GOVERNMENT POLYTECHNIC, PUNE
'120 – NEP' SCHEME

PROGRAMME	**DIPLOMA IN ELECTRICAL ENGINEERING**
PROGRAMME CODE	**02**
COURSE TITLE	**DC MACHINES AND TRANSFORMERS**
COURSE CODE	**EE31205**
PREREQUISITE COURSE CODE & TITLE	**EE 21201 - FUNDAMENTALS OF ELECTRICAL ENGINEERING**
CLASS DECLARATION COURSE	**NO**

I. LEARNING & ASSESSMENT SCHEME

Course Code	Course Title	Course Type	Learning Scheme					Credits	Assessment Scheme											
			Actual Contact Hrs./Week			SLH	NLH		Paper Duration	Theory				Based on LL &TSL				Based on SL		Total Marks
														Practical						
			CL	TL	LL					FA-TH	SA-TH	Total		FA-PR		SA-PR		SLA		
										Max	Max	Max	Min	Max	Min	Max	Min	Max	Min	
EE31205	DC MACHINES AND TRANSFORMERS	DSC	2	0	2	2	6	3	2	15	35	50	20	25	10	25@	10	25	10	125

Total IKS Hrs for Term: 00 Hrs

Abbreviations: CL-Classroom Learning, **TL**-Tutorial Learning, **LL**-Laboratory Learning, **SLH**-Self Learning Hours, **NLH**-Notional Learning Hours, **FA** - Formative Assessment**, SA** -Summative assessment, **IKS** – Indian Knowledge System, **SLA**- Self Learning Assessment
Legends: @-Internal Assessment, **#** - External Assessment,***#** - Online Examination,**@$** - Internal Online Examination

Note:

FA-TH represents an average of two class tests of 15 marks each conducted during the semester.

1. If a candidate is not securing minimum passing marks in **FA-PR** (Formative Assessment - Practical) of any course, then the candidate shall be declared as **'Detained'** in that course.
2. If a candidate does not secure minimum passing marks in SLA (Self Learning Assessment) of any course, then the candidate shall be declared as **'fail'** and will have to repeat and resubmit SLA work.
3. **Notional learning hours** for the semester are **(CL + LL + TL + SL) hrs. * 15 Weeks**
4. **1 credit** is equivalent to **30 Notional hours**.
5. * Self-learning hours shall not be reflected in the Timetable.
6. *Self-learning includes micro-projects/assignments/other activities.

II. RATIONALE:

DC machines, including motors and generators, are essential in electrical engineering because of their reliability and versatility. They offer excellent speed control and torque, making them ideal for precise applications like robotics, conveyors, and electric vehicles. Their strong and durable design ensures long-lasting performance in various industries.

Transformers are crucial for transmitting electrical power efficiently. They increase voltage for long-distance transmission and reduce it for safe distribution. Transformers also provide electrical isolation, improving safety and reducing risks. Modern transformers are highly efficient, reliable, and designed to last, playing a key role in ensuring stable and uninterrupted power supply in industries and households.

III. COURSE-LEVELLEARNINGOUTCOMES(CO'S)

Students will be able to achieve & demonstrate the following CO's on completion of course-based learning

- **CO1**: Analyze the construction, operation, and performance of DC machines for industrial applications.
- **CO2**: Evaluate the performance characteristics and efficiency of single-phase transformers in power systems.
- **CO3**: Demonstrate the ability to evaluate and select three-phase transformers based on their advantages, limitations, and application requirements.

IV. THEORY LEARNING OUTCOMES AND ALIGNED COURSE CONTENT

Sr. No	Theory Learning Outcomes (TLO'S) aligned to CO's.	Learning content mapped with TLO's.	Suggested Learning Pedagogies	Relevant COs
	UNIT-I DC MACHINE (CL Hrs-06, Marks-08)			
1.	TLO 1.1 Describe working, construction and functions of each part of DC machine with sketches.(Motor and Generator) TLO 1.2 Draw circuit diagrams of various connections of Motor and Generator . TLO 1.3 Derive E.M.F equation. Of Motor and Generator TLO 1.4 State significance of back emf. TLO 1.5 Derive torque equation of DC motor TLO 1.6. Justify the need of DC motor starter and explain its working. TLO 1.7 Calculate the losses and efficiency of dc motor.	1.1 Construction & Functions of various parts , Working principle of DC machine (Motor and Generator) 1.2 Types of DC machines (Motor and Generator) based on the interconnections of Field and Armature winding. 1.3 E.M.F Equation (Motor and Generator) 1.4 Significance of back emf , 1.5 Torque- speed characteristics of DC Motor 1.6 Necessity of starter,Working of Three-point starter. 1.7 Losses in DC motor and its Efficiency	Lecture Using Chalk-Board , Video Demonstrations,Flipped Classroom, Case Study, Collaborative learning, Presentations	CO1
	UNIT-II SINGLE PHASE TRANSFORMER (CL Hrs-14, Marks-15)			
2	TLO 2.1. Describe construction, working and role of each part of single-phase transformer. TLO 2.2 Describe Why the transformer works on AC supply only and the effect if DC is applied across he transformer winding. TLO 2.3 Differentiate between different types of transformers along with sketches TLO 2.4 Derive EMF equation	2.1 Construction , Working principle function & materials used for different parts of Single-phase transformer 2.2 Performance of the transformer if DC supply is applied to the transformer. 2.3 Core Type and shell type, Dry Type and Hermetically sealed transformer,Single Phase Distribution Transformer and High voltage Distribution Trasnformer 2.4 EMF equation and transformer,		

Sr. No	Theory Learning Outcomes (TLO'S) aligned to CO's.	Learning content mapped with TLO's.	Suggested Learning Pedagogies	Relevant COs
	of transformer and define ratios of transformer. TLO 2.5 Justify why rating of the transformer is expressed in KVA. TLO 2.6 i) State the properties of an ideal transformer. ii) Draw and explain the phasor diagram of ideal transformer and practical transformer on no load. iii) Describe various voltage drops in the windings for transformer is on load. iv) Draw & explain the phasor diagram of transformer on load. TLO 2.7 i) State the need for conducting O.C. & S.C. test on single phase transformer ii) Determine the various parameters of equivalent circuit from OC /SC test TLO 2.8 i) Draw the equivalent circuit of a single-phase transformer. ii) Determine Parameters of equivalent circuit of single-phase transformer. TLO 2.9 i)State the various losses in transformer. ii) Derive expression for efficiency and the condition for maximum efficiency of a single-phase transformer . TLO 2.10 i) Describe construction and working of an autotransformer with sketches. ii) Distinguish between an autotransformer and two winding transformer. iii) List the advantages, limitations & applications of an	Transformer ratios. i) Numerical on emf equation & ratios. ii) Numerical on Transformer ratios 2.5 Rating of the transformer. 2.6 Properties of an ideal transformer i) Ideal Transformer on no-load with phasor diagram. ii) Practical transformer on no load with Phasor diagram. iii) Various voltage drops in the windings for practical transformer is on load. iv)Numerical on calculating winding drops and induced EMFs, voltages. v) Phasor diagram of transformer on load for different type of load. 2.7 Direct load test, OC and SC test and their necessity 2.8 i) Determine Parameters of equivalent circuit (Exact, Approximate) of single-phase transformer. ii) Numerical on approximate equivalent circuit 2.9 i)Losses in transformer. Various techniques to minimise them. ii) Efficiency , All day Efficiency iii) Expression for efficiency and the condition for maximum efficiency of a single-phase transformer. iii) Numerical on efficiency & all day efficiency 2.10 i)Construction and working of an autotransformer ii) Distinguish between autotransformer and two winding transformer. iii)Advantages, limitations& applications of an autotransformer	Lecture Using Chalk-Board , Video Demonstrations, Flipped Classroom, Case Study, Collaborative learning, Presentations	CO2

Sr. No	Theory Learning Outcomes (TLO'S) aligned to CO's.	Learning content mapped with TLO's.	Suggested Learning Pedagogies	Relevant COs
	autotransformer. TLO 2.11 State the IS Codes used for transformer.	2.11 IS code of Practice		
UNIT-III THREE PHASE TRANSFORMER (CL Hrs-10, Marks-12)				
3	TLO3.1Describe construction of Three Phase Transformer TLO 3.2 Compare 3 phase transformer with a bank of 3 single phase transformers. TLO 3.3 Describe the significance of windings connection of three phase transformer. TLO 3.4 State the need and condition for parallel operation of single phase and three phase transformers. TLO 3.5 Explain the parallel operation & determine the load sharing of single phase and three phase transformer.	3.1 Construction of 3 phase transformer. 3.2 Comparison between three phase transformer and bank of 3 single phase transformers. 3.3Advantages & limitations of star-star, Delta-Delta, Star-Delta, Delta-Star winding connections. Types of Connection of Three phase Transformer 3.4 Need of Parallel Operation of single-phase transformer and three phase transformer. 3.5 Condition of Parallel Operation of single-phase transformer and three phase transformer. 3.4 Parallel operation and load sharing of single phase and three phase transformer with phasor diagram. 3.5 Numericals on Parallel Operation of single-phase transformer .	Lecture Using Chalk-Board , Video Demonstrations, Flipped Classroom, Case Study, Collaborative learning, Presentations	CO3

V. LABORATORY LEARNING OUTCOME AND ALIGNED PRACTICAL / TUTORIAL EXPERIENCES.

Sr. No	Practical / Tutorial / Laboratory Learning Outcome (LLO)	Laboratory Experiment / Practical Titles /Tutorial Titles	Number of hrs.	Relevant COs
1	LLO 1.1 Know the constructional features of D. C. machine LLO1.2Observe the shape , placement of poles of D. C. machine (salient pole structure)	Identify the constructional features of D.C. machine to know the function & material used for each part.	02	CO1
2	LLO 2.1 Obtain speed of the D.C. shunt motor below & above its rated speed. LLO 2.2 obtain smooth control of the speed	Control the speed of D.C. shunt motor	02	CO1
3	LLO 3.1 Identify and label different parts of a transformer. LLO 3.2 State the function and importance of each identified part. LLO 3.3 Demonstrate the testing of windings using a multimeter to check continuity and resistance.	Identification, Description, and Testing of Transformer Parts and Windings	02	CO2,CO3

Sr. No	**Practical / Tutorial / Laboratory Learning Outcome (LLO)**	**Laboratory Experiment / Practical Titles /Tutorial Titles**	**Number of hrs.**	**Relevant COs**
4	LLO4.1Use the auto transformer in step up & step-down modes LLO4.2 Check the functioning of Transformer	Connecting single phase autotransformer in step up & step-down modes.	02	CO2
5	LLO 5.1 Measure the primary & secondary voltages for calculating various ratios of single phase transformer. LLO 5.2 Verify the relationship between the ratios.	Calculating the voltage ratio & current ratio of single-phase transformer to verify the relation between them.	02	CO2
6	LLO 6.1 Observe variation in secondary voltage when the transformer is loaded. LLO 6.2 Verify relationship between load and efficiency LLO 6.3 Draw phasor diagram	Conducting direct loading test on single phase transformer to determine its efficiency and regulation.	02	CO2
7	LLO7.1Select proper range of meters to conduct the O.C. and S.C. test LLO7.2Measure the constant and variable losses & calculating the efficiency of the transformer	Performing O.C. and S.C. test on single phase transformer to calculate efficiency, regulation of transformer.	02	CO2
8	LLO8.1Calculate core & winding parameters of transformer	Performing O.C. and S.C. test on single phase transformer to determine parametrs of equivalent circuit of transformer.	02	CO3
9	LLO 9.1 Observe cooling methods of three phase transformer LLO 9.1 Observe constructional details of three phase transformer.	Identify the constructional features of three phase transformers to know the function & material used for each part.	02	CO3
10	LLO 10.1 Measure load shared by each transformer at different load conditions. LLO 10.2 Interpret load sharing performance of transformer from the measured values.	Perform parallel operation of two single-phase transformers and determine the apparent and real power load sharing.	02	CO2
11	LLO 11.1 Mark the terminals of the primary and secondary winding of the transformer with respect to polarity. LLO 11.2 Connect the transformer for additive and subtractive polarity.	Perform polarity test on a single-phase transformer whose polarity markings are masked.	02	CO3
12	LLO 12.1 Identify the primary and secondary winding terminals belonging to the same phase of the given three-phase transformer using phasing out test.	Perform Phasing out test on a three-phase transformer whose phase markings are masked.	02	CO3

Sr. No	Practical / Tutorial / Laboratory Learning Outcome (LLO)	Laboratory Experiment / Practical Titles /Tutorial Titles	Number of hrs.	Relevant COs
13	LLO 13.1Connect the auto-transformer in step-up and step-down modes noting the input/output readings.	Connect the autotransformer in step-up and step-down modes noting input/output readings.	02	CO3
14	LLO 14.1 Check the Functioning of CT	Check the Functioning of CT	02	CO2
15	LLO 15.1 Check the Functioning of PT	Check the Functioning of CT	02	CO2

VI. SUGGESTED MICROPROJECT/ ACTIVITIES FOR SPECIFIC LEARNING / SKILLS DEVELOPMENT (SELF-LEARNING ASSIGNMENT/)

Microproject: Teacher should give the topic on theory/lab contents

D.C. Motor

- **Line Following Robot**: Build a small robot that follows a line using sensors (like infrared or reflectance sensors) to detect the path. Use a DC motor to drive the wheels and another motor for steering. This project involves both hardware assembly and programming logic.
- **Mini Conveyor Belt**: Construct a miniature conveyor belt system using a DC motor and a few rollers. You can use this setup to demonstrate automated material handling concepts or create a small sorting system.
- **Automated Curtain Opener**: Design a mechanism using a DC motor to open and close curtains automatically. Use limit switches or sensors to detect when to stop the motor based on the curtain's position.
- **Solar Tracker**: Build a solar panel tracker that adjusts the panel's angle to maximize sunlight exposure throughout the day. Use a DC motor to rotate the panel horizontally or vertically based on light intensity measurements from sensors.
- **Miniature Wind Turbine**: Construct a small wind turbine using a DC motor as a generator. You can connect LEDs or a small battery to demonstrate how wind energy can be converted into electrical energy.
- **Electric Skateboard or Scooter**: Build a small electric vehicle using a DC motor for propulsion. This project involves designing a chassis, integrating motor control with a throttle mechanism, and ensuring safety features.
- **DIY Electric Toy Car**: Modify a toy car by replacing its manual propulsion system with a DC motor and batteries. This project is suitable for beginners and allows for creativity in designing the chassis and integrating the electrical components.
- **Remote-Controlled Boat**: Create a remote-controlled boat using a DC motor to drive a propeller. This project involves waterproofing electronics and ensuring the boat's stability and maneuverability in water.
- **Gripper or Robotic Arm**: Construct a simple robotic arm or gripper using DC motors to control the movement of joints or fingers. Use potentiometers or encoders for feedback to control the arm's position accurately.

Transformers

1. **Transformer Construction and Testing**: Build a small single-phase transformer using laminated iron core, copper wire, and insulation materials. Measure and verify its voltage transformation ratio and efficiency.
2. **Voltage Converter**: Design a voltage converter circuit using a single-phase transformer to step up or step down AC voltage. This project can include using diodes and capacitors for rectification and smoothing.
3. **Power Supply Unit**: Construct a simple AC to DC power supply unit using a transformer for voltage stepping and rectification circuitry (diodes and capacitors). This project can power low-voltage DC devices from a standard AC outlet.
4. **Isolation Transformer**: Build an isolation transformer to electrically isolate sensitive equipment or devices from the mains supply, enhancing safety and reducing electrical noise.
5. **Signal Transformer for Audio Applications**: Design and build a signal transformer suitable for audio applications, such as impedance matching or line isolation in audio circuits.
6. **Transformer Coupled Amplifier**: Create a transformer-coupled audio amplifier circuit. This project involves designing the amplifier stages and selecting an appropriate transformer for coupling signals between stages.
7. **Variable Autotransformer (Variac)**: Build a variable autotransformer using a single-phase transformer with multiple taps on the winding. This project allows for adjustable AC voltage output for testing and experimental purposes.
8. **Transformer-based Voltage Stabilizer**: Design a simple voltage stabilizer circuit using a single-phase transformer and a voltage regulator (such as a Zener diode or IC regulator) to maintain a stable output voltage despite fluctuations in input voltage.
9. **Wireless Power Transfer System**: Explore wireless power transfer using a single-phase transformer. Design a resonant circuit for efficient power transmission over short distances, such as for charging mobile devices wirelessly.
10. **Grid Tie Inverter**: Design a small grid tie inverter using a single-phase transformer to convert DC power (from solar panels or batteries) into AC power synchronized with the grid.
11. **Energy Loss Analysis in Transformers:** Construct a small transformer and analyze its energy losses, including core losses and copper losses. Compare efficiency under different load conditions.
12. **Temperature Monitoring System for Transformers:** Design a system to monitor the temperature of a transformer under load using temperature sensors and display it using an LCD or an LED indicator.
13. **Transformer Efficiency Improvement:** Experiment with different core materials (e.g., laminated iron, ferrite) to study their impact on transformer efficiency and performance.
14. **High-Frequency Transformer for SMPS:** Design and build a high-frequency transformer for a switched-mode power supply (SMPS) circuit and analyze its operation.
15. **Transformer-Based Inverter:** Construct an inverter circuit using a transformer to convert DC to AC for operating small appliances.
16. **Step-Down Transformer with Multiple Outputs:** Design a transformer with multiple secondary windings to provide various voltage levels for different applications.
17. **Harmonic Analysis in Transformer Load:** Use a transformer to power a nonlinear load and measure the harmonics generated in the system using an oscilloscope or harmonic analyzer.
18. **Current Transformer for Measurement Applications:** Build and test a current transformer for measuring high AC currents with a low-power measurement circuit.
19. **Transformer Load Tester:** Design a device to test the performance of transformers under different load conditions and measure voltage regulation and efficiency.
20. **Smart Transformer with IoT Integration:** Build a transformer monitoring system that uses IoT to collect and transmit data like load, voltage, current, and temperature for remote monitoring.
21. **Three-Phase Transformer Bank:** Construct a three-phase transformer bank using three single-phase transformers. Study its operation under different connection configurations (Delta-Delta, Delta-Star, Star-Star).

