GOVERNMENT POLYTECHNIC, PUNE
'120 – NEP' SCHEME

PROGRAMME	**DIPLOMA IN ELECTRICAL ENGINEERING**
PROGRAMME CODE	**02**
COURSE TITLE	**ELECTRICAL CIRCUITS AND NETWORK**
COURSE CODE	**EE31202**
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	
EE31202	ELECTRICAL CIRCUIT AND NETWORK	DSC	3	2	2	1	8	4	3	30	70	100	40	25	10	25@	10	25	10	175

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 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:

Electrical Circuits and Networks are integral parts of the power system. This is one of the most important core electrical engineering courses and a prerequisite to learning advanced electrical courses. This course develops skills to apply the principle of single and three-phase AC circuits and network theorems to analyze and solve simple electric circuit-related problems.

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 - Analyze the parameters of single-phase AC series circuits.
- CO2 - Analyze the parameters of single-phase AC parallel circuits.
- CO3 - Analyze the parameters of polyphase AC circuits.
- CO4 - Apply network reduction methods to solve DC circuits.
- CO5 - Apply network theorems to solve basic electrical circuits.

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 SINGLE PHASE A.C SERIES CIRCUITS(CL Hrs- 10, Marks- 16)				
1.	TLO 1.1 Determine the current, and voltage and draw a phasor diagram for the given AC series circuit. TLO 1.2 Calculate inductive, capacitive reactance and impedance for the given AC series circuit. TLO 1.3 Determine active, reactive, apparent power and power factor for the given AC series circuit. TLO 1.4 Determine the resonant frequency and Q-factor for the given R-L-C series circuit.	1.1 Overview of AC Fundamentals. 1.2 R, L, C circuit elements, its voltage and current response. Phasor diagram. 1.3 R-L, R-C, R-L-C series A.C. circuits, current and voltage relation, phasor diagram, impedance and impedance triangle, active, reactive, apparent power, power triangle and power factor. 1.4 Resonance in R-L-C series circuit, Graphical Representation, Resonance curve, Quality (Q) Factor. (Simple Numerical on above)	Lecture Using Chalk-Board, Video Demonstrations, Flipped Classroom, Case Study, Collaborative learning, Presentations	CO1
UNIT-II SINGLE PHASE A.C PARALLEL CIRCUITS (CL Hrs- 8, Marks- 10)				
2	TLO 2.1 Determine the current, and voltage and draw a phasor diagram for the given AC parallel circuit. TLO 2.2 Calculate inductive, capacitive susceptance and admittance for the given AC parallel circuit. TLO2.3 Determine active, reactive, apparent power and power factor for the given AC parallel circuit. TLO 2.4 Determine the resonant frequency and Q-factor for the given RL-C parallel circuit.	2.1 R-L, R-C and RL-C parallel combination of A.C. circuits. Admittance, admittance triangle, phasor diagram. 2.2 Use of admittance method for solving parallel circuit. 2.3 Active, reactive, apparent power and power factor 2.4 Resonance in parallel circuit-Graphical Representation, Quality (Q) Factor. (Simple Numerical)	Lecture Using Chalk-Board, Video Demonstrations, Flipped Classroom, Case Study, Collaborative learning, Presentations	CO2

