robot and robotics, advantages and disadvantages. 5.2 **Basic components of robot-**manipulator, end Effectors, actuators, sensors, controller, processor and software. 5.3 **Robot joints-**linear, orthogonal, rotational, twisting and revolving. 5.4 **Degree of freedom of robot-**vertical, radial,

degree of freedom of robot **5d** Draw details configuration of given robot	rotational traverse, wrist pitch, wrist yaw wrist roll. 5.5 **Actuators-**Construction and Working of Mechanical, hydraulic, pneumatic and electric actuators. 5.6 **End effectors-Construction and working of** grippers and types. 5.7 **Basic configuration of robot-** Cartesian, cylindrical, polar(spherical)
Unit –VI Applications of Robotics (8 Hrs, 12 Marks)	
6a. Justify the use of robots in the given industrial situation. 6b Explain with a neat sketch construction of different robots. 6c.State the maintenance procedure of robots 6d List different applications of Autonomous robot	6.1 Construction and working of robot for the following application a. Loading unloading, b. Material Handling c. Processing operations, d. Assembly of Machines e. Inspection. 6.3 Introduction to Maintenance of Robot – checkpoints, Maintenance schedule. 6.4 Autonomous robot- Introduction, Necessity, Advantages over conventional Robots, Applications

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
Section - I						
I	Introduction to CIM	04	02	04	04	10
II	Product Cycle Development through CIM	12	04	06	08	18
III	CIM Hardware, Software, Networking & Data Base Management	08	02	04	06	12
Total		24	08	14	18	40
Section – II						
IV	Group Technology and Flexible Manufacturing System	06	02	04	06	12
V	Basics of Robotics	10	04	06	06	16
VI	Applications of Robotics	08	02	04	06	12
Total		24	08	14	18	40
Total		**48**	**16**	**28**	**36**	**80**

9. SUGGESTED STUDENT ACTIVITIES

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

a. Prepare journals based on practical performed in the laboratory.
b. Follow the safety precautions.
c. Use various software and equipment related to CAD/CAM/CIM/CAE/CAPP
d. Read and use specifications various software and equipment related to CAD/CAM/CIM/CAE/CAPP
e. Library / Internet survey of CAD/CAM/CIM/CAE/CAPP/FMS.
f. Prepare powerpoint presentation or animation for GT/FMS/CIM/PLM
g. Perform a Market survey of business functions such as Flipkart /amazon service etc.
h. Visit Industries and Companies consisting of CIM, FMS, automation and robot systems.
i. Survey any one of the companies, study its product cycle, and compare it with the CIM product cycle.
j. Visit any industry to understand total CIM product cycle functions.

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*** that are relatively simpler or descriptive are 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. For item No.9, teachers need to create opportunities and provisions for ***co-curricular activities***.
d. Guide student(s) in undertaking micro-projects.
e. Arrange a visit to nearby industries for understanding CIM functions.
f. Show video on films to explain CIM/FMS/automation/robot technology functioning.

11. SUGGESTED MICRO-PROJECTS

Only one micro-project is planned to be undertaken by a student that needs to be assigned to them. 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 that 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. Collect information of any company and compare every step with the CIM product cycle.
b. Prepare a report related to suggestions to control business function according to CIM product cycle.
c. Collect information of advanced techniques related with quality control from nearby industry
d. Collect the different ERP, MRP PLM, SCM, DBMS and CRM software names, company name, product name, and features.
e. Perform web search and prepare a report on the latest advancements and industrial practices in India and abroad in CAD/CAM/CAPP/CAE/CIM/FMS/ ERP, MRP/PLM/SCM/DBMS and CRM.

12. SUGGESTED LEARNING RESOURCES

S.N.	Title	Author	Publisher, Edition and Year of publication ISBN Number
1	Automation Production System and Computer Integrated Manufacturing	Groover. Mikell P.	Pearson Education, Canada, (2018), ISBN-978-93-325-4981-4
2	CAD/CAM/CIM	Radhakrishnan. P.	New Age International Publisher, New Delhi, (2008) ISBN-97-81-224-3980-9
3	Computer Aided Manufacturing	Rao. P. N.	McGrawhill Education, New Delhi, (2010) ISBN- 9780074631034
4	Principles of computer Integrated Manufacturing	Kant. S.	PHI Learning, New Delhi, (1995), ISBN-10: 812031476X
5	Cim: Principles of Computer-Integrated Manufacturing	Waldner. J. B.	John Wiley & Sons Inc. UK, (1992), ISBN- 9780471934509

13. SOFTWARE/LEARNING WEBSITES

1. http://nptel.ac.in/courses/112102103/17
2. http://nptel.ac.in/courses/112107077/module5/lecture2/lecture2.pdf
3. http://www.intelitek.com/pdf/DS01_BU_CIM-A_100761.pdf
4. https://www.researchgate.net/post/What_are_the_differences_among_flexible_manufacturing_system_FMS_computer_integrated_manufacturing_CIM_and_totally_integrated_automation_TIA
5. https://brainmass.com/business/kaizen/cad-cae-cam-cim-fms-manufacturing-47731
6. http://www.alphace.ac.in/downloads/notes/me/10me61.pdf
7. http://www.me.nchu.edu.tw/lab/CIM/www/courses/Computer%20Integrated%20Manufacturing/Chapter2%20-CIM-introduction.pdf

14. PO - COMPETENCY- CO MAPPING

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

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

Sign: Name: Mr. Sanjay Sudhakar Harip Mr. Chandrkant S. Ghadge (Course Experts)	Sign: Name: Dr. N. G. Kulkarni (Head of Department)
Sign: Name: Dr. N. G. Kulkarni (Program Head) (Mechanical Engg Dept.)	Sign: Name: Shri A. S. Zanpure (CDC In charge)

Government Polytechnic, Pune

'180 OB' – Scheme

Programme	**Diploma in Mechanical Engineering**
Programme code	01/02/03/**04**/05/06/07/08/15/16/17/**18**/19/21/22/23/**24**/26
Name of Course	**Tool Engineering**
Course Code	**ME 5105**
Prerequisite course code and name	**NA**
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
03	00	02	05	**Marks**	80	20	25	25	
				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

Tools are essential components required for any machining process. The quality and efficiency of any machining operation depend on the quality of tools, depending on the proper shape, size, and material. Productivity and quality of machining operations may further be enhanced by the proper and quick mounting of tools and jobs on machines using suitable Jigs and Fixtures. Therefore, this course attempts to develop abilities in students to select a tool of proper size and shape for required machining operation. The design of basic cutting tools, jigs and fixtures are also dealt with in this course

3. COMPETENCY

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

- **Use different types of tools, dies, jigs and fixtures to machine simple 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 competency mentioned above:

1. Select proper tools for manufacturing operations.
2. Interpret designation system of cutting tools and tool holders.
3. Select locating and clamping devices for components.
4. Select jig and Fixture for components.
5. Use various press tools and dies for given press tools operation.

5. SUGGESTED PRACTICALS/ EXERCISES

Sr. No.	Unit No.	**Practical Exercises** (Outcomes in Psychomotor Domain)	Relevant CO	Approximate Hours Required.
1	1	Identify different types of tools and their designation.	1	2
2	2	Draw the cutting tool nomenclature of a given single point cutting tool.	2	2
3	2	Re-sharpen any one Single Point Cutting Tool as per given specification	2	2
4	2	Determine forces on tool by Merchant's circle	2	2
5	3	Identify multipoint cutting tools available in the workshop with their designation	3	2
6	3	Select relevant cutting fluid for different machine tools available in a workshop with justification	3	2
7	4	Design a Jig and Fixture for machining of a given simple component	4	2
8	4	Draw assembly and detail drawing of the designed Jig.	4	4
9	4	Draw assembly and detail drawing of the designed Fixture.	4	2
10	5	Design a progressive cutting die for a simple component.	5	2
11	5	Draw assembly and detail drawing of the designed progressive cutting die	5	4
12	6	Design a bending dies for a given component	5	2
13	All	Complete a micro project based on guidelines provided in Sr. No. 11	1 to4	4
Total Hrs				**32**

Sr. No.	Performance Indicators	Weightage in %
a.	Arrangement of available equipment or model	20
b.	Setting and operation	20
c.	Safety measures	10
d.	Observations and Recording	20
e.	Interpretation of result and Conclusion	10
f.	Answer to sample questions	10
g.	Submission of 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	Single point cutting tool- 2 Qty	1,2,3,4
2	Drill – M12/M16/M20 size	5
3	Grinding Machine- Grinder Size 100 mm min.	2
4	Different Types of Cutting Fluid (any 4)	6

7. THEORY COMPONENTS

Unit Outcomes (UOs) (in cognitive domain)	**Topics and Sub-topics**
Section I	
Unit – I Mechanics Of Metal Cutting (04 Hrs, 08 Marks)	
1a. State the mechanism of chip formation 1b. Differentiate ASA and ORS system 1c. Classify chips 1d. Define Machinability Index	1.1. Introduction, mechanics of chip formation 1.2. Single point tool geometry- ASA System, ORS System, the importance of tool angles 1.3. Methods of machining- orthogonal and oblique cutting 1.4. Types of chips, tool materials 1.5. Machinability index, chip breakers
UNIT - II Design Of Single Point Cutting Tool (10 Hrs, 18 Marks)	
2a. State the shear angle required for the given job with justification 2b. Estimate cutting forces in the given simple numerical problem situation 2c. List factors affecting Tool life	2.1. Shear angle and its determination 2.2. Velocities in metal cutting processes, determination of un-deformed chip thickness 2.3. Force relations, Merchant's circle, theory

Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
2d. Calculate the Tool life of a given tool.	of Lee and Shaffer, cutting power, MRR, energy consideration in metal cutting, oblique cutting 2.4. Tool wear- types. Tool life- definition, criteria, variables affecting tool life 2.5. Types of single point cutting tools- solid tools, tipped tools, dimensions of the tool shank 2.6. Economics of metal cutting (problems on tool angles and tool life.)
Unit - III Design of Multi Point Cutting Tool and Cutting Fluids (10 Hrs, 14 Marks)	
3a. Design Milling cutter and drill for a given operation 3b. Classify cutting fluids 3c. Write applications of Cutting fluid 3d. State the necessity of the Form tool	3.1. Design of milling cutter 3.2. Design of drills 3.3. Cutting fluids- requirements, types, application, selection of cutting fluids 3.4. Form Tools-necessity, types, applications
Section II	
Unit - IV Jigs and Fixtures (08 Hrs, 14 Marks)	
4a. Concept, definition locating and clamping. 4b. Use of locating and clamping principles on the shop floor 4c. Jigs- Types construction, working and applications. 4d. Fixtures - Types construction, working and Applications 4e. Design considerations and procedure for designing of Jigs and fixtures	4.1. Introduction, definitions, the principle of pin location, design principle for location purposes 4.2. Clamping- principles, devices 4.3. Design principles for jigs and fixtures 4.4. Drilling jigs- design principles, bushes, types 4.5. Design principles of milling fixtures, lathe fixtures, assembly fixtures 4.6. Jigs and fixture construction- casting, fabrication, welding and comparison, 4.7. Jigs and fixtures for flexible parts.
Unit - V Press working and Cutting Dies (08 Hrs, 14 Marks)	
5a. Select suitable press tool operation for the given simple press tool component with justification. 5b. Prepare scrap strip layout for the given press tool component 5c. Design progressive cutting die for the given simple press tool component 5d. Design Blanking die for the given simple press tool component	5.1. Introduction, definitions of various press operations, types of press, press working terminology. 5.2. Cutting dies- types, principle, scrap strip layout, clearance applications, cutting forces, methods to reduce cutting forces, the minimum diameter of piercing. 5.3. Design of progressive cutting die: a. Sketch the component. b. Prepare scrap strip layout. c. Calculate tonnage. d. Determine centre of pressure. e. Determine dimensions of punches,

Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
	die block and die shoe. f. Prepare sketch of stripper plate. g. General assembly sketch of punches arrangement, die block, die shoe and stripper plate. 5.4. Strippers- types. Stock stops- latch stop, automatic stop, solid stop, strip feeding, knock-outs 5.5. Blanking dies- types, die block, die block thickness, die opening, fastening of die block, punch, backup plate, centre of pressure
Unit - VI Drawing, Bending and Forging Dies (08 Hrs, 12 Marks)	
6a. Calculate bend radius, bend allowance and spring back for the simple part. 6b. Draw labelled sketch of the given die(s). 6c. Select die(s) for the given part with justification.	6.1. Drawing dies- design consideration, types, no. of draws, drawing pressure, blank holding pressure, redraw dies. 6.2. Bending dies- bending methods, design principles, spring back, bending pressure. 6.3. Forging dies- Open die forging and closed die forging, Forging design factors- draft, fillet, parting line, shrinkage and die wear, mismatch, finish allowances, tolerance, webs and ribs.

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
Section - I						
I	Mechanics of Metal Cutting	04	2	2	4	08
II	Design of Single Point Cutting Tool	10	4	6	8	18
III	Design of Multi Point Cutting Tool and cutting Fluids	10	2	4	8	14
Total		24	8	12	20	40
Section - II						
IV	Jigs and Fixtures	08	2	4	8	14
V	Press working and Cutting Dies	08	2	4	8	14
VI	Drawing, Bending and Forging Dies	08	2	2	8	12
Total		24	6	10	24	40
Total		**48**	**14**	**22**	**44**	**80**

9. SUGGESTED STUDENT ACTIVITIES

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

a. Visit any industry and collect information related to tool engineering practices.
b. Prepare journal based on practical performed in Tool Engineering laboratory. Journal consists of drawing, observations, required materials, tools, equipments, date of performance with teacher signature.
c. Prepare/Download specifications of followings:
   i. Tools and equipment in Tool engineering laboratory.
   ii. Machinery in Tool Engineering laboratory
d. Undertake a market survey of local dealers for tools, equipments; machineries and raw material and prepare a report.
e. Visit any press tool industry and prepare a report consisting of
   i. Types of press
   ii. Types of dies
   iii. Types of operations
   iv. Types of fool proofing arrangement
   v. Safety precautions observed.

10. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

A suggestive list of micro-projects is given here. The concerned faculty could add similar micro-projects:

a. Massive open online courses (***MOOCs***) may be used to teach various topics/sub topics.
b. About ***15-20% of the topics/sub-topics*** that are relatively simpler or descriptive in nature are 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. For item No.9, teachers need 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. The 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 them. 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 that 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 should submit a 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. Preparation of Wax/Rubber model of various dies/single point cutting tools.
b. Collect various Carbide inserts as per ISO specification.
c. Measure press capacity of any press available in industry or nearby industry.
d. Design simple Clamping devices/Jigs/Fixtures/ for simple jobs.
e. Collect specifications of different Jigs and fixtures.
f. Sketch different jigs /fixtures/clamping devices available in institute workshop.
g. Identify and restrict degree of freedom of a given component for designing a clamping/locating device for a given machining operation.

12. SUGGESTED LEARNING RESOURCES

S.N.	Title	Author	Publisher, Edition and Year of publication ,ISBN Number
1	Tool Engineering and Design	Nagpal G. H.	Khanna Publication, 2003 ISBN : 817409203X
2	Tool Design	Donaldson Cyril	TATA Mcgraw Hill Education, 2000 ISBN: 9780070153929, 0070153922
3	Tool Engineering, Jigs and Fixture	Atkins Albert	McGraw-Hill, 1922 ISBN/ASIN: 1151454966
4	Fundamentals of Tool Engineering Design	Basu S. K.	Oxford Ibh, 1979 ISBN: 812040016X, 9788120400160
5	Machine tool and Tool Design	Sharma P. C.	S.Chand Publishing, 2012 ISBN: 9788121923620
6	Fundamentals of tool design	ASTME	Prentice Hall of India
7	Principles of tool & jig design	M. H. A. Kempster	English Universities Press

13. SOFTWARE/LEARNING WEBSITES

1. https://www.youtube.com/watch?v=Mn9jpqI8rao
2. https://www.youtube.com/watch?v=bUrp8JMRwx4andvl=en
3. https://www.youtube.com/watch?v=qaG_vxsfLUg
4. https://www.youtube.com/watch?v=EgTzD_8dUFc
5. https://www.youtube.com/watch?v=CrWxJ58la1E
6. https://www.youtube.com/watch?v=Pb20Rkx25yA
7. https://www.youtube.com/watch?v=Hp7UC5ite5M
8. https://www.youtube.com/watch?v=lcrK2Po8fJI

9. https://www.youtube.com/watch?v=_E1GCE2dDcY
10. https://www.youtube.com/watch?v=7yzvno4AvKw
11. https://www.youtube.com/watch?v=yoUxqeAN0So
12. https://www.youtube.com/watch?v=_r7djWX8X34
13. https://www.youtube.com/watch?v=Us7kjBmRL-Q
14. https://www.youtube.com/watch?v=S9qzJat3Mzk
15. https://www.youtube.com/watch?v=I71YrXafg0o
16. https://www.youtube.com/watch?v=wulJZzORm3wandpbjreload=10
17. https://www.youtube.com/watch?v=i5ZGSMXw5nU
18. https://www.youtube.com/watch?v=WJ_VlWd0EsA
19. https://www.youtube.com/watch?v=93-VH01ACB4
20. https://www.youtube.com/watch?v=MtNTFvP0uAI
21. https://www.youtube.com/watch?v=eqKa2gv9Kx0
22. https://www.youtube.com/watch?v=m8EoGASM0SI
23. https://www.youtube.com/watch?v=til4UOBTRg0

14. PO - COMPETENCY- CO MAPPING

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

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

Sign: Name: Mr. N. B. Hirlekar Mr. V. J. Deshpande (Course Experts)	Sign: Name: Dr. N. G. Kulkarni (Head of Department)
Sign: Name: Dr. N. G. Kulkarni (Program Head) (Mechanical Engg. Dept.)	Sign: Name: Shri. A. S. Zanpure (CDC In charge)

Government Polytechnic, Pune

'180 OB' – Scheme

Programme	**Diploma in Mechanical Engineering**
Programme code	01/02/03/**04/**05/06/07/08/15/16/17/**18/**19/21/22/23/**24**/26
Name of Course	**Advanced Welding Technology**
Course Code	**ME 5106**
Prerequisite course code and name	**NA**
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
03	00	02	05	**Marks**	80	20	25	25	
				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

Advanced Welding builds on knowledge and skills developed in Welding. Students will develop advanced welding concepts and skills related to personal and career development. This course integrates academic and technical knowledge and skills. Students will have opportunities to reinforce, apply, and transfer knowledge and skills to a variety of settings and problems.

3. COMPETENCY

This course aims to help the student to attain the following industry identified competency through various teaching-learning experiences:

- **Prepare different weld plans and supervise the fabrication of process equipment using various fabrication standards, codes and safety norms.**

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. Illustrate the working principle of various welding techniques and processes used in the fabrication industry.
2. Interpret the fabrication/welding drawings of process equipment.
3. Plan the fabrication processes requirements and weld testing methods.
4. Develop welding documents like WPS, WPQ, SWP and WTP.
5. Select application based method for erection, installation and commissioning of fabricated equipment.

5. SUGGESTED PRACTICALS/ EXERCISES

Sr. No.	Unit No.	**Practical Exercises** (Outcomes in Psychomotor Domain)	Relevant CO	Approximate Hours Required.
1.	1	Survey on various advanced welding equipment and selection criteria, specifications and manufacturers.	1	02
2.		Listing of welding electrodes for advanced welding processes and their application.	1	02
3.		Collect data for preparing WPS (Welding Procedure Specification) for the given structure.	2,3	02
4.		Prepare WPS for the given structure	2,4	02
5.	2	Collect data for Preparing WPQ (Welding Procedure Qualification) for the given structure.	2,3,4	02
6.	3	Prepare WPQ document/chart for the given structure.	2,3,4	02
7.		Prepare edges for the given weld joint.	2	02
8.		Use arc welding to fabricate a given joint with M.S. pieces	3,5	02
9.		Fabricate anyone complex job like a model of industrial shade/transmission tower/heat exchanger with multiple joints.	2,3,5	04
10.		Fabricate anyone complex job like a model of condenser/bridge structure/ship with multiple joints	2,3,5	04
11.	4	Test the given weld structure using the Liquid penetrant method.	3,5	02
12.		Test the given weld structure using the Ultrasonic testing method.	3,5	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.	Preparation of Job drawing, selection of material, machine and accessories	20
b.	Setup of welding machine, tool and Job	15
c.	Performing operations of a welding machine.	20
d.	Inspection of Job using measuring instrument.	15
e.	Answer to questions on operations	10
f.	Submission of job and workshop diary in time.	10
g.	Safety precautions and good housekeeping	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	Experiment Sr. No.
1	Welding power source rectifier. 1. AC input 440 volts, 3 ph., 50 Hz. 2. DC output 115 volts- 230 volts. 3. Output wattage (1 to 5 kW).	9 to 12
2	Portable Plate rolling machine. 1. Three high rolling machines with 0.5 meter length with max. plate thickness capacity up to 10mm. 2. 3-phase induction motor with 5kW capacity. 3. Suitable reduction gear box.	7 to 12
3	Gas cutting set. 1. Acetylene and oxygen gas cylinder. 2. Pressure regulator and gas flow measuring device. 3. Cutting torch with back fire arrestor. 4. Various nozzle tip sets (2 to 6 mm).	7 and 8

7. THEORY COMPONENTS

Unit Outcomes (UOs) (in cognitive domain)	**Topics and Sub-topics**
Section I	
Unit-I Introduction (3 Hrs., 8 Marks**)**	
1a. Estimate weldability of the given job. 1b. Classify different welding power sources. 1c. Select suitable power sources to weld the given weld structure with justification.	1.1 Importance and applications of Welding, classification of welding processes. Selection of welding processes. Need for fabrication technology in industries. 1.2 Weldability-concept, meaning, definition and factors affecting it and its importance. 1.3 Welding Power sources: Types, specifications, advantages and disadvantages.