22. **Pulse Transformer for Switching Applications:** Design a pulse transformer for high-speed switching circuits, such as in power electronics or communication systems.
23. **Noise Reduction in Transformers:** Experiment with different shielding techniques to reduce electromagnetic noise from transformers in sensitive electronic circuits.
24. **Transformer Protection Circuit:** Develop a protection circuit for a transformer using fuses, circuit breakers, or thermal cutoffs to prevent damage under fault conditions.
25. **Custom Toroidal Transformer Design:** Wind and construct a toroidal transformer and compare its efficiency and size advantages over a laminated core transformer.
26. **Overvoltage Protection for Transformers:** Design a circuit with MOVs (Metal Oxide Varistors) and surge protectors to safeguard transformers against voltage spikes.
27. **Transformer Balancing for Audio Applications:** Create a balanced audio line using a transformer for noise reduction and signal clarity in professional audio systems.
28. **Inductive Coupling for Data Transfer:** Use a small transformer to demonstrate wireless data transfer between two circuits through inductive coupling.
29. **Transformer-Based Dimmer Circuit:** Build a dimmer circuit for light control using a transformer and phase-controlled rectifier.
30. **Transformer for Renewable Energy Systems:** Design a transformer to interface with renewable energy sources like wind or solar for efficient energy transfer to the grid or battery storage systems.

Assignment: -Numericals to be solved by students as self learning and teacher should assess the same

VII. LABORATORY EQUIPMENT/INSTRUMENTS/TOOLS/SOFTWARE REQUIRED

Sr.No	**EquipmentNamewithBroadSpecifications**	**Relevant LLONumber**
1	Stand alone 5 kW, 220 V, D.C Shunt motor	1,2,
2	5 kW, 220 V, D.C. M-G set Shunt motor	1,2,
3	Rheostats (1A to 10 A)	All
4	D.C. Ammeter, D.C. Voltmeter, Tachometer	1,2,
5	Single phase, 2 kVA,50 Hz, Auto Transformer (0-230) V	3 to 15
6	Single phase Transformer 2.5 kVA, 50 Hz, 230/115 V	3 to 15
7	Single phase 3 kW, 230 V, Load Bank : Resistive,Capacitive,Inductive	3 to 15
8	Low Power Factor Wattmeter (0-5-10)A, 250/500 V	5,6,7,8,10
9	Multimeterof suitable range	All

VIII. SUGGESTED FOR WEIGHTAGE TO LEARNING EFFORTS & ASSESSMENT PURPOSE

(SpecificationTable)

Sr.No	Unit	Unit Title	Aligned COs	Learning Hours	R-Level	U-Level	A-Level	Total Marks
1	**I**	**D.C. Machine**	CO1	06	02	03	03	08
2	**II**	**Single Phase Transformer**	CO2	14	03	06	06	15
3	**III**	**Three Phase Transformer**	CO3	10	02	04	06	12
			Total	**30**	**07**	**13**	**15**	**35**

IX. ASSESSMENT METHODOLOGIES / TOOLS

Formative assessment (Assessment for Learning)	Summative Assessment (Assessment of Learning)
Two-unit tests of 15 marks will be conducted and an average of marks obtained in these two-unit tests will be considered. Each practical will be assessed for 25 marks and an average of all marks obtained will be considered.	End semester assessment of 35 marks through offline mode of examination. End semester summative assessment of 25 marks for laboratory learning.

X. SUGGESTED COS- POS MATRIX FORM

Course Outcomes (COs)	Programme Outcomes(POs)							Programme Specific Outcomes *(PSOs)			
	PO-1 Basic and Discipline-Specific Knowledge	PO-2 Problem Analysis	PO-3 Design/ Development of Solutions	PO-4 Engineering Tools	PO-5 Engineering Practices for Society, Sustainability and Environment	PO-6 Project Management	PO-7 Life Long Learning	PSO-1	PSO-2	PSO-3	PSO-4
CO1	3	2	2	2	**2**	2	3	3	2	2	2
CO2	3	3	3	3	2	2	3	3	2	3	2
CO3	2	3	2	2	2	2	3	2	2	2	2
Legends:- High:03, Medium:02, Low:01. No Mapping: -- *PSOs are to be formulated at the institute level											

XI . SUGGESTED LEARNING MATERIALS / BOOKS

Sr. No	Author	Title	Publisher with ISBN Number
1	Theraja,B.L.; Theraja, A. K.	ATextBookofElectrical Technology Vol-II	S.ChandandCo.Ramnagar,NewDelh, 2012; ISBN : 9788121924405
2	Electrical Machine	S. K. Bhattarcharya	Mcgraw Hill ISBN9789332902855

3	Electrical Machine-I	J. B. Gupta	S. K. Kataria& sons, New Delhi, ISBN 9789350140550
4	Electrical Machines- I	U. A. Bakshi, M. V. Bakshi	Technical Publications, Pune ISBN 9788184317756
5	Electrical machines - Theory and Practice	M.N. Bandopadhyay	PHI publication. ISBN 812032997X, 9788120329973
6	Principles of Electrical Machines	V. K. Mehtha	S.Chand and Co., New Delhi

XII. LEARNING WEBSITES& PORTALS

Sr.No	Link/Portal	Description
1	https://nptel.ac.in/	D.C. machine, Transformer literature, video lectures
2	https://www.youtube.com/watch?v=oJtY6xn6dkQ	Video on transformer
3	https://en.wikipedia.org/wiki/Transformer	Transformer basics

Note:
Teachers are requested to check the creative common license status/financial implications of the suggested online educational resources before use by the students

Name & Signature:

Smt. V.P.Karhad
Lecturer in Electrical Engineering

Smt.T.J.Bhangale
Lecturer in Electrical Engineering

(Course Experts)

Name & Signature:	Name & Signature:
Dr. S.V.Bhangale (Programme Head)	**Shri. S. B. Kulkarni** (CDC In-charge)

GOVERNMENT POLYTECHNIC, PUNE
'120-NEP' SCHEME

PROGRAMME	**DIPLOMA IN ELECTRICAL ENGINEERING**
PROGRAMME CODE	**02**
COURSE TITLE	**ELECTRICAL ESTIMATION AND CONTRACTING**
COURSE CODE	**EE41202**
PREREQUISITE COURSE CODE AND TITLE	**EE31201-ELECTRICAL MATERIALS AND DRAWING**
CLASS DECLARTION COURSE	**YES**

I. LEARNING AND ASSESSMENT SCHEME

Course Code	Course Title	Course Type	Learning Scheme					Credits	Assessment Scheme											
			Actual Contact Hrs./Week			SLH	NLH		Paper Duration	Theory				Based on LL & TSL				Based on SL		Total Marks
														Practical						
			CL	TL	LL					FA-TH	SA-TH	Total		FA-PR		SA-PR		SLA		
										Max	Max	Max	Min	Max	Min	Max	Min	Max	Min	
EE41202	ELECTRICAL ESTIMATION & CONTRACTING	DSC	03	00	02	01	06	03	03	30	70	100	40	25	10	-	-	25	10	150

Total IKS Hrs for Term: 0 Hrs

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2. If a candidate does not secure minimum passing marks in SLA (Self Learning Assessment) of any course, then the candidate shall be declared as '**fail**' and will have to repeat and resubmit SLA work.
3. **Notional learning hours** for the semester are **(CL + LL + TL + SL) hrs. * 15 Weeks**
4. **1 credit** is equivalent to **30 Notional hours**.
5. * Self-learning hours shall not be reflected in the Timetable.

6.* Self-learning includes micro-projects/assignments/other activities.

II.RATIONALE:

This course thoroughly explores important aspects of wiring installations, covering planning of electrical installation and contracts, adherence to electrical by laws, understanding supply systems, implementing effective installation methods, and mastering the estimation of electrical wiring, installations, and contracting. This course provides students with holistic knowledge to pursue careers as contractors and entrepreneurs and empowers them to successfully execute a wide range of electrical wiring installation projects with confidence and proficiency.

III.COURSE LEVEL LEARNING OUTCOMES (COS)

Students will be able to achieve & demonstrate the following COs on completion of course-based learning

CO1: Prepare tender , quotation, comparative statement,and supply order.
CO2: Design and estimate domestic and commercial electrical installations.
CO3:Design and estimate industrial installations.
CO4:Design and estimate public lighting installations
CO5:Design and estimate distribution line installations.
CO6:Design illumination schemes.

IV. THEORY LEARNING OUTCOMES AND ALIGNED COURSE CONTENT

Sr. No.	Theory Learning Outcomes (TLO's) aligned to CO's.	Learning content mappedwith TLO's	Suggested Learning Pedagogies	Relevant COs
		SECTION - I		
		UNIT - I ESTIMATES AND CONTRACTS (CL Hrs - 6, Marks –10)		
1	TLO 1.1 Apply the principles of NEC 2023 during the preparation of the given document. TLO 1.2 State the purpose of preparation of the given type(s) of estimates. TLO 1.3 State the purpose of awarding the given type(s) of contracts. TLO 1.4 Prepare tender documents, quotations, and bills for the specified work.	1.1 National Electrical Code 2023 (NEC 2023): Importance,various types of electrical installation- Non-industrial and industrial, Standard value of voltages and their limits, Fundamental principles of electrical installations, Safety in electrical work, permit to electrical work, safety instruction and safety practices 1.2 Estimating and costing: Purpose, Qualities of a good estimator, essential elements of estimating and costing, Meaning and purpose of- rough estimate, detailed estimate, supplementary estimate, annual maintenance estimate and revised estimate, Factors to be considered while preparation of detailed estimate and economical execution of work. 1.3 Contracts: Concept, types, roles, and qualities of a good contractor 1.4 Tender and Quotation: Types of tenders, tender notice, preparation of tender document, and method of opening of tender, Government e-Market Place (GeM), features and benefits of GeM, Quotation, quotation format, comparison between tender and quotation, Comparative statement, format of comparative statement. Order format, placing of purchase order, Principles of execution of works, planning, organizing and completion of work, billing of work.	Chalk and board lectures Tutorial Assignment Demonstration	**CO1**
		UNIT - II DOMESTIC AND COMMERCIAL INSTALLATIONS (CL Hrs – 08, Marks- 12)		
2	TLO 2.1 Interpret the given electrical installation plan and electrical diagrams. TLO 2.2 Estimate materials required for the given domestic installations. TLO 2.3 Estimate materials required for the given commercial installations.	**2.1** Electrical Drawing: Electrical symbols used in electrical diagrams as per NEC 2023, , Electrical diagrams, and their Classification. Methods of representation for the wiring diagram- multiline and single line representation, Necessity and reading of Civil Engineering building drawing. Interpretation of electrical installation plan and electrical diagrams. 2.2 Design of Domestic Installations: Steps to be followed for design and estimation of domestic installations. Design consideration of electrical installation in domestic installations. Design, drawing,	Lectures using Chalk-Board Presentations Case Study Site/Industry Visit	**CO 2**

	TLO 2.4 Estimate materials required for a given type of service connection.	estimation, and costing of a domestic installation having a maximum 5 kW load. 2.3 Design of Commercial Installations: Steps to be followed for design and estimation of Electrical commercial installations. 2.4 Design electrical installation scheme of small commercial installations of classroom , small shop, dispensary etc. 2.5 Service Connection: Underground and overhead,diagram and description. Calculation of material required for underground and overhead service connection. (Simple numerical based on above points)		
UNIT - III INDUSTRIAL INSTALLATIONS (CL Hrs- 08, Marks-13)				
3	TLO 3.1 Select wiring types for industrial installations. TLO 3.2 Draw an installation plan, wiring diagrams and single-line diagrams for the given industrial installations. TLO 3.3 Describe the given design considerations of an industrial installation. TLO 3.4 Carry out estimation for the given industrial installations.	3.1 Difference between non-industrial and industrial installations, General characteristics of industrial installation, and selection of wiring system. 3.2 Wiring diagram and single line diagram for single-phase and three-phase motors, Installation plan. 3.3 Design Considerations: Calculation of Motor current, deciding the cable size, deciding the size of the Conduit, deciding the fuse rating, deciding distribution board and main switch/ MCB, and deciding the starter for Motors. 3.4 Design electrical installation scheme and preparation of estimate of the agricultural pump, flour mill and small industrial unit having a total aggregate three-phase load of less than 30 kW. (Simple numerical based on above points)	Lectures Using Chalk-Board Presentations Case Study Site/Industry Visit	**CO3**
SECTION-II				
UNIT - IV PUBLIC LIGHTING INSTALLATION (CL Hrs-08, Marks-14)				
4	TLO 4.1 Describe given terms related to public lighting installation. TLO 4.2 Select proper materials for streetlight installation. TLO 4.3 Select proper materials for High-mast lighting installation. TLO 4.4 Carry out estimation of streetlights and High-mast lighting.	4.1 Classification of outdoor installations, street lighting/ public lighting installation, terminology used according to NEC 2023 aim of public lighting installation, classification of roads, standard layout of roads. 4.2 Street light pole structures. Selection of equipment, and sources used in street light installations. Cables recommended types and sizes of cable. On-off Control of equipment of street light installation. 4.3 High-mast pole structure, selection of equipment, wiring diagram. 4.4 Design, estimation and costing of streetlights and High-mast lighting.	Lecture Using Chalk-Board Presentations Case Study Site/Industry Visit	**CO4**

UNIT - V DISTRIBUTION LINES (CL Hrs-08, Marks-11)				
5	TLO 5.1 Compare the given types of distribution lines. TLO 5.2 Describe the given material required for distribution lines. TLO 5.3 Carry out estimates for the specified distribution lines.	5.1 Block Diagram of Electrical Power system, Types of Distribution lines - Primary and Secondary, Overhead and Underground,and comparison between them. 5.2 Materials used for distribution line HT (11kV) and LT (415 V), Cables used for distribution line, factors determining the selection of LT/ HT power cables, and cable termination methods. Design, estimation and costing of HT (11kV), LT (415 V) overhead line and underground cabling. (Simple numerical based on above points)	Presentations Lecture Using Chalk-Board, Case Study Site/Industry Visit	**CO5**
UNIT – VI ILLIMINATION IN RESIDENTIAL INSTALLATION (CL Hrs-07, Marks-10)				
6	TLO6.1 Define various terms related to illumination. TLO6.2. State laws of illumination TLO6.3. Describe various factors affecting the illumination TLO6.4. Describe different types of lighting arrangements and Design consideration of good lighting scheme TLO6.5. State the use of various lamps & their illumination levels. TLO6.6. Describe the construction & working of various lamps. TLO6.7. Calculate number of luminaries. TLO6. Design the illumination scheme for small installation	6.1 Introduction,different terms used in illumination:Luminous flux, Luminous intensity, Lumen, Illumination or illuminance, Lux, Space-height ratio, utilization factor, depreciation factor, luminous efficiency 6.2 Laws of illumination-Inverse Square Law, Cosine Law, Numerical based on illumination received directly underneath, illumination received on horizontal screen and screen moved horizontally at certain distance 6.3 Factors affecting the illumination. 6.4 Different types of lighting arrangements, Design consideration of good lighting scheme. 6.5 Various types of lamps, their construction, Lumens per watt of different types of lamps, illumination levels required for different places. 6.6 Calculation of average lux level. (Numerical based on design of illumination scheme for residential unit)	Lectures Using Chalk-Board Case Study Site/Industry Visit	**CO6**

V.LABORATORY LEARNING OUTCOME AND ALIGNED PRACTICAL/ TUTORIALEXPERIENCES.

Sr. No.	Practical/Tutorial/LaboratoryLearning Outcome (LLO)	Laboratory Experiment/Practical Titles/Tutorial Titles	Number of Hrs.	Relevant COs
1	LLO 1.1 Procure tender notices fom different News papers.	Procure tender notices fom different News papers.	01	CO1
2	LLO 2.1 Prepare a tender notice for purchasing electrical mahines and equipment.	*Prepare a tender notice for purchasing 3-phase,200KVA distribution transformer.	01	CO1
3	LLO 3.1 Prepare a quotation from the given enquiry.	Prepare a quotation from the given enquiry.	01	CO1
4	LLO 4.1 Prepare comparative statement from given qoutations LLO 4.2 Place a purchase order.	*Prepare a comparative statement from a minimum of three quotations and and place a purchase order .	01	CO1
5	LLO 5.1 Use Government eMarketplace(GeM portal) for searching of software, tools/equipment for procurement.	Study of general terms and conditions of GeM and use of GeM for Sale/Purchase of Goods/Services.	02	CO1
6	LLO 6.1 Calculate the total load for a given domestic installation. LLO 6.2 Draw the electrical installation plan from the given civil engineering drawing. LLO 6.3 Calculate the number of subcircuits and ratings of the main switch and distribution board.	*Design an electrical installation system for one BHK domestic unit and carry out an estimation.	04	CO2
7	LLO 7.1 Draw the electrical installation plan from the given civil engineering drawing using suitable drawing software.	*Domestic installation drawing using suitable software / Drawing sheet	04	CO2
8	LLO 8.1 Calculate the total load for a given commercial installation. LLO 8.2 Draw the electrical installation plan from the given civil engineering drawing. LLO 8.3 Calculate the number of subcircuits and ratings of the main switch and distribution board. LLO 8.4 Draw a single-line diagram of the distribution board for the given installation. LLO 8.5 Carry out estimation for above given commercial installation.	*Design an electrical installation system for a commercial unit and carry out an estimation.	04	CO2
9	LLO 9.1 Draw the electrical installation plan from the given civil engineering drawing using suitable drawing software. LLO 9.2 Draw a single-line diagram of the distribution board for a given installation using suitable drawing software.	*Commercial installation drawing using suitable software / Drawing sheet	04	CO2

10	LLO 10.1 Calculate the total load for a given industrial installation. LLO 10.2 Draw the electrical installation plan from the given civil engineering drawing. LLO 10.3 Calculate the size of the cable and ratings of the main switch and distribution board. LLO 10.4 Draw a single-line diagram of the distribution board for the given installation. LLO 10.5 Carry out estimation for above given industrial installation.	*Design an electrical installation system for small industrial installations and carry out an estimation.	04	CO3
11	LLO 11.1 Draw a layout diagram for street light installation from a given civil engineering drawing. LLO 11.2 Draw the details of a streetlight pole and layout as per NEC 2023. LLO 11.3 Select the size of the cable by calculating the voltage drop. LLO 11.4 Carry out the estimation for the given streetlight installation.	*Design an electrical installation system for street lighting of small premises and carry out an estimation.	04	CO4
12	LLO 12.1 Design and estimate L.T. distribution line installation work.	Design and estimate L.T. distribution line installation work ,prepare a report and draw single line diagram on drawing sheet	04	CO5
13	LLO 13.1 Draw a single-line diagram of the distribution board for the given installation. LLO 13.2 Carry out estimation for given domestic installation.	Carry out an estimation and draw a single-line diagram of the distribution board for the given installation on drawing sheet	04	CO5
14	LLO 14.1 Draw a layout diagram for a low-tension (LT) line from given data.	*Draw diagrams of Overhead & Underground service connections on a drawing sheet	04	CO5
15	LLO 15.1 Design an illumination scheme for a class room	Design an illumination scheme for a class room	02	CO6

Note: Out of the above suggestive LLOs -

- '*' Marked Practicals (LLOs) Are mandatory.
- A minimum of 80% of the above list of lab experiments are to be performed.Judicial mix of LLOs is to be performed to achieve desired outcomes.
- A2 size drawing sheet should be used for drawing work.