UNIT-III THREE PHASE CIRCUITS (CL Hrs- 9, Marks- 16)				
3	TLO 3.1 Explain the principle of generation of the 3-phase waveform. TLO 3.2 Compare 3-phase circuit with 1-phase circuit. TLO 3.3 Calculate line, phase values and 3-phase power for star and delta connection. TLO 3.4 Explain the concept of balanced and unbalanced load conditions.	3.1 Generation of 3-phase emf, Phasor diagram, Phase Sequence. 3.2 Advantages of the 3-phase circuit over single-phase circuit. 3.3 Types of 3 phase connections,star and delta, Relation between phase and line values, phasor diagram. 3.4 3-Phase power- active, reactive and apparent power in star and delta connected system. Concept of balanced and unbalanced load (Numerical on balanced load only)	Lecture Using Chalk-Board, Video Demonstrations, Flipped Classroom, Case Study, Collaborative learning, Presentations	CO3
UNIT- IV NETWORK REDUCTION METHODS FOR DC CIRCUITS(CL Hrs- 8 , Marks- 12)				
4	TLO 4.1 Define the given terms related to electrical networks. TLO 4.2 Reduce the given network by applying Star/delta and delta/star transformation. TLO 4.3 Apply Mesh analysis to solve the given network. TLO 4.4 Apply Node analysis to solve the given network.	4.1 Definitions like circuit, network, loop, mesh, node, active and passive network, linear and non linear network, unilateral and bilateral network 4.2 Star to delta and delta to star transformation. 4.3 Mesh Analysis. 4.4 Node Analysis. (Simple numerical on above up to two loops)	Lecture Using Chalk-Board, Video Demonstrations, Flipped Classroom, Case Study, Collaborative learning, Presentations	CO4
UNIT –V NETWORK THEOREMS(CL Hrs- 10, Marks- 16)				
5	TLO 5.1 Apply the superposition theorem to determine the current in the given branch of a circuit. TLO 5.2 Draw Thevenin's equivalent circuit and determine the load current in the given branch of a circuit. TLO 5.3 Draw Norton's equivalent circuit and determine the load current in the given branch of a circuit. TLO 5.4 Apply the maximum power transfer theorem to determine the maximum power in the given network. TLO 5.5 Apply Reciprocity theorem for the given network. TLO 5.6 Describe the procedure to solve the AC network theorem.	DC Network theorems 5.1 Superposition theorem. 5.2 Thevenin's theorem. 5.3 Norton's theorem 5.4 Maximum power transfer theorem 5.5 Reciprocity Theorem (Simple numerical on above up to two loops) 5.6 Superposition theorem for AC Network (no numerical)	Lecture Using Chalk-Board, Video Demonstrations, Flipped Classroom, Case Study, Collaborative learning, Presentations	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 1.1 Trace the output waveforms across a given series circuit to identify the phase difference and measure the amplitude. LLO 1.2 Observe the nature of current with respect to voltage in the R-L / R-C series circuit. LLO 1.3 Operate various controls of CRO	*Determination of the phase difference between A.C voltage and current in a given R-L / R-C series circuit by using a dual trace oscilloscope.	2	CO1
2	LLO 2.1 Measure voltage, current and draw a phasor diagram to find pf and verify the same. LLO 2.2 Measure active power and calculate reactive and apparent power for the R-L series circuit and verify the same.	*Determination of voltage, current and pf in a given R-L series circuit. Draw a phasor diagram. Determination of active, reactive and apparent power consumed in a given R-L series circuit.	2	CO1
3	LLO 3.1 Measure voltage, current and draw a phasor diagram to find pf and verify the same. LLO 3.2 Measure active power and calculate reactive and apparent power for the R-C series circuit and verify the same.	*Determination of voltage, current and pf in a given R-C series circuit. Draw a phasor diagram. Determination of active, reactive and apparent power consumed in a given R-C series circuit.	2	CO1
4	LLO 4.1 Measure voltage, current and draw a phasor diagram to find pf and verify the same. LLO 4.2 Observe the nature of current with respect to voltage for $X_L > X_C$ or $X_L < X_C$ and interpret the nature of the circuit. LLO 4.3 Measure active power and calculate reactive and apparent power for the R-L-C series circuit and verify the same.	*Determination of voltage, current and pf in a given R-L-C series circuit. Draw a phasor diagram. *Determination of active, reactive and apparent power consumed in a given R-L-C series circuit.	2	CO1

Sr. No	Practical/Tutorial/Laboratory Learning Outcome (LLO)	Laboratory Experiment / Practical Titles /Tutorial Titles	Number of hrs.	Relevant COs
5	LLO 5.1 Measure the resonant frequency and verify it by calculation. LLO 5.2 Using variable frequency supply obtain the resonant condition for R-L- C series circuit OR LLO 5.1 Measure the inductance and capacitance to obtain the resonant condition. LLO 5.2 Measure current, and voltage and draw vector diagram to obtain pf at resonance in R-L-C series circuit	Resonance in given R-L-C series circuit using variable frequency supply. OR *Resonance in given R-L-C series circuit using variable inductor or capacitor.	2	CO1
6	LLO 6.1 Measure voltage, current and draw a phasor diagram to find pf and verify the same. LLO 6.2 Measure active power and calculate reactive and apparent power for a given parallel circuit and verify the same.	*Determination of voltage, current, p.f., active, reactive and apparent power for a given R-L **OR** R-C parallel circuit.	2	CO2
7	LLO 7.1 Measure line and phase values for the balanced star-connected load. LLO 7.2 Draw a phasor diagram with the help of phase values and verify the line values.	*Determination of line and phase quantities of voltage and current for balanced three-phase star-connected load. Draw a phasor diagram.	2	CO3
8	LLO 8.1 Measure line and phase values for the balanced delta-connected load. LLO 8.2 Draw a phasor diagram with the help of phase values and verify the line values.	*Determination of line and phase values of voltage and current for balanced three-phase delta-connected load. Draw a phasor diagram.	2	CO3
9	LLO 9.1 Measure line and phase values for unbalanced three-phase star OR delta-connected inductive/capacitive load.	*Determination of line and phase values of voltage and current for unbalanced three-phase star OR delta-connected inductive/capacitive load.	2	CO3
10	LLO 10.1 Measure current through the branch for a given DC network & verify by applying mesh analysis.	*Verification of Mesh analysis.	2	CO4
11	LLO 11.1 Measure current through the branch for a given DC network and verify by applying node analysis.	*Verification of Node analysis.	2	CO4
12	LLO 12.1 Measure current through the branch for a given DC network and verify by applying the superposition theorem.	*Verification of Superposition theorem.	2	CO5
13	LLO 13.1 Measure Thevenin's and Norton's equivalent circuit parameters for a given DC circuit and verify by		2	CO5