Unit- II Interpretation of Welding Drawing (9 Hrs., 12 Marks**)**	
2a. Prepare a bill of material for the given weld structure. 2b. Explain the procedure for the given weld edge preparation. 2c. Prepare welding documents for the given weld structure. 2d. Use different standards and codes of Welding in the given drawing. Interpret the given welding drawing.	2.1 Welding symbols: As per IS 696-1972 2.2 Elementary and supplementary welding symbols, Abbreviations used for welding processes and welding position. Standard location of elements of a welding symbol. 2.3 Preparation of bill of material for following types of drawings: i.Welding / fabrication. ii. Process and instrumentation. iii. Piping isometric. 2.4 Types of weld joints: Butt, lap, corner, tee and edge. Methods of weld edge preparation as per ISO9692 2.5 Welding documents - Weld Test Plan (WTP), Shop Weld Plan (SWP). 2.6 Introduction to ASME section IX, Welding Procedure Specification (WPS), Welder Performance Qualification (WPQ). 2.7 Standards and Codes used in Fabrication industries: ASME, ASTM, AWS, IS, ISO, BIS, JIS, EN, DIN, TEMA, EJMA
Unit- III Welding Processes (12 Hrs., 20 Marks**)**	
3a. Use equipment/machineries for the given edge preparation. 3b. Select preheating, post-heating and PWHT method in the given situation. 3c. Select methods of relieving thermal stresses for given weld structure with justification. 3d. Set different arc welding parameters for the given job. 3e. Explain the given advance welding method(s) and welding automation. 3f. Use various fabrication procedures for the given weld structure.	3.1 Equipment/machines used for edge preparation, their working & features. 3.2 Preheating and interpass: need, method and applications. 3.3 Post heating-need, method and applications. 3.4 Post Weld Heat Treatment (PWHT)-need, methods, applications and selection criteria. 3.5 Methods of relieving thermal stresses. 3.6 Arc welding parameters-setting criteria: Voltage, Current, Welding speed, Welding feed, Arc length. 3.7 Advance welding methods and their applications. i.Ultrasonic welding. ii.Laser beam welding. iii. Electron beam welding. iii.Friction stir welding. 3.8 Automation in the fabrication process using robots. 3.9 Process equipment fabrication procedure.(like pressure vessels)

Section -II	
Unit– IV Weld Faults Inspection and Testing (6 Hrs., 12 Marks**)**	
4a. Identify the given weld fault(s) and their causes. 4b. Identify factors affecting weld quality with justification. 4c. Select a suitable method of testing the given weld structure with justification.	4.1 Common weld faults, their causes and remedies. 4.2 Thermal distortion: concept, meaning, definition, causes, effect and types. 4.3 Weld quality-concept, meaning, definition, importance and affecting factors. 4.4 Stages of inspection of weld faults. 4.5 Types, testing methods, and importance of destructive testing (DT). (Tensile test, compressive test, impact test, bend test, hardness test.) 4.6 Types, testing methods, and importance of Non-Destructive Testing (NDT). (Liquid penetrant testing, Magnetic Particle Testing, Ultrasonic Testing, Radiography Testing, Eddy Current Testing). 4.7 Special types of tests like Hydro test, Pneumatic test, and Leak test by soap water and helium gas.
Unit- V Finishing Process of Weld (9 Hrs, 14 Marks**)**	
5a. Explain the procedure to prepare and finish weld surfaces using the given suitable process. 5b. Explain the procedure to apply colour on weld surfaces using the given suitable process. 5c. Select suitable weld preparation and finishing operation for the given job with justification.	5.1 Surface preparation methods: sand blasting and ball blasting. 5.2 Surface finishing methods: brushing and grinding. 5.3 Surface colour coating: Brush, roller and spray
Unit -VI Installation, Erection and Commissioning and Safety (9 Hrs, 14 Marks**)**	
6a. Describe steps for erection, installation, and commissioning of the given weld structure. 6b. Suggest steps for erection, installation and commissioning for the given equipment with justification. 6c. Follow safety norms during the given fabrication activity(s).	6.1 Erection steps for common fabrication structure. 6.2 Erection steps for equipment to be fabricated. 6.3 Erection steps for piping. 6.4 Installation and commissioning procedures for plant machineries and fabricated equipment. 6.5 Need precautions and safety norms during the Welding and fabrication process. 6.6 ISO 18001(OHSAS)

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
Section - I						
I	Introduction	03	05	03	00	08
II	Interpretation of Welding Drawing	09	04	04	04	12
III	Welding Processes	12	06	06	08	20
Total		24	15	13	12	40
Section - II						
IV	Weld Faults Inspection and Testing	6	03	05	04	12
V	Finishing Process of Weld	9	03	04	07	14
VI	Installation, erection and commissioning and safety	9	04	06	04	14
Total		24	10	15	15	40
Total		**48**	**25**	**28**	**27**	**80**

9. SUGGESTED STUDENT ACTIVITIES

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

a. Visit a Fabrication shop and observe different weld joints and welding machines.
b. Visit a process equipment manufacturing industry to observe various fabrication processes/equipment and weld documents.
c. Visit any process industry to observe erection of weld structure.
d. Collect information regarding national and international fabrication industries. Collect information regarding third party inspection agencies
e. Do an internet-based survey of various standards and norms for the fabrication process.
f. Activity based learning on the topics from curriculum through Flipped classroom. Team games. Prepare a list of new welding methods and their applications.

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 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. For item No.9, teachers need to create opportunities and provisions for ***co-curricular activities***.
d. Guide student(s) in undertaking micro-projects.

11. SUGGESTED MICRO-PROJECTS

Only one micro-project is planned to be undertaken by a student that needs to be assigned to them. 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 that 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 a 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. Draw sketches of various weld joints.
b. Prepare bill of material for given weld structure.
c. Prepare various edges for the given weld joints.
d. Observe weld structures in the institute and write a report on it.
e. Prepare a model of a complex weld structure.
f. Conduct an industrial survey of process equipment manufacturing industry.
g. Prepare a working model of surface color coating equipment.
h. Prepare a report on information regarding national and international fabrication industries
i. Collect technical specifications of advanced welding machines.
j. Prepare a visit report of the fabrication industry.

12. SUGGESTED LEARNING RESOURCES

S.N.	Title	Author	Publisher, Edition and Year of publication ISBN Number
1	Welding technology.	Khanna O.P.	Dhanpat Rai Publications, New Delhi ISBN: 9788189928360, 8189928368 Edition: 22nd, 2008
2	Welding engineering and technology.	Parmar R.S.	Khanna Publishers, New Delhi ISBN: 9788174090287, 8174090282 Edition: 1, 2004
3	Modern arc welding Technology.	Nadkarni S.V	Advani Oerlikon, Mumbai ISBN: 9788120416765, 8120416767 Edition: 01, 2005
4	Structural steel fabrication and erection	Saxena S.K., Asthana R.B.	Somaiya Publishers, New Delhi 3rd edition ISBN-13 : 978-8877:99778
5	Metal cutting science and production technology	Jain K. C. Agrawal L.N.	Khanna Publishers, New Delhi 4th edition ISBN: 978-81-7409-099-7
6	Instrumentation	A. K. Sawhney	Nineteenth edition, 2017, Dhanpat Rai publication ASIN : B78N5OBBQ6

13. SOFTWARE/LEARNING WEBSITES

1. www.iitk.ac.in/mse/data
2. www.nptel.ac.in/courses/welding/lecture4
3. https://www.engineering.osu.edu
4. www.aws.org
5. www.careersinwelding.com
6. www.weldingalloys.com
7. www.adorweldingacademy.com
8. www.themanufacturinginstitute.org
9. www.asme.org
10. www.weldingdesign.com
11. www.engineeringtoolbox.com
12. www.asnt.org xi. www.twi-global.com
13. http:///www.vlab.com

14. PO - COMPETENCY- CO MAPPING

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

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

Sign: Name: Dr. S. R. Adhau Mr. R. S. Solanke (Course Experts)	Sign: Name: Dr. N. G. Kulkarni. (Head of Department)
Sign: Name: Dr. N. G. Kulkarni. (Program Head) (Mechanical Engg Dept.)	Sign: Name: Shri. A. S. Zanpure. (CDC In charge)

Government Polytechnic, Pune

'180 OB' – Scheme

Programme	**Diploma in Mechanical Engineering**
Programme code	01/02/03/**04**/05/06/07/08/15/16/17/**18**/19/21/22/23/**24**/26
Name of Course	**Advanced Manufacturing and CNC**
Course Code	**WS5101**
Prerequisite course code and name	**WS 3101, L1**
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 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

Mechanical technologists (diploma holders) work with men, machines and materials. With the advancements, newer difficult to machine materials and complex shapes with high surface finish is the demand of the manufacturing sector. To machine these materials and the complex geometries with very high surface finish, the student must know non-conventional machining processes like EDM, ECM, LBM, PAM, WJM, EBM, WEDM and CNC. This course is aimed to make them achiever the various outcomes required for the given jobs.

3. COMPETENCY

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

- **Use advanced manufacturing processes.**

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. Use non-conventional machines
2. Write CNC part programme.
3. Classify manufacturing operations and levels of Automations.
4. Use Group technology, Cellular Manufacturing, Flexible Manufacturing System and CIM.
5. Justify the need for various types of maintenance.

5. SUGGESTED PRACTICALS/ EXERCISES

Sr. No	Unit No.	Practical Exercises (Outcomes in Psychomotor Domain)	Relevant CO	Approximate Hours Required.
1.	1	Demonstrate working of any one non-conventional method EDM /WEDM/ECM /PAM/AJM /USM/ EBM /LBM.	1	2
2	2	Demonstrate working & function of various elements of CNC Turning and CNC machining centers.	2	2
3	3	Prepare CNC part program using G and M codes with ISO format for Simple job involving basic machining operations on Turning centers	2	3
4	3	Prepare CNC part program using G and M codes with ISO format for Simple job involving basic machining operations on machining centers.	2	3
5	3	Produce a simple job using a part program developed in sr. no.3 or sr. no. 4.	2	2
6	3	Prepare part program for CNC turning machine/machining center for job involving canned cycles/ Do loops/ Subroutine.	2	4
07	4	Collect information on any one of primary, secondary & tertiary types of Industry.	3	2
08	5	Demonstrate material handling system of any industrial assembly line	3	2
09	5	Demonstrate working of FMS.	4	2
10	6	Prepare maintenance chart of any one machine available in workshop.	5	3
11	6	Prepare a Repair cycle analysis of any machine / vehicle.	5	3
12	All	Complete a micro project based on guidelines provided in Sr. No. 11	1 to 5	4
Total Hrs				**32**