VI. SUGGESTED MICRO-PROJECTS / ASSIGNMENTS/ ACTIVITIES FOR SPECIFIC LEARNING/ SKILLS DEVELOPMENT (SELF LEARNING)

Micro project:

- Carry out a market survey of electrical materials for comparison of quality and cost.
- Collect an electrical engineering drawing of the existing electrical installation. Interpret it. Prepare a report on it.
- Collect industrial installation plan and prepare estimation for the same using suitable software.
- Collect the existing installation plan of distribution lines and prepare an estimation for the same.

- Collect the existing installation plan of the street lighting scheme and prepare an estimation for the same.
- Collect the existing installation plan of the High-mast lighting scheme and prepare an estimation for the same.
- Collect the existing installation plan of the low-tension (LT) line and prepare an estimation for the same.
- Collect the existing installation plan of the high-tension (HT) line and prepare an estimation for the same.
- Collect any tender document related to electrical installation and fill all related documents.
- Collect a list of vendors and specifications of electrical goods from the GeM portal.

Assignment:

1) Problems / Estimation & Costing of Domestic, Commercial & Industrial Electrical Installation
2) Problems / Estimation & Costing of Overhead and Underground Distribution Line

Note : The above is just a suggestive list of microprojects and assignments; faculty must prepare their bank of microprojects, assignments, and activities similarly.

- The faculty must allocate a judicial mix of tasks, considering the weaknesses and/or strengths of the student in acquiring the desired skills.
- If a micro project is assigned, it is expected to be completed as a group activity.
- SLA marks shall be awarded as per the continuous assessment record.
- If the course does not have an associated SLA component, the above suggestive listings apply to Tutorials and may be considered for FA-PR evaluations.

VII. LABORATORY EQUIPMENT / INSTRUMENTS / TOOLS / SOFTWARE REQUIRED

Sr.No	Equipment Name with Broad Specifications	Relevant LLO Number
1	All In One Computer with following specifications. Processor - 13th Gen Intel® Core™ i5-13500T, OS-Windows 11 Pro, Graphics - Intel® Graphics, Memory - 8 GB: 1 x 8 GB, DDR4, Storage - 256 GB, M.2 2230, PCIe NVMe, SSD, Class 35, Display - 60.5-cm. display Full HD (1920X1080)	1,8,9,10
2	Laserjet multifunction printer	1,8,9,10
3	Any proprietary or open-source drawing Software such as SmartDraw, EPLAN Electric P8 , Electrical AutoCAD	8,9,10

VIII. SUGGESTED FOR WEIGHTAGE TO LEARNING EFFORTS & ASSESSMENT PURPOSE (Specification Table)

Sr.No	Unit	Unit Title	Aligned COs	Learning Hours	R-Level	U-Level	A-Level	Total Marks
SECTION - I								
1	**I**	**ESTIMATES AND CONTRACTS**	**CO1**	**06**	**2**	**4**	**4**	**10**
2	**II**	**DOMESTIC AND COMMERCIAL INSTALLATIONS**	**CO2**	**08**	**2**	**4**	**6**	**12**
3	**III**	**INDUSTRIAL INSTALLATIONS**	**CO3**	**08**	**3**	**4**	**6**	**13**
SECTION -I TOTAL				**22**	**7**	**12**	**16**	**35**
SECTION - II								
4	**IV**	**PUBLIC LIGHTING INSTALLATION**	**CO4**	**08**	**4**	**4**	**6**	**14**
5	**V**	**DISTRIBUTION LINES**	**CO5**	**08**	**2**	**3**	**6**	**11**
6	**VI**	**ILLUMINATION IN RESIDENTIAL INSTALLATION**	**CO6**	**07**	**_**	**4**	**6**	**10**
SECTION -I I TOTAL				**23**	**6**	**11**	**18**	**35**
GRAND TOTAL				**45**	**13**	**23**	**34**	**70**

IX. ASSESSMENT METHODOLOGIES/TOOLS

Formative assessment (Assessment for Learning)	Summative Assessment (Assessment of Learning)
• Two-unit tests of 30 marks will be conducted and an average of marks obtained in these two-unit tests will be considered. • Each practical will be assessed for 25 marks and an average of all marks obtained will be considered.	End semester assessment of 70 marks through offline mode of examination.

X. SUGGESTED COS- POs –PSOs MATRIX FORM

Course Outcomes (COs)	Programme Outcomes(POs)							Programme Specific Outcomes *(PSOs)			
	PO-1 Basic and Discipline-Specific Knowledge	PO-2 Problem Analysis	PO-3 Design/ Development of Solutions	PO-4 Engineering Tools	PO-5 Engineering Practices for Society, Sustainability and Environment	PO-6 Project Management	PO-7 Life Long Learning	PSO-1	PSO-2	PSO-3	PSO-4
CO1	3	3	3	--	3	3	3	3	3	3	3
CO2	3	3	3	2	3	3	2	3	3	3	2
CO3	3	3	3	2	3	3	2	3	3	3	3
CO4	3	--	--	1	1	3	3	3	1	3	3
CO5	3	--	3	--	2	2	3	2	2	3	2
CO6	3	2	2	1	--	2	2	2	1	3	2

Legends:- High:03, Medium:02, Low:01, NoMapping: --
***PSOs are to be formulated at the institute level**

XI. SUGGESTED LEARNING MATERIALS / BOOKS:

Sr. No.	AUTHOR	TITLE	PUBLISHER
1	K.B.Raina, S.K.Bhattacharya	Electrical Design Estimating and Costing	New Age International Publisher, First, Reprint 2010, ISBN:13: 978-8122443585
2	Surjit Singh, Ravi Deep Singh	Electrical Estimating and Costing	Dhanpat Rai and Sons, 2014 New Delhi, ISBN:1234567150995
3	J.B. Gupta	A Course in Electrical Installation Estimating and Costing	S.K. Kataria and Sons; New Delhi Reprint Edition, 2013, ISBN: 13: 978-9350142790
4	BIS	SP-30:2023, National Electrical Code, 2023	Bureau of Indian Standards
5	BIS	IS: 732-1989, Code of Practice for Electrical Wiring Installation	Bureau of Indian Standards
6	GeM	Step by step procedure of GeM purchase	GeM portal :https://gem.gov.in

XII. LEARNING WEBSITES & PORTALS

Sr. No.	Link/Portal	Description
1	https://www.electricaltechnology.org/2013/09/electrical-wiri ng.htm	Basics of Electrical Wiring System
2	https://www.electrical4u.com/types-of-electrical-insulator-o overhead-insulator/	Distribution line materials
3	https://www.electrical4u.com/lamps-types-and-performance-com parison/	Different types of lamps.
4	https://youtu.be/yhzhloBF_eo?si=Esgl05OzWNCOQaiD	High mast light wiring
5	https://www.youtube.com/watch?v=IoMXX6xct1g	Streetlight wiring
6	https://standardsbis.bsbedge.com/	SP:30 NEC 2023
7	https://gem.gov.in/	GeM portal for procurement.

Name & Signature:

Shri. Jabir Gulab Momin
Lecturer in Electrical Engineering

Mrs.Vaishali Prasad Karhad
Lecturer in Electrical Engineering

(Course Experts)

Name & Signature:	Name & Signature:
Dr. S. V. Bhangale (Programme Head)	**Shri.S.B.Kulkarni** (CDC In-charge)

GOVERNMENT POLYTECHNIC, PUNE

'120 – NEP' SCHEME

PROGRAMME	**DIPLOMA IN ELECTRICAL ENGINEERING**
PROGRAMME CODE	**02**
COURSE TITLE	**DISTRIBUTION AND UTILIZATION OF ELECTRICAL ENERGY**
COURSE CODE	**EE41203**
PREREQUISITE COURSE CODE & TITLE	**EE31202 - ELECTRIC CIRCUIT & NETWORK**
CLASS DECLARATION COURSE	**YES**

I. LEARNING & ASSESSMENT SCHEME

Course Code	Course Title	Course Type	Learning Scheme					Credits	Assessment Scheme										
			Actual Contact Hrs./Week			SLH	NLH		Paper Duration	Theory				Based on LL & TSL				Based on SL		Total Marks
														Practical						
			CL	TL	LL					FA-TH	SA-TH	Total		FA-PR		SA-PR		SLA		
										Max	Max	Max	Min	Max	Min	Max	Min	Max	Min	
EE41203	DISTRIBUTION AND UTILIZATION OF ELECTRICAL ENERGY	DSC	3	--	2	1	6	3	3	30	70	100	40	25	10	-	-	25	10	150

Total IKS Hrs for Term: 0 Hrs

Abbreviations: CL-Classroom Learning, **TL**-Tutorial Learning, **LL**-Laboratory Learning, **SLH**-Self Learning Hours, **NLH**-Notional Learning Hours, **FA** - Formative Assessment**, SA** -Summative assessment, **IKS** – Indian Knowledge System, **SLA**- Self Learning Assessment

Legends: @-Internal Assessment, **#** - External Assessment,***#** - Online Examination,**@$** - Internal Online Examination

Note:

FA-TH represents an average of two class tests of 30 marks each conducted during the semester.

1. If a candidate is not securing minimum passing marks in **FA-PR** (Formative Assessment - Practical) of any course, then the candidate shall be declared as **'Detained'** in that course.
2. If a candidate does not secure minimum passing marks in SLA (Self Learning Assessment) of any course, then the candidate shall be declared as **'fail'** and will have to repeat and resubmit SLA work.
3. **Notional learning hours** for the semester are **(CL + LL + TL + SL) hrs. * 15 Weeks**
4. **1 credit** is equivalent to **30 Notional hours**.
5. * Self-learning hours shall not be reflected in the Timetable.
6. * Self-learning includes micro-projects/assignments/other activities.

II. RATIONALE:

Diploma Electrical Engineers who work as technicians in the field of distribution of Electrical Power. They must know about the components used in distribution systems. This course will explain the construction, operation, and analytical performance to find values of derived parameters such as efficiency & regulations of distribution lines. Also possess knowledge and skills of operation and use of electrical drives, electrical furnaces, and traction systems. Essential theoretical and practical knowledge will be achieved by taking this course. Contents of course are designed essentially keeping in mind the job profile of an electrical engineer handling electrical utilities.

III. COURSE-LEVEL LEARNING OUTCOMES (CO's)

Students will be able to achieve & demonstrate the following COs on completion of course-based learning

CO1 – Calculate various parameters for a particular distribution system.

CO2 – Identify and apply the components of substation.

CO3 - Select the type of electric furnaces and welding system according to applications.

CO4 - Apply a suitable electric drive for a particular application.

CO5 – Maintain different electric traction system.

IV. THEORY LEARNING OUTCOMES AND ALIGNED COURSE CONTENT

Sr. No	Theory Learning Outcomes (TLO's) aligned to CO's.	Learning content mapped with TLO's.	Suggested Learning Pedagogies	Relevant COs
	SECTION I			
	UNIT – I REQUIREMNTS OF DISTRIBUTION SYSTEM (CL Hrs – 09, Marks-14)			
1	**TLO 1.1.** State the need for the distribution system. **TLO 1.2**. Describe with sketches the various connection schemes of the distribution system. **TLO 1.3** Solve simple numerical problems on voltage drop calculation of feeder fed at one end **TLO1.4** Solve simple numerical on Kelvin's Law. **TLO 1.5.** State the causes of low power factor and disadvantages of low power factor **TLO 1.6** State the advantages of improved power factor and explain the methods to improve it and simple numerical based on it. **TLO 1.7** Define the Tariff and state its necessity.	**1.1** Necessity of distribution system, Primary and secondary distribution. **1.2** Types of distribution systems. **1.3** i) AC distribution and its requirements, connection schemes of distribution system: Ring, Radial etc. ii) Voltage drops calculations for feeder fed at one end. **1.4** Selection of conductor size for distributor, Kelvin's Law **1.5** i) Causes of low power factor. Effect of harmonics on pf. ii) Disadvantages of low power factor **1.6** Advantages of improved power factor and Methods of improving power factor, by use of i) Static condenser, ii) Synchronous condensers, iii) Automatic p.f. Improvement, iv) Phase advancers (Numerical) **1.7** Tariff- Definition, necessity, and different types of tariffs as per M.S.E.D.C.L.	Chalk-Board, Demonstrations, Industry Visit	CO1
	UNIT- II COMPONENTS OF DISTRIBUTION LINE AND SUBSTATION (CL Hrs –08, Marks-12)			
2	**TLO 2.1** State the need for electrical substations. **TLO 2.2** Classify sub-stations based on service requirements and construction. **TLO 2.3**. Compare Indoor and Outdoor sub-stations. **TLO 2.4** State the need and function of sub-station equipment. **TLO 2.5** Explain different bus-bar arrangements. **TLO 2.6** Draw a single-line diagram of a typical transformer sub-station.	**2.1** Necessity of Electric substation. **2.2** Classification of Sub-Stations: according to service requirement, according to constructional features. **2.3** Comparison between indoor and outdoor substations. **2.4** Equipment in transformer sub-stations: Busbars, Insulators, Types of Insulators, Line support: Types of line structure, Method of erection. Isolators, Circuit breakers, Power transformers, Instrument transformers, Metering and indicating instruments, Carrier current equipment, and Batteries. **2.5** Bus bar arrangement: Single bus-bar system, Duplicate bus-bar system. **2.6** Single line diagram of typical transformer sub-station.	Chalk-Board, Demonstrations, Industry Visit	CO2

	UNIT –III ELECTRIC WELDING (CL 5 HRS, MARKS 09)			
3	**TLO 3.1** Describe the working principle, construction, advantages disadvantages and application of different types of welding. **TLO 3.2** Describe the various types of new modern welding techniques.	**Electric Welding**: 3.1 Methods of Electric Welding – Electric arc welding, Resistance welding. i) **Resistance Welding** – Principle, types of Resistance welding, Advantages, Disadvantages and applications. ii) **Arc welding-** Working principle, Characteristics of arc, Factors on which arc length depends, Methods of arc stabilization, Types of electrodes, Advantages of coated electrodes. Different types of Arc welding 3.2 New techniques in welding: Ultrasonic welding, Laser welding, under water welding, IGBT controlled welding. Applications of above types of welding.	Chalk-Board, Demonstrations,	CO3
	SECTION II			
	UNIT – IV ELECTRIC HEATING (CL Hrs – 08, MARKS-12)			
4	**TLO 4.1** Explain the construction, working principle and classification of the specified electrical heating system. **TLO 4.2** Recommend the Relevant heating system for the given application with proper justification. **TLO 4.3** Design the heating element of the given type of furnace from the specified data. And solve simple numerical for estimation of the size of the induction furnace.	**Electric Heating** 4.1 Concept of electrical heating, Advantages and Classification of electric heating, Modes of heat transfer. 4.2 i) **Resistance Heating**: Construction and operation of Direct Resistance Heating, Indirect Resistance Heating, Resistance Ovens, Requirements of Heating Element Material, Causes of Failure of Heating Elements, ii) **Arc Heating** - Direct Arc Furnace, Indirect Arc Furnace. Applications of Arc Heating. iii) **Induction Heating** – Core Type Induction Furnace, Coreless Induction Furnace, Applications of Induction Heating, iv) **Dielectric Heating**: Principle of Dielectric Heating, Advantages and Limitations of Dielectric Heating, Applications of Dielectric Heating. 4.3 Methods of Temperature Control, Applications of Resistance Heating, Design of Heating Element. (Simple Numerical problems on heating elements)	Chalk-Board, Demonstrations, Industry Visit	CO3