Sr. No	Practical/Tutorial/Laboratory Learning Outcome (LLO)	Laboratory Experiment / Practical Titles /Tutorial Titles	Number of hrs.	Relevant COs
	applying Thevenin's theorem. LLO 13.2 Draw the Thevenin's and Norton's equivalent circuits and verify the load current.	*Verification of Thevenin's and Norton's theorem.		
14	LLO 14.1 Measure load resistance to transfer maximum power for a given DC circuit and verify by applying the maximum power transfer theorem.	*Verification of Maximum Power Transfer theorem.	2	CO5
15	LLO 15.1 Measure current through the branch for a given AC network and verify by applying the superposition theorem.	*Verification of Superposition theorem for AC network.	2	CO5

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

Micro project: The teacher should give the topic on theory/lab contents

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

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

VII. LABORATORY EQUIPMENT/INSTRUMENTS/TOOLS/SOFTWARE REQUIRED

Sr.No	Equipment Name with Broad Specifications	Relevant LLO Number
1	Digital Storage Oscilloscope: Dual Trace 50Mhz	1
2	Single phase variable Inductor of suitable range	1,2,4,5
3	Variable Frequency Generator	5
4	Three phase Capacitor Bank 5A, 250 V or suitable range	9
5	Three phase Inductor Bank 5A, 250 V or suitable range	9
6	Load Bank: Resistive, 3-Phase, 5 kW, 415 V	7,8,9
7	Dimmer: 3-Phase, 5 kVA or suitable range	7,8,9
8	Capacitor 50 µF (micro-Farad) 250 V or suitable range	3,4,5
9	DC Regulated Power Supply	10 to 14
10	Low Power Factor Wattmeter of suitable range	2,3,4,5
11	Wattmeter of suitable range	2 to 9
12	Rheostat- 10 ohm /10A, 50 ohm / 5A, 100 ohm /5 A, or suitable range	1 to 6 And 10 to 15
13	Ammeters MI Type: AC/DC, of suitable range	All
14	Voltmeter MI Type: AC/DC, of suitable range	All
15	Dimmer: 1-Phase,1kVA, 230V	1,2,3,4,5,6, 15
16	Multimeter of suitable range	All

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	**SINGLE PHASE A.C SERIES CIRCUITS**	**CO1**	**10**	**4**	**4**	**8**	**16**
2	II	**SINGLE PHASE A.C PARALLEL CIRCUITS**	**CO2**	**08**	**2**	**2**	**6**	**10**
3	III	**THREE PHASE CIRCUITS**	**CO3**	**09**	**4**	**4**	**8**	**16**
4	IV	**NETWORK REDUCTION METHODS FOR DC CIRCUITS.**	**CO4**	**08**	**2**	**4**	**6**	**12**
5	V	**NETWORK THEOREMS**	**CO5**	**10**	**2**	**4**	**10**	**16**
			Grand Total	**45**	**14**	**18**	**38**	**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. End semester summative assessment of 50 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	3	2	3	--	--	3	2	2	2	--
CO2	3	3	2	3	--	--	3	2	2	2	--
CO3	3	3	2	3	--	--	3	3	2	3	--
CO4	3	3	2	2	--	--	3	--	--	2	--
CO5	3	3	3	3	--	--	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 with ISBN Number
1	Gupta, B. R. Singhal, Vandana	Fundamentals of Electrical Networks	S.Chand and Co., New Delhi, 2005 ISBN: 978-81-219-2318-7
2	Theraja, B. L. , Theraja, A. K.	A Text Book of Electrical Technology Vol-I	S. Chand and Co. Ramnagar, New Delhi, 2012; ISBN: 9788121924405
3	Saxena, S.B lal, Dasgupta, K.	Fundamentals of Electrical Engineering	Cambridge University Press Pvt. Ltd., New Delhi, 2016, ISBN: 978-11-0746-435-3
4	Mittle, V.N. , Mittle, Arvind	Basic Electrical Engineering	McGraw Hill Education, Noida, 2005 ISBN: 978-00-705-9357-2
5	Sudhakar, A Shyammohan, S.Palli	Circuit and network	McGraw Hill Education, New Delhi, 2015, ISBN: 978-93-3921-960-4
6	Joseph Edminister	Schaum online series- Theory and problems of electric circuits	McGraw Hill Education, Newyork, 2013, ISBN: 978-00-701-8999-7