Sr. No.	Performance Indicators	Weightage in %
a.	Arrangement of available equipment / test rig or model	10
b.	Setting and operation	20
c.	Safety measures	10
d.	Writing CNC Programme /Report	20
e.	Observations and Recording	10
f.	Interpretation of result and Conclusion	10
g.	Answer to sample questions	10
h.	Submission of 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	Equipment of Anyone of the following manufacturing-process **EDM/WEDM/ECM/PAM/AJM/USM/ EBM/LBM/WJM**.	1
2	CNC Turning 250 with standard accessories and multi controller changing facility with simulated control panel and related software. Training or Productive type minimum diameter 25 mm, Length 120 mm with ATC. (Suggested)	2,3,4,5, and 6
3	CNC Milling 250 with standard accessories and multi controller changing facility with simulated control panel and related software. Training or Productive type-X axis travel – 225 mm, Y axis travel – 150 mm, Z axis travel – 115 mm, with ATC. (Suggested)	2,3,4,5, and 6

7. THEORY COMPONENTS

Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
Section 1	
Unit I: Non-Conventional Machining Processes (08 Hrs, 12 Marks)	
1a. Describe with sketches the working principle of the given non – conventional machining method and draw set up of the same. 1b. Describe advantages, limitations and applications of the given non –conventional machining method. 1c. State NCM method for the given job with justification. 1d. List process parameters for the given job and NCM process with justification.	1.1. Fundamentals of Non – conventional methods – Needs and types of non-conventional methods. Importance of methods. 1.2. Working principle, set up, process parameters of – EDM" WEDM ECM, PAM, AJM, USM, EBM and LBM. 1.3. Advantages, limitations and applications of – EDM, WEDM ECM, PAM, AJM, USM, EBM and LBM, WJM.
Unit II: Fundamentals of Computer Aided Manufacturing (CAM) (08 Hrs, 12 Marks)	
2a. State the function of the given element(s) of the CNC Machine. 2b. Select tool(s) and tool holders(s) used on CNC machine for the given job with justification. 2c. List different elements of CNC Machine 2d. Explain constructional features of CNC turning centers 2e. List different work holding devices	2.1. CAM concept, NC (Numerical Control), CNC (Computerized Numerical Control) and DNC (Direct Numerical Control) –concept, features and differences. 2.2. CNC machines: Types, classification, working and constructional constructional features Advantages, limitations and selection criteria. 2.3. Elements of CNC machines – Types, sketch, working and importance of: Slide ways; Re-circulating ball screw; Feedback devices (Transducer and encoder). Automatic tool changer (ATC); Automatic pallet changer (APC) 2.4. CNC tooling: Tool presetting-concept and importance; Qualified tools- definition need and advantages; Tool holders types and applications. 2.5. CNC turning centres: Types; Features; Axes nomenclature; Specification; Work holding devices -types, working and applications. 2.6. CNC machining centres: Types; Features; Axes nomenclature; Specification; Work holding devices-types, working and applications.
Unit III: CNC Part Programming (10 Hrs, 16 Marks)	
3a. Define various terminology related to CNC programming 3b. Interpret given CNC part programming code(s). 3c. Prepare part programme using G and M codes for	3.1. Definition and importance of various positions like machine zero, home position, work piece zero and programme zero. 3.2. CNC part programming, Programming format, and structure of part programme 3.3. ISO G and M code for turning and milling-

<table>
<tr><th>Unit Outcomes (UOs)
(in cognitive domain)</th><th>Topics and Sub-topics</th></tr>
<tr><td>the given job.
3d. Write advanced CNC part programming features like canned cycle, do loop, subroutine etc. in the given situation.
3e. Explain procedure for setting the given compensation(s) on the given CNC machine.</td><td>meaning and application of the important code.
3.4. Simple part programming for turning using ISO format having straight turning, taper turning (linear interpolation) and convex/concave turning (circular interpolation).
3.5. Simple part programming for milling using ISO format.
3.6. Importance, types, applications and format for: Canned cycles; Macro; Do loops; Subroutine;
3.7. CNC turning and milling part programming using canned cycles, Do loops and Subroutine.
3.8. Need and importance of various compensations: Tool length compensation; Pitch error compensation; Tool radius compensation; Tool offset.
3.9. Simple part programming using various compensations.</td></tr>
<tr><td colspan="2">Section 2</td></tr>
<tr><td colspan="2">Unit IV: Manufacturing Operations & Automation (06 Hrs, 12 Marks)</td></tr>
<tr><td>4a. Classify manufacturing industry and product
4b. Explain different type of manufacturing operation
4c. List different cost of manufacturing operation
4d. Name basic element of automated system.</td><td>4.1.Manufacturing Industries and products
4.2.Manufacturing operations-Processing and assembling operations, other factory operation.
4.3.Costs of manufacturing operation-fixed and variable cost, direct labour, material and overhead, cost of equipment usage.
4.4.Definition of Automation, Basic elements of Automated system-Power to accomplish the Automated process, Program of instruction, Control system, Reason for Automating, Automation principles and strategies- USA Principle-Ten Strategies for Automation and production, Levels of Automation</td></tr>
<tr><td colspan="2">Unit V: Manufacturing Systems (09 Hrs, 16 Marks)</td></tr>
<tr><td>5a. State term Group Technology
5b. Explain cellular manufacturing
5c. List applications of FMS.
5d. Explain concept of FMS
5e. Explain the Concept and element of CIM System</td><td>5.1. Group technology and Cellular Manufacturing: Part families, part classification & coding
5.2. Cellular manufacturing- composite part concept, Machine cell design.
5.3. Flexible Manufacturing System : FMS Concept, Component- Workstation, Material handling and storage system, computer control system and human resource
5.4. FMS Application and benefits, FMS planning & Implementation
5.5. CIM – Introduction to CIM, definition, Concept and elements of CIM system. Application of CIM.</td></tr>
</table>

Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
Unit VI: Maintenance of Machine Tool (07 Hrs, 12 Marks)	
6a. State need & importance of maintenance. 6b. List different types of maintenance. 6c. Describe maintenance record 6d. Explain Repair cycle analysis.	6.1. Need and Importance of Maintenance activity 6.2. Types of Maintenance: -Preventive, Predictive, corrective, scheduled & Breakdown maintenance. 6.3. Maintenance Manual and Maintenance Records 6.4. Repair cycle analysis.

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
Section - I						
I	Non-conventional machining processes	08	02	04	06	12
II	Fundamentals of computer aided manufacturing (CAM)	08	02	04	06	12
III	CNC part programming	10	04	04	08	16
Total		26	08	12	20	40
Section - II						
IV	Manufacturing operations & automation	06	04	04	04	12
V	Manufacturing systems	09	04	04	08	16
VI	Maintenance of Machine Tool	07	04	04	04	12
		22	12	12	16	40
Total		**48**	**20**	**24**	**36**	**80**

9. SUGGESTED STUDENT ACTIVITIES

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

a. Prepare journal based on practical performed in measurement laboratory. Journal consists of drawing, observations, required measuring tools, equipment's, date of performance with teacher signature.
b. Tabulate various cutting tools materials with main elements, properties and applications.

c. List process parameters for various machines (Each student will be given different machine).
d. Calculate RPM for lathe, milling cutter and drill spindle; based on given data. (Each student should be given different data for diameters and cutting speeds)
e. Prepare a report on at least one industrial component with its complete technical details covering the points like design criterion, features included with Dimensional/Geometric constraints, manufacturing resource requirements, challenges in controlling its quality and cost, etc.
f. Collect the technical details about all production facilities available at nearby industry/industries.
g. Visit or participate in technical events, exhibitions, conferences, seminars etc.
h. Collect/download at least four different machine tool catalogues, including one special purpose, non-conventional or advanced machine.
i. Collect/download at least one catalogue of cutting tool, work holding device and tool holder.

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*** that are relatively simpler or descriptive are 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. For item No.9, teachers need to create opportunities and provisions for co-curricular activities.
d. Guide student(s) in undertaking micro-projects.
e. Correlate subtopics with power plant systems and equipments.
f. Use proper equivalent analogy to explain different concepts.
g. Use Flash/Animations to explain various components, operation
h. The teacher should ask the students to go through instruction and Technical manuals.
i. Encourage students to refer to different websites to understand the subject better.
j. Observe continuously and monitor the performance of students in the Lab.
k. Arrange the industrial visits so that students can observe advanced machining processes.
l. Encourage students to watch various videos on YouTube or any particular website related to advanced machining processes used to produce a component.

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. Prepare a list of industrial components which are produced through non-conventional machining processes and describe the manufacturing procedure of the same in brief

b. Visit a work shop which contains latest industrial Turret lathe, Capstan lathe, Single spindle, automats, Automatic machines. Write a detail report on working of such machine or machines, parts produced, and other relevant information. Identify the jobs produced on such machines and draw the sketches of jobs.

c. Prepare a report on how to select parameters for machining Aluminum, Mild steel, Stainless steel and Inconel materials on CNC machine.

d. Comparative study of any two CNC turning centers or any two Vertical Machining centers and reports the differences.

e. Study and report 10 commonly used work piece materials and best grades of cutting tools that used to cut them efficiently.

f. Comparative study of two different CNC systems for turning centers: Fanuc and Fagor using suitable virtual CNC machine simulator software.

g. Visit nearby industry having CNC machines. List and recall important features of them. submit handwritten report of 500 words

h. Construct specifications of various types of CNC machines with images and names of manufacturers.

i. Download images and videos of CNC machines and its parts. Construct one VCD/DVD in a batch and submit them.

j. Download free simulation software's available on website and practice for part programming.

k. Study of two different CNC systems for VMC: Siemens and MITSUBISHI M 70 with the help of CNC machine simulator software and furnish the report

l. Explore PRO—FICNC programming manuals and watch PROFICNC on https://youtu.be/3ghwlpmhwpm to integrated CNC machine with multiple industry standard CNC controllers like FANUC, SIEMENS, FAGOR AND MITSUBISHIOpamp as adder, sub etc.

m. Write down the basic maintenance practice for Bearing, Coupling, Shaft and pulley, chain, machine belt, gears etc.