	UNIT–V ELECTRIC DRIVE AND ELEVATOR (CL Hrs – 08, MARKS-12)			
5	**TLO 5.1** Differentiate the salient features between the given types of electric Drives. **TLO 5.2** Recommend the relevant motor for the given application with justification. **TLO 5.3** Select the relevant enclosure for the given atmospheric condition with justification. **TLO 5.4** Select the power transmission drive of the electric motor for the given application with justification. **TLO 5.5** Estimate the relevant size and rating of the electric motor for the specified load cycles. **TLO 5.6** Select the relevant elevator machine and electric motor for the Specified application with justification. **TLO 5.7** Describe the procedure to maintain the given electric drive and elevator.	**Electric drives**: **5.1** Concept, factors governing the selection of Electric drives (motor). **5.2** Types of electrical drives: Individual and Group drive, Applications. **5.3** Mechanical features of drives: Types and applications Various types of enclosures. **5.4** Transmission of Mechanical Power: Direct and Indirect drive (Belt, Rope, Chain, Gear), Vertical drives and their applications. i) Bearing: Types and applications. **5.5** Size and Rating of motor: (Simple numerical on this topic) i) Load Cycles: Concept with graphical representation. ii) Load Equalization: Concept, and methods and Condition of load equalization. **Elevators** **5.6** Elevators: Function, Application, types, safety and Precautions. **5.7** Factors on which the shape and size of the car depend.	Chalk-Board, Demonstrations, Industry Visit	CO4
	UNIT - VI ELECTRIC TRACTION (CL Hrs –07, MARKS-11)			
6	**TLO 6.1** Recommend Relevant traction system for the given application with justification. **TLO 6.2** Select the relevant traction services with justification. **TLO 6.3** Differentiate the salient features between the given types of track electrification systems. **TLO 6.4** Differentiate between the given types of traction services based on the given criteria.	**6.1** Introduction of electric traction system, Requirements of ideal traction system **6.2** System of Track Electrification: DC; Single phase 25kV AC, Composite system. **6.3** Traction Mechanics: Block diagram of AC electric locomotive and function of each part, Nomenclature of Locomotives. **6.4** Traction services: Urban, suburban, main line service (Main features and comparison between the three of them). i)Concept and function of Catenary wire, contact wire and Dropper, Different types of catenary and their speed limits, Definition and Need of Neutral Section, Current Collecting system: Diamond type pantograph and Faiveley type pantograph (Construction and Working)	Chalk-Board, Demonstrations, Industry Visit	CO5

V. LABORATORY LEARNING OUTCOME AND ALIGNED PRACTICAL/ TUTORIAL EXPERIENCES.

Sr. No	Practical/Tutorial/Laboratory Learning Outcome (LLO)	Laboratory Experiment / Practical Titles /Tutorial Titles	Number of hrs.	Relevant COs
1	**LLO 1.** Identify different distribution systems.	Write a report on different distribution system	02	CO1
2	**LLO 2.** Identify different insulators.	Write a report on different types of insulators required for the distribution system.	02	CO1
3	**LLO 3** identify different line supports and insulators.	Collect different samples of line support and line insulators required for the distribution system.	02	CO2
4	**LLO 4.** observe different types of distribution systems. Observe the different safety equipment used in the substation	Visit 33KV/11KV and 11KV/400V distribution substations and write a report.	02	CO2
5	**LLO 5.** Prepare a report on the Substation.	Prepare a report on different types of substations.	02	CO2
6	**LLO 6**.1 identify differently Components required for various Heating furnaces.	Identify different components required for various types of heating furnace	02	CO3
7	**LLO7.** Observe the construction and working of various heating furnaces.	Observe the construction and working of various heating furnaces by watching video programs	02	CO3
8	**LLO 8.** Identify the accessories and safety devices required for various Heating furnaces.	Identify different accessories and safety devices required for various types of Heating furnaces	02	CO3
9	**LLO 9.** Prepare a report on the specifications of various electrical welding machines	Prepare a report of specifications of various electrical welding machines available in the college workshop.	02	CO3
10	**LLO 10.** Observe various electrical drives and prepare a technical report.	Visit a small manufacturing unit to observe various electrical drives and prepare a technical report.	02	CO4
11	**LLO 11.** Identify different manufacturing companies of elevators for comparison	Prepare a comparative chart of two different manufacturing companies in India of the elevator with technical data.	02	CO4
12	**LLO 12.** Identify different types of switchgear used in Traction substation.	Visit a traction substation draw a single-line diagram of the substation and write a report.	02	CO5
13.	**LLO 13**. To observe the rising and lowering of pantograph & different parts of EMU during visit.	Visit a railway electric loco shed to study the power circuit of an electric locomotive.	02	CO5
14	Micro project planning and execution as written in the suggested micro project list	Micro project Report Writing.	02	ALL

Perform any 12 practical. All COs should be covered in the performed practical.

VI. SUGGESTED MICRO PROJECT/ASSIGNMENT/ACTIVITIES FOR SPECIFIC LEARNING/SKILLS DEVELOPMENT (SELF-LEARNING)

Assignment

- Prepare a power point presentation related to different distribution system.
- Prepare a power point presentation on method of improving power factor in distribution system.
- Prepare a Power Point presentation related to heating furnaces.
- Prepare a PowerPoint presentation related to welding equipment and accessories.
- Collect the Bombay Lift Act and understand the rules to inspect electrical components.
- Select any one electric drive. Explain its suitability for any one industrial application through power point Presentation. (Electrical and Mechanical Characteristics).
- Seminar on various electric drives.
- Prepare a chart of elevators.
- Prepare a chart of the components of elevators.
- Seminar on the latest electric traction trends in India.

Micro project:

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

- Draw schematic diagrams of different distribution system
- Prepare a PowerPoint presentation related to various types of heating Furnaces.
- Prepare a PowerPoint presentation related to various types of welding Methods, Equipment and accessories.
- Prepare a report on a market survey of various drives (specification, Manufacturer, Application and cost.
- Prepare a report on a market survey of various elevators (specification, manufacturer, application and cost)
- Prepare a PowerPoint presentation and the report related to electric traction systems in India and a comparison between them.

VII. LABORATORY EQUIPMENT/INSTRUMENTS/TOOLS/SOFTWARE REQUIRED

Sr. No	Equipment Name with Broad Specifications	Relevant LLO Number
1	Visit to 33 KV /11KV and 11 KV /400V Distribution substation	1,2,3,4,5
2	Video programme / Internet information on various types of heating furnaces.	6,7
3	Video programme / Internet information on various types of welding systems	8,9
4	Market survey / Internet information of various drives elevator as per application	10,11
5	Visit to Khadaki Traction substation to understand the layout equipment and protective measures used in the traction substation.	12,13

VIII. SUGGESTED FOR WEIGHTAGE TO LEARNING EFFORTS & ASSESSMENT PURPOSE (Specification Table)

Sr. No	Unit	Unit Title	Aligned COs	Learning Hours	R-Level	U-Level	A-Level	Total Marks
SEC - I								
1	I	REQUIREMNTS OF DISTRIBUTION SYSTEM	CO1	09	4	6	4	14
2	II	COMPONENTS OF DISTRIBUTION LINE AND SUBSTATION	CO2	08	4	6	2	12
3	III	ELECTRIC WELDING	CO3	05	4	4	1	09
SEC - II								
4	IV	ELECTRIC HEATING	CO3	08	4	6	1	12
5	V	ELECTRIC DRIVES AND ELEVATORS	CO4	08	4	6	2	12
6	VI	ELECTRIC TRACTION	CO5	07	2	6	4	11
Grand Total				45	22	34	14	70

IX. ASSESSMENT METHODOLOGIES/TOOLS

Formative assessment (Assessment for Learning)	Summative Assessment (Assessment of Learning)
Two unit tests of 30 marks will be conducted and an average of two unit tests considered. For formative assessment of laboratory learning 25 marks. Each practical will be assessed considering the appropriate % weightage to process and product and other instructions of assessment.	End semester assessment of 70 marks through offline mode of examination.

X. SUGGESTED COS- POS MATRIX FORM

Course Outcomes (COs)	Programme Outcomes(POs)							Programme Specific Outcomes *(PSOs)			
	PO-1 Basic and Discipline-Specific Knowledge	PO-2 Problem Analysis	PO-3 Design/ Development of Solutions	PO-4 Engineering Tools	PO-5 Engineering Practices for Society, Sustainability and Environment	PO-6 Project Management	PO-7 Life Long Learning	PSO-1	PSO-2	PSO-3	PSO-4
CO1	2	2	--	1	2	1	2	--	2	--	--
CO2	2	2	--	1	2	1	2	2	--	--	2
CO3	3	2	2	2	2	2	3	2	--	--	2
CO4	2	--	1	1	2	2	3	2	2	--	-
CO5	2	--	--	2	3	--	3	--	--	--	2

Legends:- High:03, Medium:02, Low:01, No Mapping: --
***PSOs are to be formulated at the institute level**

XI. SUGGESTED LEARNING MATERIALS/BOOKS

Sr. No	Author	Title	Publisher
1	J. B. Gupta	Transmission & Distribution of Electrical Power	S. K. Kataria & Sons ISBN: 9788185749570
2	C.L.Wadhwa	Electrical Power Systems	New Age International Pvt Ltd ISBN: 9788122428391
3	S. N. Singh	Electric Power Generation: Transmission & Distribution	Prentice Hall of India Pvt Ltd ISBN: 9788120335608
4	H.Pratab	Art and Science of Utilization of Electrical Energy	Dhanpat Rai & Sons, New Delhi, ISBN:9788177001440
5	J.B. Gupta	Utilization of Electric Power and Electric Traction	S.K. Kataria & Sons, New Delhi, ISBN:978- 9350142585
6	G.K. Dubey	Fundamentals of Electric Drive	Narosa Publishing House, New Delhi, ISBN: 8173190410, 9788173190414
7	H.Pratab	Modern Electric Traction	Dhanpat Rai & Sons, New Delhi, ISBN:1234567147206

XII. LEARNING WEBSITES & PORTALS

Sr. No	Link/Portal	Description
1.	www.education4u.in	Videos on Distribution System.
2.	https://www.youtube.com/watch?v=tyuOgA1lX2Y https://www.youtube.com/watch?v=k78GHf-aT7M	Video on Insulators
3.	https://www.youtube.com/watch?v=BDMFsYnTdVI	Videos on Electric Locomotive with full description
4.	www.nptel.iitm.ac.in	All Topics of Utilization of Electrical Energy
5.	www.khanacademy.com	All Topics of Utilization of Electrical Energy
6.	https://www.youtube.com/watch?v=fakGLu03jYg	Videos on Electric Traction

Note:
Teachers are requested to check the creative common license status/financial implications of the suggested online educational resources before use by the students

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GOVERNMENT POLYTECHNIC, PUNE

'120 – NEP' SCHEME

PROGRAMME	**DIPLOMA IN ELECTRICAL ENGINEERING**
PROGRAMME CODE	**02**
COURSE TITLE	**DIGITAL ELECTRONICS AND MICROCONTROLLER APPLICATION**
COURSE CODE	**EE51201**
PREREQUISITE COURSE CODE & TITLE	**NA**
CLASS DECLARATION COURSE	**NO**

I. LEARNING & ASSESSMENT SCHEME

Course Code	Course Title	Course Type	Learning Scheme					Credits	Assessment Scheme											
			Actual Contact Hrs./Week			SLH	NLH		Paper Duration	Theory				Based on LL & TSL				Based on SL		Total Marks
														Practical						
			CL	TL	LL					FA-TH	SA-TH	Total		FA-PR		SA-PR		SLA		
										Max	Max	Max	Min	Max	Min	Max	Min	Max	Min	
EE51201	DIGITAL ELECTRONICS AND MICROCONTROLLER APPLICATION	SEC	2	0	2	2	6	3	2 Hrs.	15	35	50	20	25	10	25@	10	25	10	125

Total IKS Hrs for Term: 0 Hrs

Abbreviations: CL-Classroom Learning, **TL**-Tutorial Learning, **LL**-Laboratory Learning, **SLH**-Self Learning Hours, **NLH**-Notional Learning Hours, **FA** - Formative Assessment**, SA** -Summative assessment, **IKS** – Indian Knowledge System, **SLA**- Self Learning Assessment

Legends: @-Internal Assessment, **#** - External Assessment,***#** - Online Examination,**@$** - Internal Online Examination

Note:

FA-TH represents an average of two class tests of 15 marks each conducted during the semester.

1. If a candidate is not securing minimum passing marks in **FA-PR** (Formative Assessment - Practical) of any course, then the candidate shall be declared as '**Detained**' in that course.
2. If a candidate does not secure minimum passing marks in SLA (Self Learning Assessment) of any course, then the candidate shall be declared as **'fail'** and will have to repeat and resubmit SLA work.
3. **Notional learning hours** for the semester are **(CL + LL + TL + SL) hrs. * 15 Weeks**
4. **1 credit** is equivalent to **30 Notional hours**.
5. * Self-learning hours shall not be reflected in the Timetable.
6. * Self-learning includes micro-projects/assignments/other activities.

II. RATIONALE:

In today's digital world, all the equipment like computers, mobiles, music systems, ATMs, automation and control circuits and systems are built on digital circuits. Electrical Engineering Diploma pass out plays a key role in control panel operations based on microcontroller systems. This course builds the knowledge of digital electronics required to use microcontroller-based systems

III. COURSE-LEVEL LEARNING OUTCOMES (CO'S)

Students will be able to achieve & demonstrate the following COs on completion of course-based learning

CO1 - Apply knowledge of number system and logic circuits in working of digital system.
CO2 - Access various registers in the 8051 microcontroller.
CO3 - Develop and execute programs in assembly language for microcontroller and interface 8051 microcontrollers for various applications.

IV.THEORY LEARNING OUTCOMES AND ALIGNED COURSE CONTENT

Sr. No	Theory Learning Outcomes (TLO's) aligned to CO's.	Learning content mapped with TLO's.	Suggested Learning Pedagogies	Relevant COs
UNIT - I DIGITAL CIRCUITS (CL Hrs- 08, Marks- 10)				
1.	TLO 1.1 Recognize and convert the given number into the specified number system. TLO 1.2 Perform the binary and BCD arithmetic operation on the given numbers. TLO 1.3 Develop the basic gates using the given NAND/NOR gate as a universal gate. TLO 1.4 Draw MUX/DEMUX tree for the given number of input and output lines. TLO 1.5 Describe the building process of the specified type of flip-flop.	1.1 Number System: Decimal, Binary, octal, hexadecimal, BCD. Conversion of one number system into another. 1.2 Binary Arithmetic: - Addition, Subtraction (1's and 2's complement) Multiplication, Division. BCD addition. 1.3 Logic Gates: Symbol, switch circuit, logical expression, truth table of basic logic gates (AND, OR, NOT), Universal gates (NAND and NOR) and Special purpose gates (EX-OR, EX-NOR). 1.4 Multiplexer and Demultiplexer: working, truth table and applications. 1.5 SR Flip Flops: SR-flip flop, clocked SR flip flop with preset and clear, drawbacks of SR flip flop. JK Flip Flops: Clocked JK Flip flop with preset and clear, D and T type flip flop.	Chalk-Board, Video Demonstrations, Model Demonstration, PowerPoint Presentations, Charts	CO1
UNIT - II 8051 MICROCONTROLLER ARCHITECTURE (CL Hrs- 10, Marks- 10)				
2	TLO 2.1 State salient features of 8051 microcontroller TLO 2.2 Compare the given types of architecture TLO 2.3 Draw pin diagram and architectural block diagram of 8051. Describe the given types of registers of 8051. TLO 2.4 Justify the use of the given type of memory in 8051.	2.1 8051 Microcontroller: Introduction, block diagram and features. Types of buses, address bus, data bus and control bus. 2.2 Harvard and Von-Neumann architecture. 2.3 8051 Microcontroller Architecture: - Pin configuration, Register banks, bit and byte addressable area. Registers: PC, DPTR, A&B, PSW and other Special function registers (SFR), I/O ports, Timers (pins and associated SFRs). Stack and stack pointer 2.4 Memory organization (RAM, ROM).	Chalk-Board, Video Demonstrations, Model Demonstration, PowerPoint Presentations, Charts	CO2

UNIT - III 8051 INSTRUCTION SET, PROGRAMMING , INTERFACING AND APPLICATION (CL Hrs- 12, Marks- 15)				
3	TLO 3.1 Identify the addressing mode of the given instruction with examples. TLO 3.2 Describe the function of the given instruction with suitable examples. TLO 3.3 Justify the use of the given assembler directives with examples. TLO 3.4 Explain the instruction syntax for 8051 assembly language program TLO 3.5 Develop assembly language programs to perform simple operations TLO 3.6 Describe with sketches the procedure to interface the given external memory. TLO 3.7 Describe with sketch the interfacing of the given external I/O devices.	3.1 Addressing Modes: Immediate, register, direct, indirect, indexed, relative, absolute, bit inherent, bit direct. 3.2 Instruction Set (with appropriate example): Data transfer, Logical, Arithmetic, Branching, Stack operation. 3.3 Assembler Directives: ORG, DB, EQU, END, CODE, DATA . 3.4 Assembly language programming process with instruction syntax. 3.5 Develop assembly language programs for the following commonly used applications: i) Addition and subtraction of two 8-bit unsigned numbers. ii) Multiplication and division on two 8-bit unsigned numbers. iii) Average of 8-bit numbers. iv) Data transfer from one location to another. v) Incrementing and decrementing the contents of registers and RAM. Programming for the same. 3.6 Memory interfacing - Program and Data memory 3.7 Draw an interfacing diagram and develop a flowchart to interface following with 8051 i) LED ii) LCD iii) Relay iv) Stepper Motor	Chalk-Board, Video Demonstrations, Model Demonstration, PowerPoint Presentations, Charts	CO3

V. LABORATORY LEARNING OUTCOME AND ALIGNED PRACTICAL/TUTORIAL EXPERIENCES.

Sr. No	Practical/Tutorial/Laboratory Learning Outcome (LLO)	Laboratory Experiment / Practical Titles /Tutorial Titles	Number of hrs.	Relevant COs
1	LLO 1.1 Build AND, OR, NOT gates to verify its truth table.	* Verification of truth table of AND, OR, NOT gates using ICs.	2	CO1
2	LLO 2.1 Test the function of the RS flip flop.	Testing the function of RS flip flop using NAND Gate.	2	CO1
3	LLO 3.1 Test the function of the JK flip flop.	Testing the function of JK flip flop using 7476.	2	CO1