12. SUGGESTED LEARNING RESOURCES

S.N.	Title	Author	Publisher, Edition and Year of publication, ISBN Number
1	Unconventional manufacturing processes	Rao, K Vara Prasada	New Edge Publication, New Delhi,2009, ISBN: 978-81-224-2759-2
2	A text book of Production Engineering	Singh M.K.	New Edge Publication, New Delhi, 2009, ISBN: 978-81-224-2244-3
3	Advanced Machining Processes	Jain V. K.	Allied Publishers, Mumbai, 2009, ISBN 81-7764-294-4
4	CNC Machines,	Pabla B.S.	Adithan M. New Age International, New Delhi, 2014, ISBN: 9788122406696
5	Computer Numerical Control-Turning and Machining centres	Quesada Robert	Prentice Hall India, New Delhi, 2014, ISBN: 978-0130488671
6	CAD/CAM	Sareen Kuldeep	S. Chand, New Delhi, 2012, ISBN: 978812192874
7	Introduction to NC/CNC Machines	Vishal S.	S.K. Kataria and Sons, New Delhi, 2010, ISBN: 978-8188458110
8	Computer Aided Manufacturing	Rao P N, Tiwari N K, Kundra T	Tata McGraw Hill, New Delhi, 2017, ISBN: 978-0074631034
9	CAD/CAM: computer aided design and manufacturing	Groover Mikell P	Zimmered W Emory, Prentice Hall, New Delhi, 2011, ISBN: 9780131101302
10	Industrial engineering and Production Management	Martand Telsang	S Chand,1998, ISEB:81-219-1773-5

13. SOFTWARE/LEARNING WEBSITES

1. www.nptel.com
2. http://nptel.ac.in/video.php?subjectId=112105126
3. http://nptel.ac.in/courses.php?disciplineId=112
4. http://nptel.ac.in/courses/112104028/
5. http://nptel. ac. in/courses/112105126/27
6. http://www.youtube.com/watch?v=bmooEZyivxo
7. http://www.youtube.com/watch?v=mWy9awGv6so
8. http://www.youtube.com/watch?v=49GpJ7yhecg
9. http://www.youtube.com/watch?v=XfYXe1Z4IaY
10. http://www.youtube.com/watch?v=N7NofmHWWPQ
11. http://en.wikipedia.org/wiki/Microelectromechanical_systems
12. http://www.nptel.ac.inhttps://cadem.com/lms/
13. https://cadem.com/cncetc/
14. http://www.mtabindia.com
15. http://www.swansoftcncsimulator.com
16. https://goo.gl/4xvdhwhttps://goo.gl/fi4eqf
17. https://cadem.com/cncetc/

14. PO - COMPETENCY- CO MAPPING

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

	PSO1	PSO2
CO1	-	3
CO2	3	3
CO3	-	3
CO4	-	3
CO5	1	3

Sign: Name: Smt. V. G. Talkit Smt. P. S. Sarode (Course Experts)	Sign: Name: Dr. N. G. Kulkarni (Head of Department)
Sign: Name: Dr. N. G. Kulkarni (Program Head) (Mechanical Engg. Dept.)	Sign: Name: Shri. A. S. Zanpure (CDC In charge)

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/**15**/16/17/18/**19**/**21**/22/23/24/26
Name of Course	**Engineering Drawing**
Course Code	**ME2103**
Prerequisite course code and name	**NA**
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	04	06	Marks	80	20	00	25	125
				Exam Duration	4 Hrs	1.5 Hrs	--	--	--

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 a detailed description of any part to be manufactured or a dam to be built or an electric circuit to be used. For all technicians thorough 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 projection of lines and planes and regular solids.
5. 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)	--	02
2	01	01	Line letters and numbers. Dimensioning technique. One problem on Redraw the figure (Sheet No.1).	--	04
3	02	02	Engineering curves Any four problems (Sheet No.2)	1	08
4	03	03	Draw a problem on orthographic projections using First angle method of projection having plain surfaces. (Sheet No.3-Problem-1)	2	04
5	03	03	Draw a problem on orthographic projections using Third angle method of projection having plain surfaces. (Sheet No.3-Problem2)	2	04
6	03	04	Draw a problem on orthographic projections using first angle method of projection having slanting surfaces, cylindrical surfaces, ribs.(Sheet No-4-Problem-1)	2	04
7	03	04	Draw a problem on orthographic projections using Third angle method of projection having slanting surfaces, cylindrical surfaces, ribs.(Sheet No-4-Problem-2)	2	04
8	04	05	Draw a problem on sectional orthographic projections using first angle method of projection having slanting surfaces, cylindrical surfaces, ribs.(Sheet No-5-Problem-1)	2	04
9	04	05	Draw a problem on sectional orthographic projections using Third angle method of	2	04

Sr. No.	Unit No	Sheet No.	**Practical Exercises** (Learning Outcomes in Psychomotor Domain)	Relevant CO	Approx. Hrs. required
			projection having slanting surfaces, cylindrical surfaces, ribs.(Sheet No-5-Problem-2)		
10	05	06	Draw one problems on Isometric view of simple objects having plain and slanting and cylindrical surfaces by using natural scale.(Sheet No.6-Problem-1)	3	04
11	05	06	Draw one problems on Isometric projection of simple objects having plain and slanting and cylindrical surfaces by using isometric scale. (Sheet No.6-Problem-2)	3	04
12	06,07	07	Draw two problems on projection of straight lines and two problems on projection of planes.(Sheet no.7)	4	06
13	08	07	Draw two problems on projection of solid.(Sheet no.7)	4	04
14	09	08	Draw neat and proportionate free hand sketches. Any six elements (Sheet No.8)	5	04
15	All		Complete a micro project based on guidelines provided in Sr. no. 11	1 to 5	04
			Total		**64**

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.	Equipment Name with Broad Specifications	Experiment Sr.No
1	Drawing Table with Drawing Board of Full Imperial/ A1 size.	All
2	Models of objects for orthographic / isometric projections	3,4,5,6,7,8, 9
3	Models/ Charts of objects mentioned in unit no. 7	-
4	Set of various industrial drawings being used by industries.	All

Sr. No.	Equipment Name with Broad Specifications	Experiment Sr.No
5	Drawing equipment's and instruments for class room teaching-large size: a. T-square or drafter (Drafting Machine) b. Set squares (450 and 300- 600) 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. (02 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 constructions.	**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. 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, 16 Marks)	
2a. Explain different engineering curves with areas of application. **2b.** Draw different conic sections based on given situation. **2c.** Draw involute and cycloidal curves based on given data. **2d.** Draw helix and spiral curves from given data	**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. **2.5** To draw involute of circle, Regular polygon such as pentagon **2.6** To draw a cylindrical helix (limited to two turns). **2.7** To draw cycloid, epicycloids and hypocycloid.
Unit III: Orthographic Projections (06 Hrs, 08 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.)

<table>
<tr><th>Unit Outcomes (UOs)
(in cognitive domain)</th><th>Topics and Sub-topics</th></tr>
<tr><td colspan="2">Unit IV: Sectional orthographic views (04 Hrs, 08 Marks)</td></tr>
<tr><td>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</td><td>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</td></tr>
<tr><td colspan="2">Unit V: Isometric Projections (06 Hrs, 16 Marks)</td></tr>
<tr><td>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.
5d. Draw Isometric views from given orthographic views.</td><td>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 and slots on slanting surfaces.
5.5 Conversion of orthographic views into Isometric view/Projection.</td></tr>
<tr><td colspan="2">Unit VI: Projection of Lines (02 Hrs, 08 Marks)</td></tr>
<tr><td>6a. Classify various positions of lines with respect to projection planes.
6b. Draw projection of lines in different positions.</td><td>6.1 Projection of straight lines with following positions:
a) Parallel to both the planes.
b) Perpendicular to one plane.
c) Inclined to one plane and parallel to the other.
d) Inclined to both the planes. Traces of Line. (Concept purpose only ,No problems)</td></tr>
<tr><td colspan="2">Unit VII: Projection of Planes (02 Hrs, 08 Marks)</td></tr>
<tr><td>7a. Classify various types of planes according to orientations.
7b. Draw projection of planes with different orientations.</td><td>7.1 Projection of Planes with following orientations:
a) Plane parallel to one principal plane and perpendicular to the other.
b) Plane inclined to one principal plane and perpendicular to the other</td></tr>
<tr><td colspan="2">Unit VIII: Projection of solids (02 Hrs, 08 Marks)</td></tr>
<tr><td>8a. Classify various types of solids.
8b. Explain orientation of axis with respect to projection planes.
8c. Draw projection of standard regular solids like polyhedron, prisms, pyramids, solids of revolution.</td><td>8.1 Types of Solids
8.2 Projection of the following solids:
a) Regular Polyhedron – Tetrahedron,
b) Regular prisms and Pyramids – Triangular, Square, Pentagonal, Hexagonal</td></tr>
</table>

Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
	c) Regular solids of Revolution – Cylinder, Cone. With Axis: i) Perpendicular to one of the principal projection plane. ii) Inclined to one of the principal plane and parallel to the other. iii) Parallel to both principal planes
Unit IX: Free Hand Sketches (02 Hrs, 08 Marks)	
9a. Sketch proportionate freehand sketches of given machine elements. **9b.** Select proper fasteners and locking arrangement for given situation.	**9.1** 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.	02	--	--	--	--
II	Curve and Tangential exercises	06	--	16	--	16
III	Orthographic Projection	06	--	--	08	08
IV	Sectional orthographic views	04	--	--	08	08
V	Isometric Views	06	--	--	16	16
VI	Projection of Lines.	02	--	--	08	08
VII	Projection of Planes.	02	--	--	08	08
VIII	Projection of solids	02	--	--	08	08
IX	Free hand sketches	02	08	--	--	08
Total		32	**08**	**16**	**56**	**80**

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 a dated work diary consisting of individual contributions in the project work and give a seminar presentation of it before submission. The student ought to submit a 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 sketchbook.
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 sketchbook.
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. involute curves: Each batch will try to develop cardboard/thermocol working models which can generate involute curve of any regular geometrical shape.

h. Cycloidal curves: Each batch will collect 3 different sizes bicycle tyres and compare the locus of tube air valve by rolling them on flat road.
i. Conic curves: Each batch will go to institute's play ground 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.
j. Involute and Cycloidal curves: Each batch will collect one Involute and one cycloidal tooth profile spur gear and find out the Involute function.

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

1. https://www.youtube.com/watch?v=TJ4jGyD-WCw
2. https://www.youtube.com/watch?v=dmt6_n7Sgcg
3. https://www.youtube.com/watch?v=_MQScnLXL0M
4. https://www.youtube.com/watch?v=3WXPanCq9LI
5. https://www.youtube.com/watch?v=fvjk7PlxAuo
6. http://www.me.umn.edu/courses/me2011/handouts/engg%20graphics.pdf

14. PO - COMPETENCY- CO MAPPING (CIVIL 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	3	2
CO2	2	3	2
CO3	2	3	2
CO4	2	3	2
CO5	2	3	2

PO - COMPETENCY- CO MAPPING (METALLURGY 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	PSO4
CO1	2	1	1	1
CO2	2	1	1	1
CO3	2	1	1	1
CO4	2	1	1	1
CO5	2	1	1	1

Sign: Name: Shr. M. W. Giridhar (Course Expert) Sign: Name: Shri. M. R. Mundhe. (Course Expert)	Sign: Name: Dr. N. G. Kulkarni. (Head of Department)
Sign: Name: (Program Head) (Mechanical Engg Dept.)	Sign: Name: Shri A. S. Zanpure. (CDC In charge)

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	**NA**
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. (Course Expert) Sign: Shri. M. W. Giridhar (Course Expert)	Sign: Name: Dr. N. G. Kulkarni. (Head of Department)
Sign: Name: (Program Head) (Mechanical Engg Dept.)	Sign: Name: Shri A. S. Zanpure. (CDC In charge)

Government Polytechnic, Pune

'180 OB' – Scheme

Programme	**Diploma in Metallurgical Engineering**
Programme code	01/02/03/04/**05**/06/07/08/15/16/17/18/**19**/21/22/23/24/26
Name of Course	**Elements of Mechanical Engineering**
Course Code	**ME 2106**
Prerequisite course code and name	**NA**
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></th><th colspan="5">Examination Scheme</th></tr>
<tr><th></th><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></th><th>ESE</th><th>PA</th><th>ESE</th><th>PA</th></tr>
<tr><td rowspan="2">03</td><td rowspan="2">--</td><td rowspan="2">02</td><td rowspan="2">05</td><td>Marks</td><td>80</td><td>20</td><td>--</td><td>25</td><td>125</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, 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

Metallurgy Engineers often come across various engg. components for selection of materials and manufacturing processes .They are required to know basic principles of working of different machines and equipments. They are also required to look after the maintenance of the machines .It is therefore necessary for them to know how to interpret the assembly drawings, component drawings in order to carry out any engineering work

3. 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 proportionate free hand drawing of IC engine parts etc.
2. Develop the ability to read the drawing and identify conventional representations.
3. Use principles of heat transfer.
4. State working principal of IC engines, compressors, pumps etc.
5. Identify different power transmission devices.
6. Prepare drawings on AutoCAD.