Sr. No	Practical/Tutorial/Laboratory Learning Outcome (LLO)	Laboratory Experiment / Practical Titles /Tutorial Titles	Number of hrs.	Relevant COs
4	LLO 4.1 Develop and execute an assembly language program (ALP) to perform the addition of 8-bit data.	* Assembly language program (ALP) to perform addition of 8-bit data using a) various addressing modes, b) through stack	2	CO2 , CO3
5	LLO 5.1 Develop and execute an assembly language program (ALP) to perform subtraction of 8-bit data.	* Assembly language program (ALP) to perform subtraction of 8-bit data using a) addressing modes, b) through stack	2	CO2 , CO3
6	LLO 6.1 Develop and execute an assembly language program (ALP) to perform multiplication and division of 8-bit data.	*Assembly language program (ALP) to perform multiplication and division of 8-bit data, take the input data from data memory and display the output data on port 2	2	CO2 , CO3
7	LLO 7.1 Develop and execute an assembly language program to transfer data using internal data memory.	* Assembly language program to transfer data from source to destination location of internal data memory.	2	CO2 , CO3
8	LLO 8.1 Develop and execute an assembly language program to transfer data using external data memory.	Assembly language program to transfer data from source to destination location of external data memory.	2	CO2 , CO3
9	LLO 9.1 Develop and execute an assembly language program to exchange data of memory locations.	* Assembly language program to exchange data from source to destination memory location.	2	CO2 , CO3
10	LLO 10.1 Develop and execute an assembly language program for masking a particular bit of a given register. LLO 10.2 Develop and execute an assembly language program to SET a particular bit of a given register.	* Assembly language program to MASK and SET particular bit of given register using 1) bit addressable instructions and 2) Logical instructions.	2	CO2 , CO3
11	LLO 11.1 Develop and execute an assembly language program to get a rolling display on a given I/O port.	* Assembly language program to get a rolling display on port 2.	2	CO2 , CO3
12	LLO 12.1 Interface LED with 8051. LLO 12.2 Interface SWITCH with 8051.	* Interfacing of LED and switch with 8051 to turn ON / OFF the LED.	4	CO3
13	LLO 13.1 Interface RELAY with 8051.	* Interfacing of RELAY with 8051 to turn ON / OFF the LED.	2	CO3
14	LLO 14.1 Interface 7-segment display with 8051.	Interfacing of stepper motor with 8051 microcontrollers and writing ALP to rotate stepper motor in a clockwise and anti-clockwise direction at given angles.	2	CO3

Note: Out of the above suggestive LLOs -

- '*' Marked Practicals (LLOs) Are mandatory.
- A minimum of 80% of the above list of lab experiments are to be performed. A judicial mix of LLOs is to be performed to achieve the desired outcomes

VI. SUGGESTED MICRO PROJECT/ASSIGNMENT/ACTIVITIES FOR SPECIFIC LEARNING/SKILLS DEVELOPMENT (SELF-LEARNING)

Micro project

- Build a circuit of ALU using IC 74181.
- Build a water level controller to indicate overflow & under the level of water in a tank.
- Prepare a chart of various features using data sheets of the 8051 microcontroller and its derivatives.
- Build a circuit to turn the buzzer ON after 10 seconds

Suggested Student Activity –

- Prepare a chart of various logic gates & their truth table.
- Prepare Power Point presentation on digital circuit microcontroller applications.
- Give a seminar on a relevant topic.
- Undertake a market survey of different microcontroller ICs and collect information regarding- the number of pins, number of bits, clock frequency of operation etc.

Note: A suggestive list of micro-projects and assignments is given here. Similar activities could be added by the course teacher. By considering allotted self-learning hours the course teacher has to allocate a judicial mix of tasks may be a combination of assignments and/or micro projects. The micro project is expected to be completed as a group activity. Course teachers can assign specific learning or any other skill development task. According to task assignments, the course teacher can set rubrics for continuous (formative) type assessment. SLA marks shall be awarded as per continuous assessment records.

VII. LABORATORY EQUIPMENT/INSTRUMENTS/TOOLS/SOFTWARE REQUIRED

Sr.No	Equipment Name with Broad Specifications	Relevant LLO Number
1	Digital Multimeter: 3 and ½ digits with R, V, I measurements, diode and BJT testing.	1,2,3
2	DIGITAL IC tester: Provision for testing a wide range of Digital ICs such as 74 Series, and 40/45 Series of CMOS ICs.	1,2,3
3	Bread Board Development System: Bread Board system with DC power output 5V, +/-12V and 0-5V variable, digital voltmeter, ammeter, LED indicators 8 no, logic input switches 8 no, 7 segment display 2 no, clock generator, Manual pulser, Breadboard with about 1,600 points, Potentiometer, relay etc.	1,2,3
4	Trainer kits for digital ICs: The trainer kit shall consist of digital ICs for logic gates, flop-flop, shift registers, and counters along with toggle switches for inputs bi-colour LED at outputs, and built-in power supply.	1,2,3
5	Regulated power supply: Floating DC Supply Voltages Dual DC: 2 x 0 -30V; 0-2 A Automatic Overload (Current Protection) Constant Voltage and Constant Current Operation Digital Display for Voltage and Current Adjustable Current Limiter Excellent Line and Load Regulation	1,2,3
6	Latest Desktop PC compatible with microcontroller IDE simulation software / KEIL software.	4,5,7,8,9,10,11,12,13,14
7	Microcontroller kit: -single board systems with 8K RAM, ROM memory with battery back up,16X4,16 X2, LCD, PC keyboard interfacing facility, Hex keypad facility, single user cross c- compiler, RS-232, USB, interfacing facility with built-in power supply.	12,13,14
10	Stepper Motor, 50/100 RPM with driver circuitry	14

VIII. SUGGESTED FOR WEIGHTAGE TO LEARNING EFFORTS & ASSESSMENT PURPOSE (Specification Table)

Sr.No	Unit	Unit Title	Aligned COs	Learning Hours	R-Level	U-Level	A-Level	Total Marks
1	I	Digital Circuits	CO1	08	2	6	2	10
2	II	8051 Microcontroller Architecture	CO2	10	2	4	4	10
3	III	8051 Instruction Set, Programming , Interfacing And Application	CO3	12	3	6	6	15
			Grand Total	30	7	16	12	35

IX.ASSESSMENT METHODOLOGIES/TOOLS

Formative assessment (Assessment for Learning)	Summative Assessment (Assessment of Learning)
Two-unit tests of 15 marks will be conducted and an average of marks obtained in these two-unit tests will be considered. Each practical will be assessed for 25 marks and an average of all marks obtained will be considered.	End semester assessment of 35 marks through offline mode of examination. End semester summative assessment of 25 marks for laboratory learning.

X. SUGGESTED COS- POS MATRIX FORM

Course Outcomes (COs)	Programme Outcomes(POs)							Programme Specific Outcomes *(PSOs)			
	PO-1 Basic and Discipline-Specific Knowledge	PO-2 Problem Analysis	PO-3 Design/ Development of Solutions	PO-4 Engineering Tools	PO-5 Engineering Practices for Society, Sustainability and Environment	PO-6 Project Management	PO-7 Life Long Learning	PSO-1	PSO-2	PSO-3	PSO-4
CO1	3	1	1	2	2	1	1	--	2	2	--
CO2	3	1	2	1	2	1	1	2	2	2	3
CO3	3	3	3	2	3	2	2	2	3	2	3
Legends:- High:03, Medium:02, Low:01. No Mapping: -- *PSOs are to be formulated at the institute level											

XI.SUGGESTED LEARNING MATERIALS/BOOKS

Sr.No	Author	Title	Publisher with ISBN Number
1	R.P. Jain	Modern Digital Electronics	McGraw-Hill Publishing, New Delhi, 2009; ISBN: 9780070669116
2	V.K.Puri	Digital Electronics	McGraw Hill Education (1 July 2017); ISBN-13: 978-0074633175
3	Salivahanan S.; Arivazhagan S.	Digital Circuits and Design	Oxford University Press India; 5th edition ; ISBN13- 978-0199488681
4	Malvino, A.P.; Leach, D.P.; Saha G.	Digital Principles and Applications	McGraw Hill Education, New Delhi, 2014, ISBN: 9789339203405
5	V. Udayashankara M. S. Mallikarjuna Swamy	8051 Microcontroller: Hardware, Software and Application.	McGraw Hill Education; 1st edition; ISBN-13 : 978-0070086814
6	Kenneth Ayala	8051 Microcontroller Architecture Programming and Application	Cengage Learning India; 3rd edition ; ISBN-13 : 978-8131502006
7	Mazidi, Mohmad Ali; Mazidi, Janice Gelispe; Mckinlay Roline D.	The 8051 Microcontroller and Embedded system	Pearson Education India; 2nd edition; ISBN-13 : 978-0199681273
8	Ajay Deshmukh	Microcontroller Theory and Application	Mc Graw Hill., New Delhi,2011, ISBN- 9780070585959

XII. LEARNING WEBSITES & PORTALS

Sr.No	Link / Portal	Description
1	https://www.keil.com/download/	Simulation software
2	https://archive.nptel.ac.in/courses/108/105/108105102/	NPTEL course on-Microprocessors and Microcontrollers
3	https://nptel.ac.in/courses/117104072	NPTEL Course-Microcontrollers and Applications, IIT Kanpur by Dr. S.P. Das
4	https://play.google.com/store/apps/details?id=com.coderbro.t utorial.a8051microcontroller&hl=en_IE	Android App for Microcontroller 8051

Note :

- Teachers are requested to check the creative common license status/financial implications of the suggested online educational resources before use by the students

Name & Signature;

Shri. Sunil Padmakar Date
Lecturer in Electrical Engineering

Smt. Sujala Parimal Phadnaik
Lecturer in Electrical Engineering

(Course Experts)

Name & Signature:

Dr. S. V. Bhangale
(Programme Head)

Name & Signature:

Shri. S. B. Kulkarni
(CDC In-charge)

GOVERNMENT POLYTECHNIC, PUNE
'120 – NEP' SCHEME

PROGRAMME	**DIPLOMA IN ELECTRICAL ENGINEERING**
PROGRAMME CODE	**02**
COURSE TITLE	**INSTRUMENTATION AND CONTROL**
COURSE CODE	**EE31206**
PREREQUISITE COURSE CODE & TITLE	**NA**
CLASS DECLARATION COURSE	**NO**

I. LEARNING & ASSESSMENT SCHEME

Course Code	Course Title	Course Type	Learning Scheme					Credits	Assessment Scheme											
			Actual Contact Hrs./Week			SLH	NLH		Paper Duration	Theory				Based on LL & TSL				Based on SL		Total Marks
														Practical						
			CL	TL	LL					FA-TH	SA-TH	Total		FA-PR		SA-PR		SLA		
										Max	Max	Max	Min	Max	Min	Max	Min	Max	Min	
EE31206	INSTRUMENTATION AND CONTROL	DSC	2	--	2	2	6	3	1	15	35*#	50	20	25	10	25@	10	25	10	125

Total IKS Hrs for Term: -- 00 Hrs
Abbreviations: CL-Classroom Learning, **TL**-Tutorial Learning, **LL**-Laboratory Learning, **SLH**-Self Learning Hours, **NLH**-Notional Learning Hours, **FA** - Formative Assessment**, SA** -Summative assessment, **IKS** – Indian Knowledge System, **SLA**- Self Learning Assessment
Legends: @-Internal Assessment, **#** - External Assessment,***#** - Online Examination,**@$** - Internal Online Examination
Note:

FA-TH represents an average of two class tests of 15 marks each conducted during the semester.

1. If a candidate is not securing minimum passing marks in **FA-PR** (Formative Assessment - Practical) of any course, then the candidate shall be declared as **'Detained'** in that course.
2. If a candidate does not secure minimum passing marks in SLA (Self Learning Assessment) of any course, then the candidate shall be declared as **'fail'** and will have to repeat and resubmit SLA work.
3. **Notional learning hours** for the semester are **(CL + LL + TL + SL) hrs. * 15 Weeks**
4. **1 credit** is equivalent to **30 Notional hours**.
5. * Self-learning hours shall not be reflected in the Timetable.
6. * Self-learning includes micro-projects/assignments/other activities.

II. RATIONALE:

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

III. COURSE-LEVEL LEARNING OUTCOMES (CO's)

Students will be able to achieve & demonstrate the following CO's on completion of course-based learning

CO1 - Know the basics of the instrumentation system, classification and selection of the relevant transducers in the measurement of displacement, temperature, pressure, flow and level.
CO2 – know the construction of signal conditioning and data acquisition circuits in the instrumentation system
CO3 - Identify and describe the basic components of the control system and its application.

IV. THEORY LEARNING OUTCOMES AND ALIGNED COURSE CONTENT

Sr. No	Theory Learning Outcomes (TLO's) aligned to CO's.	Learning content mapped with TLO's.	Suggested Learning Pedagogies	Relevant COs
	UNIT-I TRANSDUCER & APPLICATIONS (CL Hrs- 13, Marks-15)			
1.	TLO1.1. Describe the function of each block of the instrumentation system. TLO1.2. Define sensor, and transducer and classify it. TLO1.3. Know the construction and working of the linear and angular potentiometer, construction and working of bounded and unbounded strain gauge, Define gauge factor TLO 1.4 Know the construction and working of LDR and its application TLO 1.5 Understand the construction & working of LVDT/ RVDT, their characteristics, advantages and disadvantages. TLO 1.6 Understand the construction and working of the active transducer with its application. TLO 1.7 Write the selection criteria of the transducer. TLO 1.8 State different temperature scales and understand the construction, working principle and characteristics of thermister, thermocouple & RTD TLO 1.9 Define the Seebeck	1.1 Introduction- generalized block diagram of Instrumentation system. Function of each block of the Instrumentation system. 1.2 Sensors: basic definition, classification- thermal, optical, magnetic and electric sensors 1.3 Transducer: Need, Classification 1.4 Electrical Passive Transducers: a. Resistive type - linear and angular potentiometer, strain gauges, LDR. b. Inductive type - Linear variable differential transformer (LVDT), Rotational variable differential transformer (RVDT). c. Capacitive transducer 1.5 Piezoelectric transducer, Photovoltaic cell. 1.6 Selection criteria of transducer. 1.7 Measurement of Temperature Temp. and its Units.RTD (PT-100), Thermistor, Thermocouple –Seebeck effect and Peltier effect. Construction and working principle, common thermocouples and their parameters. Pyrometer – Radiation method. Typical specifications of Thermistor, RTD and Thermocouple. 1.8 Measurement of Level units, level measurement methods.	Lecture Using Chalk-Board Presentations Video Demonstrations Flipped Classroom Collaborative learning Case Study	CO1

Sr. No	Theory Learning Outcomes (TLO's) aligned to CO's.	Learning content mapped with TLO's.	Suggested Learning Pedagogies	Relevant COs
	effect and Peltier effect. TLO 1.10 Understand working of the pyrometer. TLO 1.11 Know different methods of measurement of level. TLO 1.12 State different types of pressures TLO 1.13 Classify pressure measuring devices and understand the measurement of pressure by various types of sensors. TLO 1.14 State mass flow rate and volumetric flow rate TLO 1.15 Know the construction and working principles of different types of flow meters.	Indirect methods: Capacitive type, Ultrasonic type, 1.9 Measurement of Pressure Pressure - units, Types- Absolute, Gauge, Atmospheric & Vacuum. Pressure measuring devices - (i) Manometer (ii) Bourdon tube Specification of pressure transducer 1.10 Measurement of Flow Flow - units, mass flow rate, volumetric flow rate, Type- (i) Venture tube (ii) Rotameter (iii) Ultrasonic flow meter 1.11 Specification of Various Flow Meters		
UNIT-II SIGNAL CONDITIONING AND DATA ACQUISITION CIRCUITS (CL Hrs- 13, Marks- 15)				
2	TLO 2.1 State the importance of signal conditioning circuits in the instrumentation system. TLO 2.2 Know the basics of op-amp and its parameters TLO 2.3 Understand the construction and working of different circuits using op-amp in the instrumentation system. TLO 2.4 Know the necessity of a data acquisition system in the instrumentation system. TLO 2.5 Understand different circuits of DAS in the instrumentation system. TLO 2.6 Know the terms Mux, De-Mux, TDM, FDM, Modulation, and demodulation, TLO 2.7 Know the working of different displays.	2.1 Signal Conditioning: Definition, the importance of signal Conditioning, 2.2 Operational Amplifier and its parameters. Op-Amp IC's (741) pin diagram and pin function. Virtual ground concept. 2.3 Op-amp basic Circuits- inverting, non-inverting amplifier, adder, subtractor, integrator, differentiator. 2.4 Application of Op-amp- instrumentation amplifier, comparator, zero crossing detector, filters- low pass, high pass, band pass and band stop filter. 2.5 Necessity of data processing in instrumentation, data acquisition system (DAS), classification of DAS, 2.6 Signal converter-ADC – successive approximation and DAC – R-2R network type. 2.7 Basic definition of Multiplexer & de –multiplexer, TDM & FDM, modulation &demodulation 2.8 Display, analog and digital, 7 segments and 14 segments display.	Lecture Using Chalk-Board Presentations Video Demonstrations Flipped Classroom Collaborative learning Case Study	CO2

Sr. No	Theory Learning Outcomes (TLO's) aligned to CO's.	Learning content mapped with TLO's.	Suggested Learning Pedagogies	Relevant COs
UNIT –III BASIC CONCEPT OF CONTROL SYSTEM (CL Hrs- 4, Marks- 5)				
3	TLO 3.1 State the basic concept of the control system and its components and application. TLO 3.2 Know different control actions. TLO 3.3 State different applications of the control system.	3.1 Control system, types of control system – close loop and open loop control system 3.2 Automatic controller, basic function. Control actions- two positions, proportional (P), integral (I), proportional plus integral (PI), proportional plus derivative (PD), proportional plus integral plus derivative (PID) using Op-amp. 3.3 Application of control system.	Lecture Using Chalk-Board Presentations Video Demonstrations Flipped Classroom Collaborative learning Case Study	CO3

V. LABORATORY LEARNING OUTCOME AND ALIGNED PRACTICAL/TUTORIAL EXPERIENCES.

Sr. No	Practical/Tutorial/Laboratory Learning Outcome (LLO)	Laboratory Experiment / Practical Titles /Tutorial Titles	Number of hrs.	Relevant Cos
1	LLO 1.1 Use a potentiometer to measure the linear displacement. LLO 1.2 Plot the nature of out-put voltage against displacement.	Use a potentiometer to measure the linear displacement and plot characteristics	2	CO1
2	LLO 2.1 Use a potentiometer to measure the angular displacement. LLO 2.2 Plot the nature of out-put voltage against displacement.	Use a potentiometer to measure the angular displacement and plot characteristics	2	CO1
3	LLO 3.1 Use LVDT to measure linear displacement. LLO 3.2 Plot relation between linear displacement and output voltage.	Use LVDT to measure linear displacement and plot the relation between linear displacement and output voltage.	2	CO1
4	LLO 4.1 Use RTD- PT-100 to measure the temperature of the water. LLO 4.2 Plot characteristics of resistance versus temperature.	Use RTD- PT-100 to measure the temperature of the water and plot characteristics of resistance versus temperature	2	CO1
5	LLO 5.1 Use a 4hermistor to measure the temperature of the water. LLO 5.2 plot characteristics of resistance versus temperature.	Use a 4hermistor to measure the temperature of the water and plot characteristics of resistance versus temperature	2	CO1
	LLO 6.1 Use a thermocouple to measure the temperature of water.	Use a thermocouple to measure the temperature of water and plot characteristics	2	CO1

Sr. No	Practical/Tutorial/Laboratory Learning Outcome (LLO)	Laboratory Experiment / Practical Titles /Tutorial Titles	Number of hrs.	Relevant Cos
6	LLO 6.2 Plot characteristics of output voltage versus temperature	of output voltage versus temperature		
7	LLO 7.1 Use a strain gauge to measure applied pressure or weight. LLO 7.2 Plot characteristics of output voltage versus weight.	Use a strain gauge to measure applied pressure or weight and plot characteristics of output voltage versus weight.	2	CO1
8	LLO 8.1 Study measurement of flow by using rotameter/ venture tube/ orifice. LLO 8.2 Calculate the amount of flow	Study measurement of flow by using rotameter/ venture tube/ orifice	2	CO1
9	LLO 9.1 Perform Inverter / Non-inverter using Op-Amp. LLO 9.2 Perform Adder/Subtractor using Op-Amp.	Perform Inverter / Non- inverter and Adder – Subtractor using Op-Amp	2	CO2
10	LLO 10.1 Perform Instrumentation amplifier using three Op-Amps	Perform Instrumentation amplifier using three Op-Amps	2	CO2
11	LLO 11.1 Test the performance of Portable DAC.	Test the performance of Portable DAC.	2	CO2
12	LLO 12.1 Study 7 segment display system.	Study digital and analog display system	2	CO2
13	LLO 13.1 Test the performance of the portable PID controller. LLO 13.2 Study different control actions.	To Study the performance of portable PID controller	2	CO3
14	LLO 14.1 Prepare a report on given topic	Report writing on a given assignment selected in a group	2	

VI. SUGGESTED MICRO PROJECT/ASSIGNMENT/ACTIVITIES FOR SPECIFIC LEARNING/SKILLS DEVELOPMENT (SELF-LEARNING)

Micro project:

A suggestive list of micro-projects is given here. Similar micro-projects could be added by the concerned faculty. Students should prepare slides/ charts/ prototype models for this

a) RTD/Thermistor/Thermocouple basics for indication of temperature
b) Use a level transducer to indicate and control the level of the water tank.
c) Use float type level sensor for indication of the level of water tank
d) Use a strain gauge for weight measurement in a simple platform.
e) Sketch LVDT / RVDT.
f) Do various circuits using Op-Amp.

Asignment: -

Course teachers can assign various tasks in groups and will assess the same**.**

Other than the classroom and laboratory learning, the following are the suggested student-related activities which 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 5 pages for each activity, also collect/record physical evidence for their portfolio which will be useful for their placement interviews.

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

VII. LABORATORY EQUIPMENT/INSTRUMENTS/TOOLS/SOFTWARE REQUIRED

Sr.No	Equipment Name with Broad Specifications	Relevant LLO Number
1	DC Regulated Dual power supply (0-30V,0-2A) or equivalent	1,2,7,9,10,11
2	Digital Multimeter- 31 /2 digit, 0-800 volts,0-10A, or suitable	All
3	Instrumentation kits (LVDT)	3
4	Instrumentation kits (temp)	4,5,6
5	Instrumentation kits (Load cell)	7
6	Instrumentation kits (op-amp)	8,9
7	Instrumentation kits (Flow)	10
8	Instrumentation kits (op-amp)	11
9	7 segment display	12
10	Basic analog PLC trainer	13

VIII. SUGGESTED FOR WEIGHTAGE TO LEARNING EFFORTS & ASSESSMENT PURPOSE

(Specification Table)

Sr. No	Unit	Unit Title	Aligned COs	Learning Hours	R-Level	U-Level	A-Level	Total Marks
1	**I**	**TRANSDUCER & APPLICATIONS**	**CO1**	**13**	**5**	**5**	**5**	**15**
2	**II**	**SIGNAL CONDITIONING AND DATA ACQUISITION CIRCUITS**	**CO2**	**13**	**3**	**5**	**7**	**15**
3	**III**	**BASIC CONCEPT OF CONTROL SYSTEM**	**CO3**	**04**	**2**	**2**	**1**	**05**
			Grand Total	**30**	**10**	**12**	**13**	**35**

IX. SSESSMENT METHODOLOGIES/TOOLS

Formative assessment (Assessment for Learning)	Summative Assessment (Assessment of Learning)
Two-unit tests of 15 marks will be conducted and an average of marks obtained in these two-unit tests will be considered. Each practical will be assessed for 25 marks and an average of all marks obtained will be considered.	End semester assessment of 35 marks through online mode of examination. End semester summative assessment of 25 marks for laboratory learning.

X. SUGGESTED COS- POS MATRIX FORM

Course Outcomes (COs)	Programme Outcomes(POs)							Programme Specific Outcomes *(PSOs)		
	PO-1 Basic and Discipline-Specific Knowledge	PO-2 Problem Analysis	PO-3 Design/ Development of Solutions	PO-4 Engineering Tools	PO-5 Engineering Practices for Society, Sustainability and Environment	PO-6 Project Management	PO-7 Life Long Learning	PSO-1	PSO-2	PSO-3
CO1	3	3	2	3	2	1	3	2	1	1
CO2	3	2	2	3	2	2	2	2	3	1
CO3	2	2	2	2	1	1	1	1	1	1

Legends:- High:03, **Medium:**02, **Low:**01, **NoMapping:** --
*PSOs are to be formulated at the institute level

XI. SUGGESTED LEARNING MATERIALS/BOOKS

Sr.No	Title	Author	Publisher with ISBN Number
1	Industrial Instrumentation and Control	S. K. Singh, Tata, McGraw-Hill Publishing Company Limited, New Delhi.	ISBN O-07-048290-X
2	Introduction to Instrumentation and Control	A.K. Ghosh, Prentice-Hall of India Private Limited, New Delhi	ISBN-81-203-1626-6
3	Electrical and Electronic Measurements and Instrumentation	A K Sawhney, Nineteenth edition, Dhanpat Rai & Sons, New Delhi, 2005	ISBN-13-9788177000160 :
4	Electronic Instrumentation	H. S. Kalsi, McGraw Hill, New Delhi, 2010	ISBN-13-9780070702066
5	Modern Electronic Instrumentation and Measurement Techniques	A. D. Helfrick, W. D. Cooper, Pearson Education India, Ist Edition, New Delhi, 2005	ISBN-13-978-9332556065

LEARNING WEBSITES & PORTALS

Sr.No	Link/Portal	Description
1	www.nptel.com	Instrumentation Engineering
2	www.instrumentioncontrolbox.com	Instrumentation and control
3	www.myklassroom.com/Engineering	Electronics & Instrumentation Engineering
4	www.en.wikibooks.org/wiki	Electronics/Measuring _Instruments
5	www.capabilitydevelopment.org	Capability development
6	www.tatasteelelearning.com	
Note: Teachers are requested to check the creative common license status/financial implications of the suggested online educational resources before use by the students		

Name & Signature: **Shri. Sunil Padmakar Date** Lecturer in Electrical Engineering	**Smt. Sujala Parimal Phadnaik** Lecturer in Electrical Engineering
(Course Experts)	
Name & Signature: **Dr. S. V. Bhangale** (Programme Head)	Name & Signature: **Shri. S. B. Kulkarni** (CDC In-charge)

GOVERNMENT POLYTECHNIC, PUNE
'120-NEP' SCHEME

PROGRAMME	**DIPLOMA IN ELECTRICAL ENGINEERING**
PROGRAMME CODE	**02**
COURSE TITLE	**ELECTRIC VEHICLE TECHNOLOGY**
COURSE CODE	**EE51202**
PREREQUISITE COURSE CODE & TITLE	**NA**
CLASS DECLARATION COURSE	**YES**

I. LEARNING AND ASSESSMENT SCHEME:

Course Code	Course Title	Course Type	Learning Scheme					Credits	Assessment Scheme										
			Actual Contact Hrs./Week						Paper Duration(hrs.)	Theory				Based on LL & TL				Based on Self Learning	Total Marks
														Practical					
			CL	TL	LL	SLH	NLH			FA-TH	SA-TH	Total		FA-PR		SA-PR		SLA	
										Max	Max	Max	Min	Max	Min	Max	Min	Max	Min
EE51202	ELECTRIC VEHICLE TECHNOLOGY	DSC	03	00	02	01	06	03	03	30	70	100	40	25	10	--	--	25	10	150

Total IKS Hrs. for Semester: 0 Hrs.

Abbreviations: CL-Class Room Learning, TL- Tutorial Learning, LL- Laboratory Learning, SLH- Self Learning Hours, NLH-Notional Learning Hours, FA - Formative Assessment, SA-Summative assessment, IKS – Indian Knowledge System, SLA - Self Learning Assessment

Legends: @ Internal Assessment, # External Assessment, *# Online Examination, @$- Internal Online Examination.

Note:

1. FA-TH represents average of two class tests of 30 marks each conducted during the semester.
2. If candidate is not securing minimum passing marks in FA-PR of any course, then the candidate shallbedeclared as "Detained" in that semester.
3. If candidate is not securing minimum passing marks in SLA of any course, then the candidate shall bedeclared as fail and will have to repeat and resubmit SLA work.
4. Notional Learning hours for the semester are (CL+LL+TL+SL) hrs.* 15 Weeks
5. 1 credit is equivalent to 30 Notional hrs.
6. * Self-learning hours shall not be reflected in the Timetable.
7. * Self-learning includes micro project/assignments / other activities.

II. RATIONALE:

The present movement for sustainable energy has positioned electric vehicle (EV) technology as a crucial field for electrical engineers. This course is designed to provide students with the essential knowledge and skills to understand, test, and work with EV systems. Through a blend of theoretical instruction and hands-on laboratory experiments, students will develop a skill and knowledge of EV technology, equipping them for careers in the rapidly expanding electric vehicle industry.

III. COURSE LEVEL LEARNING OUTCOMES (COS)

Students will be able to achieve & demonstrate the following COs on completion of course-based learning

CO1 - Identify components and subsystems used in electric vehicles. CO2 -
Select electrical drives for EV applications.
CO3 - Check the performance of batteries and energy storage systems used for EV applications.
CO4 - Apply the concept of converters and charging systems in EVs.
CO5 - Implement Indian and state EV policies for EV applications.

IV. THEORY LEARNING OUTCOMES AND ALIGNED COURSE CONTENT

Sr. No.	Theory Learning Outcomes(TLO's) aligned to CO's.	Learning content mappedwith TLO's	Suggested Learning Pedagogies	Relevant Cos
		SECTION - I		
		UNIT 1: Introduction of Electric Vehicles (CL Hrs.- 10 , Marks – 15)		
1	TLO 1.1 Compare electric vehicles and internal combustion engine vehicles on the given points. TLO 1.2 Describe the configuration of given types of EV systems. TLO 1.3 Compare given EVs based on given points. TLO 1.4 Describe the function of a given EV subsystem.	1.1 History system of electric vehicles (EV), need of EV, Electric vehicles and internal combustion engine vehicles: Comparison based on environmental impact, power source, maintenance, gear change, noise level, vibrations level, capital cost, and running cost. 1.2 Electric vehicle architecture, Classification of EV: Battery Electric Vehicle (BEV), Hybrid Electric Vehicle (HEV), Plug-in Hybrid Electric Vehicle (PHEV), Fuel Cell Electric Vehicle (FCEV). 1.3 Comparison of different electric vehicle types based on Driving Components, Energy Source used, Features, Problems and models available in the market. 1.4 EV Block diagram subsystems: energy source, propulsion, and auxiliary subsystem.	Lecture Using Chalk-Board, Presentations, Visit, Hands-on, Video Demonstrations	CO1
		UNIT 2: Electric Vehicle Drives (CL Hrs. – 12 , Marks--20)		
	TLO 2.1 Classify Electric Vehicles. TLO 2.2 Interpret the characteristics of the electric motor(s) used in EV. TLO 2.3 Distinguish between given EV motors based on given points. TLO 2.4 Select given electrical drives for EV applications.	2.1 Types of electric drives used in EV: DC Motor drives, AC Motor drives. 2.2 Brushed DC Motor, Brushless DC Motor (BLDC), Permanent Magnet Synchronous Motor (PMSM), Induction Motor (IM), Synchronous Reluctance Motor (SynRM), PM Assisted Synchronous Reluctance Motor, Axial Flux Ironless Permanent Magnet Motor: Salient features, characteristics, advantages, limitations, and usage of different motor types in EV models. 2.3 Comparison of EV motors based on power-weight ratio, torque-speed characteristic, cost of controllers required and cost of motors. 2.4 Position of motor in EV, Rating of motors, Connections (Mechanical and Electrical), and Selection criteria of various types of EV motors.	Lecture Using Chalk-Board , Presentations, Visit, Hands-on, Video Demonstrations	CO 2
		SECTION - II		
		UNIT-3 Energy Storage Systems (Batteries) (CL Hrs.- 8 , Marks- 14)		
3.	TLO 3.1 Describe given terms related to battery parameter. TLO 3.2 Describe the procedure for selection of battery for the given EV. TLO 3.3 Calculate EV battery capacity based on mileage and load. TLO 3.4 Describe the	3.1 Energy storage technology: EV Batteries, Supercapacitors, flywheel energy storage. Battery Parameters: Cell and Battery Voltages, Charge (or Amphour) Capacity, Energy Stored, Specific Energy, Energy Density, Specific Power, Amphour (or Charge) Efficiency, Energy Efficiency, Charging -discharge	Lecture Using Chalk-Board, Presentations, Visit, Hands-on, Video Demonstrations	CO 3

	process of given Battery Management System (BMS). TLO 3.5 Compare given type of fuel cells based on given points.	Rates, Battery Structure, Battery Temperature, Heating and Cooling Needs, Battery Life and Number of Deep Cycles. 3.2 Batteries: Lead-acid, NiMH (Nickel-Metal Hydride), Li-Ion (Lithium-Ion), Ni-Zn (Nickel-Zinc), Ni-Cd (Nickel-Cadmium), Aluminium–Ion batteries (Al–Ion batteries), Aluminium–air batteries (Al–air batteries)- their basic construction components, lifetime (cycles), efficiency, advantages, and disadvantages. Comparison of various batteries. Factors affecting the operation of battery, and selection of battery. Series and Parallel connection of Batteries, Calculation of battery capacity. 3.3 Battery Management Systems (BMS): Need of BMS, Block diagram of BMS, the function of each block, Battery Condition Monitoring, "3R" (Reduce, Reuse, Recycle) process for the battery. Fuel Cell: Difference between fuel cell and batteries, Fuel Cell Terminology: Anode, Cathode, Electrolyte, Catalyst, Reformer, Direct Fuel Cell, Working principle of fuel cell. Types of Fuel Cells used in EVs: Alkaline Fuel Cell (AFC), Polymer Electrolyte Membrane Fuel Cell (PEMFC), Phosphoric Acid Fuel Cell (PAFC), Molten Carbonate Fuel Cell (MCFC), Solid Oxide Fuel cell (SOFC), Their comparison based on Electrolyte type, Cell voltage, Operating temperature, System output (kW), Efficiency (%) and Applications.		
UNIT-4 Converters and EV Chargers (CL Hrs. - 8, Marks- 11)				
4	TLO 4.1 Describe the configuration and functions of the given type of converter. TLO 4.2 Describe given type of EV charging method(s). TLO 4.3 Distinguish between given charging systems. TLO 4.4 Describe given type of charging station. TLO 4.5 Calculate charging time based on given data.	4.1 Introduction to power electronics components used in EV, Block diagram of typical EV: Functions of DC-to-DC Converter, DC to AC Converter, AC to DC Converter (Rectifier) and filters. 4.2 Battery Charging methods: Home charging, Trickle charging, Household AC charging, public charging (DC Fast charging). 4.3 Battery Charging System: Classification-Wireless, Onboard and Off-board charging, V1G (Uni-directional smart charging), V2B/V2H (Vehicle-to-Building/ Vehicle-to-Home), V2X (Vehicle-to-Everything), V2G (Vehicle-to-Grid, Bi-directional smart charging). Charging Stations: Types of charging station, Public charging station: Selection and sizing, components and, single line diagram. Calculation of charging time and concept of battery swapping. Precautions were observed while charging.	Lecture Using Chalk-Board, Presentations, Visit, Hands-on, Video Demonstrations	CO 4

UNIT-5 Electric Vehicle (EV) Policies (CL Hrs- 7, Marks- 10)				
5	TLO 5.1 State the given points related to NEMMP. TLO 5.2 Compare incentive policies for the given types of electric vehicle.	5.1 Goal of EV30@30 campaign. Goals of electric vehicles initiative in India. National Electric Mobility Mission Plan 2020 (NEMMP): Objectives, Steps taken by the Indian Government for faster adoption of electric vehicles, Barriers to adoption of electric mobility, E-mobility strategy, NEMMP 2020 Implementation structure. 5.2 Maharashtra Electric Vehicle Policy, 2021: Objectives, Basic demand incentives for electric vehicles, Vehicle segment-wise scrappage incentives, Incentives for charging infrastructure.	Lecture Using Chalk-Board , Presentations, Visit, Hands-on, Video Demonstrations	CO 5