4. COMPETENCY

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

- Operate different mechanical engineering devices and software.

5. SUGGESTED PRACTICALS/ EXERCISES

Sr. No.	Practical Exercises (Learning Outcomes in Psychomotor Domain)	Relevent CO	Approx. Hrs. Required
1	Draw three views from given isometric view	2	04
2	Draw assembly and details.	2	04
3	Draw free hand sketches of IC engine parts	1	02
4	Observe IC engine parts and write function of each.	1, 4	02
5	Demonstrate working of centrifugal and reciprocating pump	4	02
6	Demonstrate working of compressor.	4	04
7	Calculate parameters of heat transfer for furnace.	3	04
8	Demonstrate working of power transmission devices	5	04
9	Draw simple drawings on AutoCAD.	6	04
10	Complete the given micro project as per guidelines given at Sr. no 11	4, 5	02
	Total		**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 used in uniformity in conduct of practical.

Sr. No.	Equipment Name with Broad Specifications	Experiment Sr.No
1	Drawing board/minidrafter and drawing instruments, Std.specifications	1,2,
2	Petrol engine with any standard specifications	2
3	Centrifugal pump with any standard specifications	3
4	Reciprocating pump with any standard specifications	3
5	Belt drive, chain drive with any standard specifications	5
6	Different models of gears	5
7	AutoCAD software	6

7. THEORY COMPONENTS

Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
Unit I Advanced Sectional Views (13 Hrs, 18 Marks)	
1a. Draw different types of sections 1b. Draw sectional views of IC engine parts 1c. Draw sectional views of pulley, gear, flanged couplings and bearings.	1.1 Types of sections: Conventional, revolved, removed, partial, offset. 1.2 Crankshaft, Engine body, camshaft, flywheel 1.3 Pump body, pulley, gear, flanged coupling, bearing.
Unit-II Blue Print Reading (9 Hrs, 14 Marks)	
2a. Draw machine symbols and surface finish symbols. 2b. Identify specifications on drawing 2c. Draw simple assembly.	2.1 Machine symbols, surface finish. 2.2 Specification on drawing such as material hardness, heat treatment, micro structure. 2.3 Simple assembly containing six parts.
Unit-III IC Engines Working (4 Hrs, 10 Marks)	
3a. Classify IC engines. 3b. Identify different IC engine parts. 3c. State working of two stroke and four stroke engines.	3.1 Classification of I.C.engine, construction 3.2 Working of 2 stroke and 4 stroke I.C.engine
Unit-IV Pumps and Compressors (8 Hrs, 12 Marks)	
4a. Classify pumps. 4b. State working of pump. 4c. Classify compressors.	4.1 Pumps: Classification, Construction, Working, application. 4.2 Compressors: Classification, working of reciprocating, rotary, roots blower, vacuum pumps.
Unit-V Heat Transfer (6 Hrs, 10 Marks)	
5a. Identify modes of heat transfer for practical applications. 5b. Solve problems on conduction, convection, radiation. 5c. Identify different heat exchangers.	5.1 Modes of heat transfer, calculations of heat transfer for given condition, 5.2 Simple problems on conduction, Convection, radiation. 5.3 Heat exchangers.
Unit VI Power Transmission Devices (6 Hrs, 10 Marks)	
6a. Identify different types of drives. 6b. Name different types of gears. 6c. Compare different drives and gears.	6.1 Belt- Open and cross belt, Flat belt and V belt. Chain Drives. 6.2 Gears- Spur, Helical, Bevel, Worm. Gear Terminology- circular pitch, module, addendum, dedendum, pressure angle. 6.3 Comparison, advantages & disadvantages of different drives.

Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
Unit VII Introduction to Autocad (2 Hrs, 6 Marks)	
7a. Draw simple drawings on autocad.	7.1 Introduction to AutoCAD and AutoCAD commands.

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	Advance Sectional Orthographic view	13	02	08	08	18
II	Blue print reading	09	04	05	05	14
III	IC engine working	04	04	04	02	10
IV	Pumps and compressors	08	04	06	02	12
V	Heat transfer	06	04	04	02	10
VI	Power transmission device	06	02	04	04	10
VII	Introduction to AutoCAD	02	--	04	02	06
Total		48	**20**	**35**	**25**	**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. Group discussion
c. Assignments
d. Seminar

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.
c. With respect to item No.8, teachers need to ensure to create opportunities and provisions for ***co-curricular activities***.
d. Correlate subtopics with practical applications.
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 one micro project is planned to be undertaken by student that needs to be assigned to him/her. It should preferably be undertaken individually to build up skill and confidence in every student to become problem solver so that he/she contributes to the projects of industry. In special situations where groups have to be formed for micro projects, the number of students in one group should not exceed three.

A suggestive list of micro projects is given here.

a. Prepare model of any suitable topic from syllabus.
b. Prepare charts of suitable topics from syllabus.
c. Any other suitable micro project as decided by teacher and industry expert.
d. Literature survey and report writing on recent developments in any area from syllabus.

12. SUGGESTED LEARNING RESOURCES

S.N.	Title	Author	Publisher, Edition and Year of publication, ISBN Number
1	Machine Drawing	N.D.Bhatt	Chartor Publishing House ISBN: 9789385039232
2	Machine Drawing	N.Sidheswar P.Kannaiah Sastry V.V.S	McGraw Hill Education ISBN: 9780074603376
3	Hydraulic Machinery	R S Khurmi	S. Chand Co Ltd.,New Delhi ISBN: 9788121901628
4	IC Engines	V.Ganesan	Tata Mc Graw Hill ISBN: 9781259006197
5	Hydraulic Machinery	Jagadish Lal	Metropolitan Publishers ISBN: 9788120004405
6	S.P.Sukhatme	Heat Transfer	Tata Mc Graw Hill ISBN: 9788173715440

13. SOFTWARE/LEARNING WEBSITES:

Software: - Autocad

Websites: -www.howstuffworks.com

Other websites related to relevant topics from syllabus.

14. PO - COMPETENCY- CO MAPPING

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

	PSO1	PSO2	PSO 3	PSO4
CO1	--	--	--	1
CO2	--	--	--	1
CO3	1	--	--	1
CO4	--	--	--	1
CO5	--	--	--	1
CO6	--	--	--	--

Sign: Name: Dr.R R Saraf (Course Expert)	Sign: Name: Dr. N. G. Kulkarni. (Head of Department)
Sign: Name: (Program Head) (Metallurgical Engg. Dept.)	Sign: Name: Shri. A. S. Zanpure. (CDC In charge)

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	**NA**
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	02	**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	Experiment Sr.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	**2.1.** Introduction, Classification of I.C Engines, construction of I.C Engine, Its Terminology

Unit Outcomes (UOs) (in cognitive domain)	**Topics and Sub-topics**
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 **2e.** Compare Petrol engine and Diesel engine	**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 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	**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

Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
5e. Explain with sketches the construction and working of single acting and Double acting reciprocating pump	**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 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 /s)	Sign: Name: Dr. N G. Kulkarni (Head of Department)
Sign: Name: (Program Head) (Electrical Engineering Dept.)	Sign: Name: Shri 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	**Workshop Practice**
Course Code	**WS2101**
Prerequisite course code and name	**NA**
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	04	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

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 their duties in industries. Students can perform various operations using hand tool equipment and machineries in various shops. Working in a workshop develops the attitude of group working and safety awareness. This course provides a miniature industrial environment in the educational institute.

3. COMPETENCY

The course should be taught and implemented to develop the course outcomes (COs) so that students demonstrate 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 competency mentioned above:
After studying this course, the student will be able to

1 Select tools and machinery according to a job.
2 Use hand tools in different shops for performing the different operations.
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	Approx. Hours Required
1	1	Demonstration of a smithy and forging equipment and process.	1,2,3,4	4
2	2	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	16
3	3	Prepare job with following operations a. Prepare Socket joint pipe fitting job as per given drawing (individually) b. Prepare elbow joint pipe fitting job as per given drawing c. Prepare bill of material for given pipeline layout	1,2,3,4	8
4	4	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	12
5	5	Prepare utility job (like stool, benches, tables or similar jobs) involving arc welding and artificial wood as per given drawing a. Fabrication operation involves measuring, marking, cutting, edge preparation, welding b. Carpentry operations involve measuring, marking, cutting, and assembly with fabrication parts.	1,2,3,4	16
6	6	Prepare sheet metal utility job using following operations a. Cutting and Bending b. Edging c. End Curling d. Lancing e. Spot Welding f. Riveting	1,2,3,4	8
		Total Hrs		**64**

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

Sr. No.	Major Equipment/ Instruments Required	Experiment Sr. No.
1	Fire buckets of standard size.	1 to 6
2	Fire extinguisher A,B and C types	1 to 6
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	5
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	5
5	Wood working tools- marking and measuring tools, saws, claw hammer, II mallet, chisels, plans, squares,	5
6	Carpentry Vice 200 mm	5
7	Work Benches- size:1800 x 900 x 750 mm	2
8	Bench Drilling machine (upto 13 mm drill cap.) with ½ H.P. Motor 1000 III mm. Height	2
9	Power Saw machine 350 mm mechanical with 1 HP Motor & all III Accessories.	2
10	Bench Grinder 200 mm Grinding Disc diameter 200 mm. with 25 mm. bore III 32 mm. with ½ HP/1HP Motor.	2
11	Vernier height Guage 450 mm	2
12	Surface Plate 600 x 900 mm Grade I	2
13	Angle Plate 450 x 450 mm	2
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	4
15	Oxygen and acetylene gas welding and cutting kit with cylinders and IV regulators	4
16	Pipe Bending Machine	3
17	Pipe Vice – 100 mm	3
18	Pipe Cutter- 50 mm	3
19	Bench Vice 100 mm	3

Sr. No.	Major Equipment/ Instruments Required	Experiment Sr. No.
20	Portable Hammer Drill Machine 0-13 mm II, III, A.C. 230 V, 2.5Amp, Pistol type, having different types of bits	6
21	Sheet Bending Machine	6
22	Sheet Cutting Machine	6
23	Brazing Equipment	6
24	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.	2
25	Plumbing tools- pipe vice, pipe bending equipment, pipe wrenches, dies.	3
26	Gas welding hand tools- welding torch, welding tip, pressure regulator, V oxygen and acetylene cylinders, spark lighter	4
27	Arc welding hand tools- electrode holder, cable connector, cable lugs, V chipping hammer, earthing clamp, wire brush.	4
28	Sheet metal hand tools- snip, shears sheet gauge, straight edge, L square, VI scriber, divider, trammel, punches, pliers, stakes, groovers, limit set	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 to consist of freehand sketches of tools and equipments in each shop, detailed specifications and precautions to be observed while using tools and equipment.
c. Prepare/Download the following specifications: 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 to procure workshop tools, equipment machineries and raw material. i.e. Visit any fabrication/woodworking/sheet metal 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 teach various topics/subtopics.
b. Guide student(s) in undertaking micro-projects.
c. Arrange a visit to nearby industries and workshops for understanding various manufacturing processes.
d. Show video/animation films to explain 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 them. 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 that 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. Prepare a utility job using various wood working shop operations as per given drawing.
b. Prepare a utility job using various plumbing operations as per the given drawing.
c. Prepare a utility job using various sheet metal operations as per the given drawing. Note: i. The teacher will assign utility job. ii. Utility Job will be completed in a group of 4 to 5 students. Students have to maintain a work diary consisting of job drawing, operations details, required raw materials, tools, equipments, and date-wise performance records.