V. LABORATORY LEARNING OUTCOME AND ALIGNED PRACTICAL / TUTORIAL / EXPERIEMENT

.Sr. No.	Practical/Tutorial/Laboratory Learning Outcome (LLO)	Laboratory Experiment/Practical Titles/Tutorial Titles	No. of Hrs.	RelevantCOs
1	LLO 1.1 Identify components of various types of electric vehicles.	*Identification of electric vehicle components.	2	CO1
2	LLO 2.1 Identify various subsystems of electric vehicles.	*Identification of subsystems of electric vehicles.	2	CO1
3	LLO 3.1 Identify the terminals of the Permanent Magnet Synchronous Motor. LLO 3.2 Identify the terminals of the Three-phase Squirrel cage Induction Motor. LLO 3.3 Identify the terminals of the Synchronous Reluctance Motor. LLO 3.4 Identify the terminals of the Brushless DC motor.	*Identification of terminals of motors used in EVs.	2	CO2
4	LLO 4.1 Determine and compare the characteristics of given EV motors.	Comparison of characteristics of EV motors.	2	CO2
5	LLO 5.1 Measure the open circuit voltage of a given battery using multimeter. LLO 5.2 Identify the charged, discharged and dead battery conditions. LLO 5.3 Determine Amp-hour (Ah) capacity of the battery.	*Testing of EV batteries.	2	CO3
6	LLO 6.1 Perform Active Lithium-Ion Cell balancing using a Plastic Platform Scale.	Battery Cell balancing.	2	CO3
7	LLO 7.1 Estimate capacity of battery pack for specified capacity of EV.	*Estimation of battery for EV.	2	CO3
8	LLO 8.1 Charge an EV battery using various methods, and record charging times and efficiency.	*Charging of EV battery.	2	CO4
9	LLO 9.1 Develop a charging station layout. LLO 9.2 Select the		2	

	appropriate components of the charging station. LLO 9.3 Draw a single-line diagram of a charging station. LLO 9.4 Simulate the charging process of a charging station using any open-source software.	Development of a public charging station.		CO4
10	LLO 10.1 Calculate the charging time for different battery capacities using given formulas.	*Calculation of charging time of battery.	2	CO4
11	LLO 11.1 Prepare a report on Indian EV policy.	Report on Indian EV policy.	2	CO5
12	LLO 12.1 Prepare a report on Maharashtra EV Policy, 2021.	*Report on Maharashtra EV Policy, 2021.	2	CO5

Note : Out of above suggestive LLOs -

- '*' Marked Practicals (LLOs) are mandatory.
- Minimum 80% of above list of lab experiment are to be performed. Judicial mix of LLOs are to be performed to achieve desired outcomes.

Perform Any 10 Practical. All COs should be covered in the Perform practical.

VI. SUGGESTED MICRO PROJECT / ASSIGNMENT/ ACTIVITIES FOR SPECIFIC LEARNING/SKILLS DEVELOPMENT (SELF LEARNING)

Micro project

Prepare a report on the performance analysis of DC-DC converters and inverters in an EV setup.
Build and test simple DC-DC converters and inverters.
Develop an EV system model and simulate using any open-source software. Test sensors and systems for autonomous EVs and submit a report on it.
Perform sub-system simulations of an electric vehicle using any open-source software.

Assignment

Prepare a report on the comparative study of various two-wheeler EVs available in the market. Prepare a report on the setting of the Fast DC charging station.
Prepare a report on EV battery swapping technology.
Prepare a report on the comparative study of various four-wheeler EVs available in the market.
Prepare a report on the Internet of Things (IoT)/ Virtual Reality (VR)/ Augmented Reality (AR) related to EV.
Prepare a report on driverless EV cars available in the market.

Note : Above is just a suggestive list of microprojects and assignments; faculty must prepare their own bank of microprojects, assignments, and activities in a similar way.

The faculty must allocate judicial mix of tasks, considering the weaknesses and / strengths of the student in acquiring the desired skills.
If a microproject is assigned, it is expected to be completed as a group activity.
SLA marks shall be awarded as per the continuous assessment record.
For courses with no SLA component the list of suggestive microprojects / assignments/ activities are optional . Faculty may encourage students to perform these tasks for enhanced learning experiences.
If the course does not have associated SLA component, above suggestive listings is applicable to Tutorials and maybe considered for FA-PR evaluations.

VII. LABORATORY EQUIPMENT / INSTRUMENTS / TOOLS / SOFTWARE REQUIRED

Sr.No	Equipment Name with Broad Specifications	Relevant LLO Number
1	Electric Vehicle two-wheeler: Top Speed-23 KM/H, Minimum Range-80 KM/C, Full Charge-4 to 5 HRS, Minimum Motor Power-250 Watts, Wheel Size-12 Inch, Minimum Battery Capacity/Rating-50V / 30Ah.	1,2,3,4
2	3½ Digit Digital Multimeter.	1,2,3,4
3	Brushless DC motor: 1 kW, 3000 rpm, at 3 Nm load torque/ whichever is available.	2
4	Three-phase AC Induction Motor: Max Motor Power: 41hp at 4500rpm, Max Motor Torque: 91Nm at 3000rpm/ whichever is available.	2
5	Permanent Magnet Synchronous Motor: Minimum power and torque/ whichever is available.	2
6	Synchronous Reluctance Motor: Minimum power and torque/ whichever is available.	2
7	Plastic Platform Scale Active Lithium Cell Balancing, Size: A3, Capacity: 80Ah.	3
8	Lithium-Ion E-Bike Battery, 20 Ah, Capacity (Ah).	3,4
9	Nickel-Metal Hydride E-Bike Battery, 20 Ah, Capacity (Ah).	3,4

VIII. SUGGESTED FOR WEIGHTAGE TO LEARNING EFFORTS & ASSESSMENT PURPOSE (Specification Table)

Sr.No	Unit	Unit Title	Aligned COs	Learning Hours	R-Level	U-Level	A-Level	Total Marks
SECTION - I								
1	**I**	**Basics of Electric Vehicles**	CO1	10	2	8	5	15
2	**II**	**Electric Vehicle Drives**	CO2	12	4	6	10	20
SECTION - II								
3	**III**	**Batteries and Energy Storage Systems**	CO3	8	2	4	8	14
4	**IV**	**Converters and EV Chargers**	CO4	8	2	4	5	11
5	**V**	**Electric Vehicle (EV) Policies**	CO5	7	2	4	4	10
Grand Total				**45**	**12**	**26**	**32**	**70**

IX. ASSESSMENT METHODOLOGIES/TOOLS

Formative assessment (Assessment of learning)	Summative Assessment (Assessment of learning)
Two unit tests of 30 marks will be conducted and an average of two unit tests considered. For formative assessment of laboratory learning 25 marks. Each practical will be assessed considering the appropriate % weightage to process and product and other instructions of assessment.	End semester assessment of 70 marks through offline mode of examination.

X. SUGGESTED COS- POs –PSOs MATRIX FORM

Course Outcomes (COs)	Programme Outcomes(POs)							Programme Specific Outcomes *(PSOs)			
	PO-1 Basic and Discipline-Specific Knowledge	PO-2 Problem Analysis	PO-3 Design/ Development of Solutions	PO-4 Engineering Tools	PO-5 Engineering Practices for Society, Sustainability and Environment	PO-6 Project Management	PO-7 Life Long Learning	PSO-1	PSO-2	PSO-3	PSO-4
CO1	3	2	3	2	3	2	2	2	2	2	1
CO2	3	2	3	2	3	1	2	2	2	3	2
CO3	3	2	2	2	2	2	2	2	1	2	1
CO4	3	2	1	2	2	2	2	1	2	2	1
CO5	3	1	2	2	2	1	2	1	1	2	1

Legends:- High:03, Medium:02, Low:01, No Mapping: --
***PSOs are to be formulated at the institute level**

XI. SUGGESTED LEARNING MATERIALS / BOOKS

Sr.No	Author	Title	Publisher with ISBN Number
1	Mehrdad Ehsani, Yimin Gao, Stefano Longo, and Kambiz Ebrahimi.	Modern Electric, Hybrid Electric, and Fuel Cell Vehicles.	CRC Press, 2019, ISBN 13: 978-0367137465.
2	James Larminie, John Lowry.	Electric Vehicle Technology Explained.	Wiley-Blackwell, 2012, ISBN 13: 978-1119942733
3	Dr. Nitesh Tiwari, Dr. Shekhar Yadav.	Electric Vehicle (Green and Sustainable Transportation).	S.K. Kataria & Sons, 2023, ISBN 13: 987-81-963589-0-7.
4	Ali Emadi, Mehrdad Ehsani, John M. Miller.	Vehicular Electric Power Systems: Land, Sea, Air, and Space Vehicles.	CRC Press, 2003, ISBN 13: 978-0824747510.
5	Sunil R. Pawar.	Electrical Vehicle Technology: The Future Towards Eco-Friendly Technology.	Notion Press Publication, 2021, ISBN 10:1685545610.

XII. LEARNING WEBSITES & PORTALS

Sr. No	Link / Portal	Description
1	https://youtu.be/2IgZSDDFW-Y?si=Z1tfZO24ljBppzVA	Identification of terminals of BLDC motor.
2	https://www.niti.gov.in/sites/default/files/2023-02/EV_Handbook_Final_14Oct.pdf	Handbook of electric vehicle charging infrastructure implementation.
3	https://heavyindustries.gov.in/sites/default/files/2023-07/N EMMP-2020.pdf	National Electric Mobility Mission Plan 2020.
4	https://www.cleanenergyministerial.org/initiatives-campaigns/electric-vehicles-initiative/	Goal of EV30@30 campaign.
5	https://maitri.mahaonline.gov.in/PDF/EV%20Policy%20GR%202021.pdf	Maharashtra Electric Vehicle Policy, 2021.
6	https://www.mdpi.com/1996-1073/10/8/1217	Electric vehicle review paper.

7	https://archive.nptel.ac.in/courses/108/103/108103009/	NPTEL electric vehicle course literature.
8	https://onlinecourses.nptel.ac.in/noc22_ee53/preview	NPTEL electric vehicle course videos.
9	https://www.mdpi.com/1996-1073/15/3/1241	DC-AC converters for electric vehicle review paper.
10	https://www.niti.gov.in/sites/default/files/2022-05/Battery_swapping_report_09052022.pdf	Battery swapping.

Note :

- Teachers are requested to check the creative commons license status/financial implications of the suggested online educational resources before use by the students

Name & Signature:

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Head Electrical Department

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Lecturer in Electrical

(Course Experts)

Name & Signature	Name & Signature:
(Dr. Sanjay V. Bhangale) (Program Head)	**Shri. S.B. Kulkarni** (CDC In-charge)

GOVERNMENT POLYTECHNIC, PUNE

'120 – NEP' SCHEME

PROGRAMME	**DIPLOMA IN CE/EE/ET/ME/MT/CM/IT/DDGM**
PROGRAMME CODE	**01/02/03/04/05/06/07/08**
COURSE TITLE	**SOCIAL AND LIFE SKILLS**
COURSE CODE	**HU21204**
PREREQUISITE COURSE CODE & TITLE	**NA**
CLASS DECLARATION COURSE	**NO**

I. LEARNING & ASSESSMENT SCHEME

Course Code	Course Title	Course Type	Learning Scheme					Credits	Assessment Scheme											
			Actual Contact Hrs./Week			SLH	NLH		Paper Duration	Theory				Based on LL & TSL				Based on SL		Total Marks
														Practical						
			CL	TL	LL					FA-TH	SA-TH	Total		FA-PR		SA-PR		SLA		
										Max	Max	Max	Min	Max	Min	Max	Min	Max	Min	
	SOCIAL AND LIFE SKILLS	**VEC**	**1**	**--**	**2**	**1**	**4**	**2**	**--**	**--**	**--**	**--**	**--**	**25**	**10**	**--**	**--**	**25**	**10**	**50**

Total IKS Hrs for Term: 0 Hrs

Abbreviations: CL-Classroom Learning, **TL**-Tutorial Learning, **LL**-Laboratory Learning, **SLH**-Self Learning Hours, **NLH**-Notional Learning Hours, **FA** - Formative Assessment**, SA** -Summative assessment, **IKS** – Indian Knowledge System, **SLA**- Self Learning Assessment

Legends: @-Internal Assessment, **#** - External Assessment,***#** - Online Examination,**@$** - Internal Online Examination

Note:

FA-TH represents an average of two class tests of 30 marks each conducted during the semester.

1. If a candidate is not securing minimum passing marks in **FA-PR** (Formative Assessment - Practical) of any course, then the candidate shall be declared as '**Detained**' in that course.
2. If a candidate does not secure minimum passing marks in SLA (Self Learning Assessment) of any course, then the candidate shall be declared as '**fail**' and will have to repeat and resubmit SLA work.
1. **Notional learning hours** for the semester are **(CL + LL + TL + SL) hrs. * 15 Weeks**
3. **1 credit** is equivalent to **30 Notional hours**.
4. * Self-learning hours shall not be reflected in the Timetable.

6.* Self-learning includes micro-projects/assignments/other activities.

II. RATIONALE:

The introduction of a social and life skills course for diploma engineers is indeed a significant step forward in shaping well-rounded professionals. By integrating soft skills training with technical education, this curriculum addresses the growing need for engineers who are not only experts in their field but also adept in interpersonal communication, collaboration, and leadership. Such skills are crucial for success in the modern workforce, where the ability to navigate complex social dynamics can be just as important as technical know-how. Moreover, the emphasis on ethical decision-making prepares engineers to approach their work with integrity and responsibility. As these professionals progress in their careers, the benefits of this comprehensive education will manifest in their ability to innovate, lead, and contribute positively to their communities and the broader society. This forward-thinking approach ensures that the engineers of tomorrow are equipped not just with the tools to excel in their careers, but also with the vision to drive societal progress.

III. COURSE-LEVEL LEARNING OUTCOMES (CO's)

Students will be able to achieve & demonstrate the following CO's on completion of course-based learning

CO1: Achieve shared goals through effective teamwork in executing sustainable community development projects.
CO2: Improve cooperation and understanding through refined communication skills.
CO3: Encourage ethical choices and compassionate behaviour by nurturing moral values.
CO4: Foster ethical judgment, honesty, and societal accountability to shape principled and conscientious professionals.
CO5: Equip students with practical financial literacy skills for efficient financial management.

IV. THEORY LEARNING OUTCOMES AND ALIGNED COURSE CONTENT:

Sr. No	TheoryLearning Outcomes (TLO's) aligned to CO's.	Learning content mapped with TLO's.	Suggested Learning Pedagogies	Relevant COs
UNIT-I ENGAGEMENTS WITHIN UNNAT MAHARASHTRA ABHIYAN (UMA) (CL Hrs-03, Marks-NIL)				
1.	**TLO1.1:** Recognize the importance of addressing societal needs and involving relevant stakeholders in problem-solving efforts. **TLO1.2:** Integrate academia, society, and technology to devise comprehensive solutions for complex societal issues. **TLO1.3:**Enhance communication and negotiation skills to effectively engage stakeholders, ensuring diverse perspectives and productive collaboration in problem-solving. **TLO1.4:** Utilize critical data sources such as economic surveys, and environmental data to guide decision-making and solution development in problem-solving endeavours. **TLO1.5:** Identify key stakeholders and delineate their roles and interests in addressing societal challenges. **TLO1.6:** Identify essential attributes for measurement in the problem-solving process. **TLO1.7:** Explore diverse tools and templates for data	**1.1 Identifying Regional Societal Challenges:** Recognizing Community Needs Requiring Engineering Solutions. **1.2Integrating Multidisciplinary Approaches:** Linking Academia, Society, and Technology **1.3 Involving Diverse Stakeholders:** Engaging Various Actors in the Problem-Solving Process **1.4Accessing Secondary Data Sources:** Utilizing Resources like Census and Economic Surveys **1.5Mapping Problems and Stakeholders:** Understanding Activities' Relevance to System Components and Key Stakeholders **1.6Defining Measurement Metrics:** Identifying Essential Attributes for Evaluation **1.7 Employing Data Collection Tools:** Exploring Surveys and Measurement Equipment **1.8Establishing Measurement Standards:** Developing Survey Forms and Piloting Processes **1.9Conducting Field Surveys:** Quantifying Local Systems such as Agriculture and Transportation **1.10Analyzing Data and Creating Reports:** Summarizing Data and	Considering the unit design, it's vital to consider the following factors during the implementation of the unit: i) Organize students into smaller groups of 5-6 members to carry out fieldwork within the larger cohort. ii) Allocate multiple student groups evenly among all faculty members involved in the course. iii) A team of course faculty will visit local governing bodies like Municipal Corporations, Villages, Panchayats, Zilla Parishads, and Panchayat Samitis to assess small-scale technological or engineering needs within their jurisdiction. iv) The team of course instructors will conduct initial field visits to explore various scenarios and options	**CO1**

	collection, including surveys and measurement equipment. **TLO1.8:** Establish a structured framework for measuring identified attributes, including the development of survey forms and piloting the measurement process. **TLO1.9:** Gain practical experience in conducting fieldwork to gather primary data, such as agricultural output, rainfall, and transportation networks. **TLO1.10:** Develop proficiency in data analysis to draw meaningful conclusions, informing decision-making and solution development processes.	Reflections in Reports, Utilizing Various Formats like Tables and Graphs	for student-led fieldwork to assess and quantify different parameters and characteristics. **a) Session I** will introduce the development approach, fieldwork methodology, and the utilization of case studies as instructional tools. **b) Sessions II** - VII will cover topics such as societal dynamics, stakeholder engagement, value creation, establishing metrics, basic analysis, and preliminary reporting. **c) Session VIII** will wrap up the program with feedback collection and assessment. **d) Field Work:** **1. Pilot Visit** - Testing the survey instrument **2. Survey Visit 1** - Gathering data/information Survey. **3**. **Visit 2-** Further data collection. **4.SummaryVisit-** Concluding activities post-analysis.	
UNIT - II NATIONAL SERVICE SCHEME (NSS) (CL Hrs-03, Marks- NIL)				
2	**TLO2.1:** Enhance communication and leadership abilities to effectively interact with local leaders. **TLO2.2:** Develop proficiency in conducting socio-economic surveys using appropriate data collection techniques and analysis methods to understand community needs. **TLO2.3:** Identify suitable villages and devise activity plans based on community	2.1 Engaging with Village/Area 2.2 Conducting initial socio-economic surveys in nearby villages. 2.3 Selecting villages for adoption and initiating project activities. 2.4 Conducting thorough socio-economic surveys in the adopted village or area. 2.5 Identifying key issues and challenges within the community. 2.6 Raising awareness about advancements in agriculture, watershed management, wasteland reclamation, renewable energy, affordable housing, sanitation,	Considering the unit design, it's vital to consider the following factors during the implementation of the unit: i) Organize students into smaller groups of 5-6 members to carry out fieldwork within the larger cohort. ii) Allocate multiple student groups evenly among all faculty members involved in the course.	**CO2**

	needs and available resources. **TLO2.4:** Analyze survey findings to discern socio-economic patterns, obstacles, and potential avenues for progress. **TLO2.5:**Prioritize community issues according to their significance and impact on community welfare. **TLO2.6:** Communicate information on agriculture, watershed management, renewable energy, housing, sanitation, nutrition, and hygiene effectively. **TLO2.7:** Cultivate networking and advocacy skills to foster collaboration among government agencies, development organizations, and the community.	nutrition, and personal hygiene. Also, informing about skill enhancement programs, income generation opportunities, government initiatives, legal aid, consumer rights, and related topics. 2.7 Facilitating collaboration between the government and development agencies to implement various schemes in the adopted village or slum.	iii) Before selecting a village or slum for NSS activities, it's advisable for teachers to conduct an initial visit. iv)The selected area should have a dense population. iv)Community members should exhibit a willingness to improve their living conditions and actively engage in projects initiated by the NSS for their benefit. vi) NSS units should avoid areas with a history of political conflicts. vii) The chosen area should be conveniently accessible for NSS volunteers to conduct regular visits to the slums.	
UNIT - III UNIVERSAL HUMAN VALUES (CL Hrs-03, Marks- NIL)				
3	**TL03.1:** Apply love and compassion to promote harmony and well-being. **TL03.2:** Demonstrate honesty and transparency to build trust and authenticity. **TL03.3:** Utilize non-violent approaches to resolve conflicts and enhance empathy. **TL03.4:** Align actions with moral principles to promote justice and fairness. **TL03.5:** Employ peace-building strategies for harmony and reconciliation. **TL03.6:** Engage in acts of service to cultivate empathy and social responsibility. **TL03.7:** Prioritize others' needs to foster altruism and generosity.	**4.1 Exploring Love and Compassion (Prem and Karuna):** Learning about and embodying the principles of love and compassion in daily life. **4.2 Embracing Truth (Satya):** Understanding the significance of truthfulness and integrating it into one's actions and interactions. **4.3 Embracing Non-Violence (Ahimsa):** Understanding the importance of non-violence and applying it in personal and societal contexts. **4.4 Upholding Righteousness (Dharma):** Exploring the concept of righteousness and practising it through ethical conduct and moral values. **4.5 Cultivating Peace (Shanti):** Reflecting on the essence of peace and cultivating	Proposed Learning Approaches for: i) Lecture Delivery ii) Demonstrations iii) Case Studies iv)Role-playing exercises v)Observational Learning vi)Portfolio Development vii) Simulations viii) Inspirational Talks from Industry Professionals ix) On-site Visits to sites or Industries	**CO3**

	TL03.8: Exhibit behaviours that uphold gender equality and respect for diversity to create an inclusive	inner tranquillity while promoting harmony in relationships and communities. **4.6 Embracing Service (Seva):** Understanding the value of selfless service and actively engaging in acts of kindness and support for others. **4.7 Embracing Renunciation (Sacrifice) Tyaga**: Understanding the concept of renunciation and willingly **letting go of self-interest for the greater good. and attitudes.** **4.8 Promoting Gender Equality and Sensitivity:** Recognizing the importance of gender equality and fostering an environment of inclusivity and respect for all genders through actions and attitudes.		
UNIT - IV VALUE EDUCATION (UNNATI FOUNDATION) (CL Hrs-03, Marks- NIL)				
4	**TLO4.1:** Display comprehension of one's own identity, values, and beliefs. **TLO4.2**: Recognize and express personal strengths and weaknesses effectively. **TLO4.3:**Demonstrate adeptness in active listening by providing feedback and demonstrating empathy. **TLO4.4:**Acquire strategies for handling conflicts constructively and respectfully. **TLO4.5:** Assess and reflect on moral values and principles that influence personal actions and choices. **TLO4.6:** Analyze and assess the moral values and principles guiding individual actions and decisions.	**4.1. Self-awareness and Personal Development** Self-understanding, Identification of strengths and weaknesses, Setting goals and devising plans, Building self-esteem and confidence **4.2.Interpersonal Skills and Effective Communication** Engaging in active listening, Resolving conflicts, Cultivating healthy relationships **4.3. Ethics and Morality** Grasping ethical concepts, Upholding moral values and principles, Making ethical decisions, Demonstrating integrity and honesty **4.4. Social Values and Responsibility** Being punctual and initiating conversation, Managing emotions effectively, Introducing oneself and others, Maintaining a positive attitude Valuing family bonds, Creating favourable impressions,	i)Video Demonstrations ii)Flipped Learning Environment iii) Case Studies iv)Role-playing Activities v)Group-based Learning vi)Team-based Learning vii)Utilization of Chalkboard	**CO4**

		Communicating effectively, Emphasizing cleanliness, hygiene, and organization, Expressing preferences, Fostering confidence Enhancing listening skills, Demonstrating appropriate greetings, Promoting gender equality and sensitivity, Exercising responsibility, Integrating visual and verbal learning, Establishing and pursuing goals, Observing social media etiquette, Efficiently managing time and daily routines		
UNIT - V FINANCIAL LITERACY(CL Hrs-03, Marks- NIL)				
5	**TLO5.1:**Comprehending Savings and Investment Practices. **TLO5.2:**Cultivating Proficiency in Financial Planning. **TLO 5.3:**Developing Competence in Transaction Handling. **TLO5.4:**Achieving Proficiency in Income, Spending, and Budget Management. **TLO 5.5:**Attaining Understanding of Inflation Concepts. **TLO 5.6:** Fostering Competence in Loan Administration. **TLO5.7: A**cknowledging the Significance of Insurance.	**5.1. Fundamentals of Finances:** Grasping concepts of income, expenses, and savings, Employing budgeting techniques, Understanding assets and liabilities, and Recognizing the significance of emergency funds. **5.2. Banking Essentials** Initiating and managing bank accounts, Familiarizing oneself with various account types (savings, checking, etc.), Comprehending interest rates, and Safely utilizing ATMs. **5.3. Management of Credit and Debt** Interpreting credit scores and reports, Identifying different credit types (credit cards, loans, etc.), Responsible debt management, and Preventing involvement in predatory lending. **5.4. Foundations of Investment** Understanding investment types (stocks, bonds, mutual funds, etc.), Assessing risk and return, Implementing diversification strategies, and Formulating investment approaches. **5.5. Financial Planning and Goal Establishment** Establishing financial objectives, Crafting a personalized financial blueprint, Continuously monitoring and adjusting financial goals, and Engaging in long-term financial	i) Video Demonstrations ii) Presentations iii) Case Studies iv) Chalkboard Utilization v) Collaborative Learning	**CO5**

		strategizing. **5.6. Consumer Rights and Duties** Familiarizing oneself with consumer entitlements, Safeguarding against financial scams and fraudulent activities Exercising responsible borrowing and spending practices, Upholding financial privacy and security measures. **5.7. Essentials of Insurance** Exploring different insurance categories (health, life, auto, home, etc.), Understanding insurance policy specifics, Recognizing the importance of insurance coverage, and Navigating the insurance claims process. **5.8. Economic Literacy** Grasping fundamental economic principles, Understanding the concepts of inflation and deflation, Analyzing market trends, and Interpreting economic indicators.		

V. LABORATORY LEARNING OUTCOME AND ALIGNED PRACTICAL/ TUTORIAL EXPERIENCES.

Sr. No	Practical/Tutorial/Laboratory Learning Outcome (LLO)	Laboratory Experiment/ Practical Titles /Tutorial Titles	Number of hrs.	Relevant COs
1	**LLOI.I.1:** Communicating and interacting with residents or children with compassion and empathy, demonstrating an understanding of their needs and emotions.	1.1 Encouraging empathy and kindness through volunteer work at: i) a nearby nursing home ii)a care centre for children from disadvantaged families or similar types of facilities.	2	CO3
2	**LLO 2.1** Enhance goal-setting abilities by engaging in collaborative planning, analyzing obstacles, and reflecting on personal aspirations to align them with broader academic or career goals.	2.1 Pathway to Success: Goal-Setting Exercise	2	CO4
3	**LLO3.1:** Develop effective communication skills by demonstrating compassion, empathy, and understanding towards residents or children, while acknowledging and addressing their needs and emotions.	3.1 Exploring Your Inner World: Self-Reflection Activity	2	CO4
4	**LLO4.1:** Laboratory Learning Outcome: Cultivate structured self-reflection skills to assess personal strengths and weaknesses.	4.1 Strengths and Weaknesses Identification and Analysis Exercise	2	CO4

Sr. No	Practical/Tutorial/Laboratory Learning Outcome (LLO)	Laboratory Experiment/ Practical Titles /Tutorial Titles	Number of hrs.	Relevant COs
5	**LLO 5.1:** Display proficiency in time management through the creation and adherence to structured timelines for task coordination.	5.1 Time Management Simulation for Coordinating Industrial Visits	2	CO4
6	**LLO 6.1**: Demonstrate competency in social media etiquette through engaging in activities and adhering to established norms and guidelines.	6.1 Activity on Social Media Etiquette	2	CO4
7	**LLO 7.1:** Develop skills in mapping and analyzing family income and expenses through structured exercises.	7.1. Exercise on Mapping and Analyzing Family Income and Expenses	2	CO5
8	**LLO 8.1**: Apply their knowledge of interest rate calculation to real-world financial situations, improving decision-making skills.	8.1 Exploring Simple and Compound Interest: A Hands-On Exercise on Interest Rate Calculation and Its Impact on Savings and Loans.	2	CO5
9	**LLO9.1:** Enhance comprehension of interest rates and their impact on financial dealings, encompassing savings accounts, Fixed Deposits (FDs), and loans.	9.1 Interest Rate Comparison Exercise: Analyzing Rates for Savings, Fixed Deposits, and Loans.	2	CO5
10	**LLO10.1:** Mastering and implementing safety protocols for ensuring secure ATM transactions.	10.1 Safety Precautions for ATM Usage: Exploring Tips for Secure Transactions	2	CO5

Note: Out of the above suggestive LLOs –

1. A judicial mix of LLOs is to be performed to achieve the desired outcomes

VI. SUGGESTED MICRO PROJECT/ASSIGNMENT/ACTIVITIES FOR SPECIFIC LEARNING/SKILLS DEVELOPMENT (SELF-LEARNING)

SELF-LEARNING - MICRO PROJECT/ASSIGNMENT/ACTIVITIES (ANY ONE)

The following list provides examples of activities that can be pursued under the program. Each group has the flexibility to choose from these options or undertake any other activity deemed suitable based on local requirements. The group focuses on the holistic development of the selected area, whether it is a village or a slum.

a) Community clean-up drives

Group tasks for community clean-up drives are,

1. Site Survey and Planning: Identify areas needing attention and plan tasks.
2. Logistics Management: Coordinate supply distribution to volunteers.
3. Volunteer Coordination: Welcome, register, and assign tasks to volunteers.
4. Trash Collection and Segregation: Collect and sort waste into categories.
5. Street Sweeping and Cleaning: Sweep and clean streets, sidewalks, and public areas.
6. Beautification and Landscaping: Enhance aesthetics by planting and trimming.
7. Safety and First Aid: Ensure volunteer safety and manage emergencies.
8. Documentation and Reporting: Capture progress through photos and reports.
9. Community Engagement: Educate and raise awareness among residents.
10. Post-Clean-up Evaluation: Review success and plan future initiatives.

b) Tree plantation initiatives

Group tasks for Tree plantation initiatives,

1. Community Awareness: Workshops to educate on tree benefits.
2. Community Participation: Engage locals in all planting
3. Team Building: Group activities to strengthen community bonds.
4. Leadership Development: Empower individuals to lead initiatives.
5. Communication Workshops: Enhance effective messaging.
6. Problem-solving Discussions: Address planting challenges.
7. Environmental Responsibility: Foster care for green spaces.
8. Cultural Integration: Incorporate local traditions into initiatives.
9. Sustainability Education: Teach sustainable planting practices.
10. Monitoring and Evaluation: Assess impact and plan improvements.

c) Environmental conservation awareness

Group tasks for Environmental conservation awareness

1. Educational Workshops: Teach about conservation methods.
2. Art Competitions: Promote environmental themes through art.
3. Street Plays: Perform interactive skits in public spaces.
4. Awareness Walks: Organize marches with environmental messages.
5. Tree Plantation: Plant trees to enhance green spaces.
6. Clean-up Campaigns: Remove litter from local areas.
7. Guest Lectures: Invite experts to discuss environmental issues.
8. Film Screenings: Show documentaries on conservation topics.
9. Social Media Campaigns: Spread awareness through online platforms.
10. Community Workshops: Educate on waste management and sustainability.

d) Health and sanitation programs

1. Health Education Sessions: Conduct informative sessions on hygiene, disease prevention, and nutrition.
2. Sanitation Infrastructure Evaluation: Assess the effectiveness of existing sanitation facilities and propose improvements.
3. Community Clean-up Events: Organize collective efforts to clean and maintain public spaces for better health outcomes.
4. Distribution of Hygiene Kits: Provide essential hygiene items such as soap, toothpaste, and sanitary products to community members.
5. Vaccination Drives: Coordinate vaccination campaigns to protect against prevalent diseases and promote community health.
6. Water Quality Testing: Conduct regular testing of water sources to ensure safe drinking water for residents.
8. Personal Hygiene Workshops: Offer workshops focusing on personal grooming, handwashing techniques, and menstrual hygiene.
9. First Aid Training: Provide basic first aid training to community members to equip them with life-saving skills.
10. Community Health Surveys: Conduct surveys to assess health needs and gather feedback for future program planning.

VII. LABORATORY EQUIPMENT/INSTRUMENTS/TOOLS/SOFTWARE REQUIRED

Sr. No.	Equipment Name with Broad Specifications	Relevant LLO Number
1	Basic engineering measurement instruments, GPS data collection devices, and open-sour GIS software like Google Earth and QGIS, along with the Microsoft Office suite.	ALL

VIII. SUGGESTED FOR WEIGHTAGE TO LEARNING EFFORTS & ASSESSMENT PURPOSE (Specification Table)

NOT APPLICABLE

IX. ASSESSMENT METHODOLOGIES/TOOLS

Formative assessment (Assessment for Learning)	Summative Assessment (Assessment of Learning)
Formative assessment (Assessment for Learning) Report and presentation of fieldwork activities, Self- Learning (Assignment)	--

X. SUGGESTED COS- POS MATRIX FORM

NOT APPLICABLE

XI. SUGGESTED LEARNING MATERIALS/BOOKS

Sr.No	Author	Title	Publisher
1	Mark Stafford Smith and Pamela Matson	Sustainable Development: Principles, Frameworks, and Case Studies	Oxford University Press, ISBN: 9780199588952
2	Katar Singh	Rural Development: Principles, Policies and Management	SAGE Publications Pvt. Ltd, ISBN:978-9351502867.
3	Anand Kumar, Asim Kumar Mandal, and R. Venkata Rao	Maharashtra: Governance and Development"	Routledge India, ISBN: 978-0367709133
4	Dalai Lama and Howard C. Cutler	The Art of Happiness	Riverhead Books, and the ISBN: 978-1594488894.
5	Stephen R. Covey	The 7 Habits of Highly Effective People	Simon & Schuster, ISBN : 978-1982137274.
6	Local college students, UMA staff	Sample Case Studies on the UMA website	IITB-UMA team

XI. LEARNING WEBSITES & PORTALS

Sr.No.	Link/Portal	Description
1	https://www.ugc.gov.in/pdfnews/4371304_LifeSKill_JeevanKaushal_2023.pdf	UHV: UGC Course on life skills. Unit 4 i.e. Course 4 is to be referred
2	https://nss.gov.in/	The National Service Scheme (NSS) website provides information about the NSS program in India. It includes details about the objectives, history, and structure of NSS. Additionally, the website offers resources for NSS volunteers and coordinators, such as program guidelines, training materials, and reports.
3	https://gr.maharashtra.gov.in/Site/Upload/Government%20Resolutions/English/201601131501523808.pdf	Government Resolution of Government of Maharashtra regarding Unnat Maharashtra Abhiyan
4	https://gr.maharashtra.gov.in/Site/Upload/Government%20Resolutions/English/201606151454073708.pdf	Government Resolution of Government of Maharashtra regarding Unnat Maharashtra Abhiyan Guidelines
5	https://www.humanvaluesfoundation.com/.	The Human Values Foundation website offers educators resources for teaching human values and social-emotional learning to children and youth. It provides curriculum-based programs, lesson plans, and activities to foster character development, resilience, and positive behaviour. Additionally, the website shares insights into the foundation's mission, values, and the global impact of its programs in schools.

Name & Signature: **Mr. S.B.Kulkarni** Lecturer in Mechanical Engineering **(Course Experts)**	
Name & Signature: **Dr. S.V. Bhangale** (Programme Head)	Name & Signature: **Shri. S.B. Kulkarni** (CDC In-charge)