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

Sr. No.	Title	Author	Publisher, Edition and Year of publication, ISBN Number
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.machineworkshop.com
4.www.turningworkshop.com
5.www.smithyworkshop.com
6.www.plumbingworkshop.com

14. PO - COMPETENCY- CO MAPPING (Mechanical 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
CO1	3	2
CO2	3	2
CO3	3	2
CO4	3	2

PO - COMPETENCY- CO MAPPING (Civil 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
CO1	3	2	2
CO2	3	2	2
CO3	3	2	2
CO4	3	2	2

PO - COMPETENCY- CO MAPPING (Metallurgical 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 Experts)	Sign: Name: Dr. N. G. Kulkarni. (Head of Department)
Sign: Name: . (Program Head)	Sign: Name: Shri 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	**Workshop Practice (Electrical)**
Course Code	**WS2102**
Prerequisite course code and name	**NA**
Class declaration Course	**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 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">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><td>50</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

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	Experiment 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: (Program Head) (Electrical Engg Dept.)	Sign: Name: Shri A. S. Zanpure. (CDC In charge)

GOVERNMENT POLYTECHNIC PUNE
Mechanical Engineering Department
Equivalence of 180 (S) Curriculum to 180 (OB) Curriculum

Sr. No.	Existing 180 (S) Curriculum												180 (OB) Curriculum											RemarkS Equivalent/Not Equivalent
	Course code	Course Name	CREDITS				EXAM SCHEME						Course code	Course Name	CREDITS				EXAM SCHEME					
			TH	PR	TU	Total	TH	PA	PR	OR	T W	Total			TH	PR	TU	Total	TH ESE	TH PA	PR-ESE	PR-PA	Total	
1	HU181	English	2	2	0	4	80	20	0	0	25	125	HU1101	Communication Skills I	2	0	1	3	40	10	25	25	100	Not Equivalent
2	HU182	Communication Skill	2	2	0	4	80	20	0	25	0	125	HU1102	Communication Skills II	2	0	1	3	40	10	0	50	100	Not Equivalent
3	SC181	Applied Maths I	3	0	1	4	80	20	0	0	0	100	SC1101	Applied Mathematics -I	3	0	2	5	80	20	0	25	125	Equivalent
4	SC182	Applied MathsII	3	0	1	4	80	20	0	0	0	100	SC1102	Applied Mathematics II	3	0	2	5	80	20	0	25	125	Not Equivalent
5	SC183	Engineering Physics	3	2	0	5	80	20	50	0	0	150	SC1103	Applied Physics	3	2	0	5	80	20	25	25	150	Equivalent
6	SC184	Engineering Chemistry	3	2	0	5	80	20	50	0	0	150	SC1106	Applied Chemistry	3	2	0	5	80	20	25	25	150	Equivalent
7	ME281	Engineering Graphics	2	4	0	6	80	20	--	--	25	125	ME2101	Fundamentals of Engineering Graphics	2	2	0	4	80	20	--	25	125	Equivalent
8												0	ME2102	Mechanical Engineering Drawing	2	2	0	4	80	20	--	25	125	Equivalent
9	ME282	Computer Aided Drafting	1	2	0	3	0	0	50	--	25	75	ME 3107	Computer Aided Drafting	0	4	0	4	0	0	50	50	100	Equivalent
10	WS281	Work Shop Practice	0	4	0	4	0	0	--	--	50	50	WS2101	Work Shop Practice	0	4	0	4	0	0	--	50	50	Equivalent
11	AM281	Engineering Mechanics	4	2	0	6	80	20	--		25	125	AM2101	Engineering Mechanics	4	2	0	6	80	20		25	125	Equivalent
12	EE 282	Electrical Technology	3	2	0	5	80	20	--	--	25	125	EE2102	Electrical Technology	3	2	0	5	80	20	--	25	125	Equivalent
13	ET 285	Elements of Electronics Engineering	3	2	0	5	80	20	--	--	25	125	ET2105	Elements of Electronics Engineering	3	2	0	5	80	20	--	25	125	Equivalent
14	CM286	Computer Fundamentals	1	2	0	3	0	0	50	--	25	75	CM2102	Fundamentals of Information and Communication Technology	1	2	0	3	0	0	25	25	50	Not Equivalent
15	SC281	Applied Maths-III	2	0	1	3	80	20	--	--	--	100	SC2101	Applied Maths-III	3	0	1	4	80	20	--	25	125	Not Equivalent
16	ME283	Programming in C	1	2	0	3	0	0	50	0	50	100	ME2105	Programming in C	0	4	0	4	0	0	100	25	125	Equivalent
17	ME 381	Machine Drawing	3	4	0	7	80	20	--	0	25	125	ME 3101	Machine Drawing	2	4	0	6	80	20	0	50	150	Equivalent
18	ME 382	Thermodynamics & Heat Engines	3	2	0	5	80	20	--	25	25	150	ME 3102	Thermal Engineering	3	2	0	5	80	20	25	25	150	Equivalent
19	ME 383	Fluid Mechanics & Fluid Machinery	3	2	0	5	80	20	25		25	150	ME 3103	Fluid Mechanics & Fluid Machinery	4	2	0	6	80	20	25	25	150	Equivalent
20	ME 384	Mechanical Measurement	2	2	0	4	40	10	--	--	25	75	ME 3104	Metrology and Measurements	4	2	0	6	80	20	25	25	150	Not Equivalent
21	ME 385	Theory of Machines & Mechanisms	4	2	0	6	80	20	--	25	25	150	ME 3105	Theory of Machines & Mechanisms	4	2	0	6	80	20	25	25	150	Equivalent
22	--	--	0	0	0	0	0	0	0	0	0	0	ME 3106	Fundamentals of Mechatronics	1	2	0	3	40	10	25	25	100	NA
23	MT 388	Engineering Materials	2	0	2	4	80	20	--	--	25	125	MT 3108	Mechanical Engineering Materials	2	2	0	4	80	20	--	25	125	Not Equivalent
24	WS 381	Manufacturing Processes	2	4	0	6	80	20	25		25	150	WS 3101	Manufacturing Processes	2	4	0	6	80	20	25	25	150	Equivalent
25	AM 384	Strength of Materials	4	2	0	6	80	20	0	0	25	125	AM 3104	Strength of Materials	4	2	0	6	80	20	0	25	125	Equivalent
26	AU481	Environmental Science	0	2	0	2	0	0	0	0	50	50	AU 4101	Environmental Science@	0	2	0	2	0	0	0	50	50	Equivalent
27	AU 482	Community Development	2	0	0	2	80	20	0	0	0	100	AU 4104	Ethical Sources and Sustainibility	2	0	0	2	40	10	0	0	50	New Course hence NA
28	AU483	Renewable & Sustainable Energy	2	0	0	2	80	20	0	0	0	100	AU 4102	Renewable Energy Technologies	2	0	0	2	40	10	0	0	50	Equivalent
29	AU484	Engineering Economics	2	0	0	2	80	20	--	--	--	100	AU 4103	Engineering Economics	2	0	0	2	40	10	0	0	50	Equivalent
30	--	--	0	0	0	0	0	0	0	0	0		AU 4105	Digital Marketting	0	2	0	2	0	0	0	50	50	New Course hence NA
31	MA481	Construction Mnagement	3	0	0	3	80	20	0	0	0	100	--	--	0	0	0		0	0	0	0	0	NA
32	MA482	Industrial Organisation&Mnagement	3	0	0	3	80	20	0	0	0	100	MA 4102	Industrial Organization & Management	2	0	0	2	40	10	--	--	50	Equivalent
33	MA483	Entrepreneurship Development	3	0	0	3	80	20	0	0	0	100	MA 4101	Entrepreneurship Development@	2	0	0	2	40	10	--	--	50	Equivalent
34	MA484	Materials Management	3	0	0	3	80	20	0	0	0	100	MA 4103	Materials Management	2	0	0	2	40	10	--	--	50	Equivalent
35													MA 4104	Disaster Management	2	0	0	2	40	10	--	--	50	New Course hence NA
36	MA485	Superviosary Management	3	0	0	3	80	20	0	0	0	100	--	--	0	0	0		0	0	0	0	0	NA

37													MA 4105	Introduction to E-commerce	2	0	0	2	40	10	--	--	50	New Course hence NA
38	MA486	Total Quality Management	3	0	0	3	80	20	0	0	0	100	--	--	0	0	0		0	0	0	0	0	NA
39	MA487	Management Information System	3	0	0	3	80	20	0	0	0	100	MA 4106	Information Management	2	0	0	2	40	10	--	--	50	**Not Equivalent**
40	ME 481	Project & Seminar	0	8	0	0	0	50	0	50	50	150	ME4103	Seminar	0	2	0	2	0	0	25	25	50	Equivalent
41													ME4102	Project	0	4	0	4	0	0	50	50	100	Equivalent
42	ME 482	Power Engineering	4	2	0	6	80	20	0	25	25	150	ME 4105	Power Engineering	3	2	0	5	80	20	25	25	150	Equivalent
43	ME 483	Industrial Hyd. & Pneumatics.	4	2	0	6	80	20	0	25	25	150	ME 4106	Industrial Hydraulics & Pneumatics	4	2	0	6	80	20	25	25	150	Equivalent
44	ME 484	Prod. Planning and Control	3	2	0	5	80	20	0	25	25	150	--	--	0	0	0		0	0	0	0	0	NA
45	ME 485	Design of Machine Elements	4	2	0	6	80	20	0	25	25	150	ME 4107	Machine Design	4	2	0	6	80	20	25	25	150	Equivalent
46	ME 486	Metrology & Quality Control	4	2	0	6	80	20	25	0	25	150	ME 4104	Quality Techniques	3	0	0	3	80	20	25	25	150	**Not Equivalent**
47	WS 481	Production Technology	4	4	0	8	80	20	25	0	25	150	WS 4101	Production Technology	3	4	0	7	80	20	25	25	150	Equivalent
48	NC 481	Development of Soft Skill-I	0	2	0	2	0	0	0	0	25	25	--	--	0	0	0		0	0	0	0	0	NA
49	NC 482	Development of Soft Skill-II	0	2	0	2	0	0	0	0	25	25	--	--	0	0	0		0	0	0	0	0	NA
50	--	--	0	0	0	0	0	0	0	0	0		ME 4101	Industrial Inplant Training#	0	6	0	6	0	0	50	50	100	NA
51	WS 581	CNC&Adva. Manufacturing	3	3	0	6	80	20	0	25	25	150	WS 5101	Adv. Mfg. & CNC	3	2	0	5	80	20	25	25	150	**Not Equivalent**
52	ME 581	Refrigeration & Air conditioning	4	2	0	6	80	20	0	25	25	150	ME5102	Refrigeration & Air condationing	3	2	0	5	80	20	25	25	150	Equivalent
53	ME 582	Instrumentation & Control	4	2	0	6	80	20	0	25	25	150	--	--	0	0	0		0	0	0	0	0	NA
54	--	--	0	0	0	0	0	0	0	0	0		ME 5104	CIM and Robotics	3	2	0	5	80	20	25	25	150	NA
55	ME 583	Tool Engineering.	4	2	0	6	80	20	0	25	25	150	ME 5105	Tool Engineering.	3	2	0	5	80	20	25	25	150	Equivalent
56	ME 584	Automobile Engineering	4	2	0	6	80	20	0	25	25	150	ME 5103	Automobile Engineering	3	2	0	5	80	20	25	25	150	Equivalent
57	ME 585	Advanced welding Technology	4	2	0	6	80	20	0	25	25	150	ME 5106	Advanced welding Technology	3	2	0	5	80	20	25	25	150	Equivalent
58	ME 586	Mechatronics	4	2	0	6	80	20	0	25	25	150												NA
59	ME 587	Computer aided 3D Modelling	4	2	0	6	80	20	0	25	25	150	ME 5101	Computer aided 3D Modelling	1	4	0	5	0	50	50	50	150	Equivalent
60	ME281	Engineering Graphics (CE, MT)	2	4	0	6	80	20	--	--	25	125	ME2103	Engineering Drawing (CE, MT)	2	4	0	6	80	20	--	25	125	Equivalent
61	ME284	Engineering Drawing (EE, ET)	2	4	0	6	80	20	--	--	25	125	ME2104	Engineering Drawing (EE, ET)	2	2	0	4	--	--	--	25	25	Equivalent
62	ME286	Elements of Mechanical Engineering(MT)	3	2	0	5	80	20	--	--	25	125	ME 2106	Elements of Mechanical Engineering(MT)	3	2	0	5	80	20	--	25	125	Equivalent
63	ME285	Fundamentals of Mechanical Engineering(EE)	2	2	0	4	--	--	--	--	50	50	ME 2107	Fundamentals of Mechanical Engineering(EE)	2	2		4	80	20		25	125	Equivalent
64	ME287	Fundamentals of Mechanical Engineering(EE)	2	2	0	4	80	20	--	--	25	125											0	Equivalent
65	WS281	Work Shop Practice	0	4	0	4	0	0	--	--	50	50	WS2102	Basic Workshop Practice (Electrical)	0	2	0	2	0	0	0	50	50	Equivalent

Dr. A. A. Gadhikar
LME, Mechanical Engg. Deptt.

Mr. A. S. Zanpure
LME, Mechanical Engg. Deptt.

Dr. N. G. Kulkarni
HoD, Mechanical Engg. Deptt.

Annexure

GOVERNMENT POLYTECHNIC, PUNE

(An Autonomous Institute of Govt. of Maharashtra)

University Road, Pune - 411 016

Website: www.gppune.ac.in

Department of Mechanical Engineering

INDUSTRY QUESTIONNAIRE

Dear friend,

We are conducting a survey to identity the skills needed at the 'Entry Level' by Diploma Engineers to work efficiently and effectively in the industry. Your experience in the industry and your valuable time to respond to this short survey will greatly help to develop a competency-based diploma curriculum to enhance their employability and match the industry need for the next couple of years.

General Information

Sr. No.	Particulars	Information							
1	Name of Industry								
2	Type of Industry :– (Please Tick)	Small		Medium		Large		Others	
3	Product(s) /Service(s) of the Industry								
4	Postal Address and Seal								
5	Telephone Numbers								
6	Website								
7	Contact Person Details	**Name**							
		Designation							
		E-mail							
		Contact No.							

Sr. No.	In your industry, Mechanical diploma engineers are involved to what extent in the following activities?:	Please tick (√) in any one column			
		To a great extent	**To a considerable extent**	**To some extent**	**Very rarely**
8	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 Required of Diploma in (Course Name) Engineering

Sr. No.	Competencies (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**
	Behaviour Competencies				
1	Use relevant soft skills such as team work, leadership, time management, decision making, planning, conflict resolutions, counselling 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	Exhibit Innovations and entrepreneurship.				
5	Motivate others for achieving desire goal.				
	Generic Competencies				
Sr. No.	**Competencies (**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**
1	Communicate in English in oral and written form.				
2	Use relevant management principles in industry.				
3	Prepare tender documents and comparative statements.				
4	Apply Quality principles for assuring quality of products and services.				
5	Effective use of computers for word processing, Data analysis, presentation.				
	Technical Competencies				
1	Prepare engineering drawings manually using prevailing drawing instruments.				
2	Prepare production/assembly drawings using CAD software.				
3	Use basic principles of electrical and electronics engineering in relevant situations.				
4	Use relevant mechanical engineering materials.				
5	Estimate stresses in machine components and mechanical properties of materials and design simple machine elements.				
6	Use principles of kinematics and dynamics for failure analysis of machine components.				
7	Produce components through casting, forming and joining processes.				
8	Produce components using conventional and advanced machining processes.				
9	Maintain various equipment in Thermal, hydro and plant and Refrigeration and Air conditioning systems.				
10	Select cutting tools, tool holders, dies, jigs and fixtures to machine simple components.				
11	Manufacture jobs using different types of CNC machines.				
12	Use relevant analog and digital measuring devices in mechanical related applications.				
13	Implement Industrial Engineering and Management techniques to improve productivity, store and purchase operations, costing, materials management and quality using IT tools.				
14	Maintain the mechanical equipment of wind, solar nuclear and bio energy power plants, micro-hydro, ocean energy and geothermal energy power plants.				
15	Maintain different types of hydraulic and pneumatic systems.				
16	Implement energy conservation and pollution reduction techniques for sustainable development in mechanical engineering related industries.				
17	Apply TQM principles for assuring quality of products and services.				
18	Please mention any other (Use separate sheet for more)				

Format for the letter of introduction

Government Polytechnic, Pune

To,

____

____

Subject: - Validation of 180 OB curriculum from stake holders

Dear Sir/Madam

This autonomous institute is catering to the technical (diploma) education system since 1994, under academic autonomy. Recently institute has developed 180 outcome based (180 OB) curriculum for all the eight programmes as below .

S. No	Programme
1	Diploma in Civil Engineering
2	Diploma in Electrical Engineering
3	Diploma in Electronics and Telecommunication Engineering
4	Diploma in Mechanical Engineering
5	Diploma in Metallurgy
6	Diploma in Computer Engineering
7	Diploma in Information technology
8	Diploma in DDGM

As a part of curriculum development process, validation of class declaration course from industry is an important step for further improvement. Hence you are kindly requested to fill the validation report attached here with. We would appreciate if this validation report reaches on or before ___ ____. Please send this report on the following email id.--------

Thanks & Regards

HOD,(Program name)

Enclosed- 1) Copy of the curriculum(along with the details of the necessary prerequisites,if any)

2) validation report

Government Polytechnic, Pune

MECHANICAL ENGINEERING DEPARTMENT

Validation of 180 OB curriculum by Industry / Engineering Institute/ Research Institute

Course Details

Name of Program: **Diploma in Mechanical Engineering**

Name of the Course: ____

Course code : ____

Course offered to: - First year/Second year/Third year

Validator information

Name of the Validator/Expert:- ____

Designation of the Validator/Expert:____

Name of the Organisation:____

Please mention the Field/s of Expertise:- ____

Email :-___________________________ Mobile No: ______________________________

Validator report

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:

____

____

____

____

____

Date Seal of Organization Signature of Validator

List of Industries visited/contacted for identifying industry needs

Sr.No	Name of Industry
1	Tata Motors Ltd, Ltd
2	Carraro India Ltd, Ranjangaon, Pune
3	FIAT INDIA Ltd, Pune
4	Caswell Services, Jaipur
5	Spicer India Ltd , Chakan, Pune
6	Anand Auto. Ltd, Chakan,Pune
7	L & T Ltd ,Ahmednagar
8	John Deere Ltd, Pune
9	ACG Pampac Pvt.Ltd, Pune
10	Suraj Pressing Pvt . Ltd, Chakan, Pune
11	Bruckhardt Compression Ltd, Pune
12	Indo German Tool Room, Aurangabad
13	Larson and Tubro Ltd, Mumbai
14	Asara Equipments Pvt Ltd, Ahmednagar
15	Husco Hydraulics Ltd, Talegaon, Pune
16	Mahindra and Mahindra Ltd, Pune
17	Thyssenkrupp Pvt.ltd, Pune
18	Spicer India, Ltd, Chakan
19	Vehicle Research Development Establishment, Ahmednagar
20	Automotive Research Association of India, Pune
21	Bajaj Auto Ltd, Pune

Government Polytechnic, Pune

MECHANICAL ENGINEERING DEPARTMENT

List of Industries used for Curriculum Validation

Sr. No.	Course Code	Course Name	Names of the Industry visited
1	ME 3104	Metrology & Measurements	Accurate Sales & Services Pvt. Ltd. Pune
2	ME4105	Power Engineering	Fiat India Automobiles Pvt. Ltd.
3	ME 4106	Industrial Hydraulics and Pneumatics	SMC Corporation (India) Pvt. Ltd. Pune
4	ME4107	Machine Design	M/S Mojj engineering Systems Ltd. Pune
5	WS4101	Production Technology	Technocraft Design Solution Pvt. Ltd. Pune
6			Aarohi Industries ,Pune
7	ME5101	Computer Aided 3d Modelling	Technocraft Design Solution Pvt. Ltd. Pune
8	ME5102	Refrigeration and Air Conditioning	SK Energy Technology Pvt. Ltd,
9	ME5103	Refrigeration and Air Conditioning	Emerson Commercical & Residential Solutions, Pune
10	ME 5103	Automobile Engineering	Royal Env.Tech.
11			ARAI Pune
12	ME 5104	CIM & Robotics	Technocraft Design Solution Pvt. Ltd. Pune
13	WS5101	Advanced Manufacturing and CNC	Technocraft Design Solution Pvt. Ltd. Pune
14	ME 5105	Tool Engineering	Technocraft Design Solution Pvt. Ltd. Pune
15	ME 5106	Advance Welding Technology	Technocraft Design Solution Pvt. Ltd. Pune