Sr.No	Author	Title	Publisher with ISBN Number
7	David A. Bell	Electric Circuits	Oxford University Press New Delhi, 2009; ISBN: 978-01-954-2524-6
8	M.E. Van Valkenburg	Network Analysis	Pearson Education ISBN: 9789353433123

XII. LEARNING WEBSITES & PORTALS

Sr.No	Link/Portal	Description
1	www.cesim.com/simulations	Graphical representation of series and parallel resonance
2	https://ndl.iitkgp.ac.in/	NeworkTheorems
3	https://nptel.ac.in/	Single phase Series and Parallel Circuit, Three Phase Circuit
4	http://vlabs.iitkgp.ac.in/asnm/	Series and Parallel Resonance, Network Theorems, Reduced Network Methods
5	https://vlab.amrita.edu	Single phase Series and Parallel Circuit, Three Phase Circuit, Series and Parallel Resonance
6	www.dreamtechpress.com /ebooks	Free reference books for more practice
7	www.nptelvideos.in/electrical engineering/ circuit theory	Network Circuit Theory
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 S. Ashtaputre** Lecturer in Electrical Engineering **Shri. Sunil P. Date** Lecturer in Electrical Engineering (Course Experts)	
Name & Signature: **Dr. Sachin. S. Bharatkar** (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	**ELECTRICAL AND ELECTRONIC MEASUREMENT**
COURSE CODE	**EE31203**
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	
EE31203	ELECTRICAL AND ELECTRONIC MEASUREMENT	DSC	3	--	2	1	6	3	3 Hrs.	30	70	100	40	25	10	25@	10	25	10	175

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 holders have to carry out many tests on electrical machines and equipment. For testing, meters and instruments are required to be used, operated and handled. Construction, working principle and operation of such meters, instruments equipment should be known to electrical technicians, which is required lifelong in the student's job profile.

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: Apply the basics of measurement to the measuring instruments.
CO2: Measure electric circuit parameters by different methods.
CO3: Measure electrical power for single phase & 3-phase circuits.
CO4: Use analog as well as digital meters to measure electrical energy,
CO5: Use various special measuring instruments considering the construction & working.

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 FUNDAMENTALS OF MEASUREMENT (CL Hrs- 12, Marks- 18)				
1.	TLO 1.1 Describe the necessity of measurement and electrical measuring Instruments TLO 1.2 State the different qualities of instruments and define the terms sensitivity, accuracy, Precision, reliability, stability TLO 1.3 Give the classification of instruments and compare between Indicating, integrating and recording, absolute and secondary instrument TLO 1.4 Differentiate between deflecting, controlling and damping torques TLO 1.5 Different types of errors with examples TLO 1.6 State the different types of Ammeter and Voltmeter and explain the principle of operation, construction, merits and demerits of each type of meter TLO 1.7 Illustrate the use of shunts and multipliers for range extension of ammeter and voltmeter TLO 1.8 Illustrate the use of an Instrument transformer like C.T and P.T with constructional details TLO 1.9 Describe the ways to extend the ranges of meters using CT and PT	1.1 Need for measurement and electrical measuring instruments 1.2 Qualities of electrical measuring instruments: sensitivity, accuracy, precision, reliability, stability 1.3 Classification of instruments based on : a) Methods of measurement as absolute and secondary instruments b) Limits of percentage error Instrument classes - Standard and sub-standard instruments c) Principle of operation. Nature of operation as indicating, recording and integrating type 1.4 Essential torques in indicating instruments:-Deflecting, Controlling and damping torques. 1.5 Types of errors. 1.6 Types of Ammeter and Voltmeter:- PMMC, MI, & dynamometer type 1.7 Construction, principle of operation, merits and demerits of above types of meters 1.8 Extension of range of voltmeter and ammeter using multiplier & shunt respectively 1.9 Introduction of Instrument Transformers- C.T. and P.T. with regard to their application, and construction 1.10 Precautions to be taken in their use 1.11 Extension of range A.C. Ammeter and A.C. Voltmeter using CT and PT 1.12 Advantages of CT and PT over shunt and multiplier 1.13 Calibration: Need, significance and general procedure 1.14Simple numerical on the extension of the range of voltmeter and ammeter	Chalk-Board, Video Demonstrations, Model Demonstration, PowerPoint Presentations, Charts	CO1

UNIT-II MEASUREMENT OF RESISTANCE, INDUCTANCE AND CAPACITANCE (CL Hrs- 10, Marks- 16)				
2	TLO 2.1 Classify different types of Resistances TLO 2.2 Explain the procedures used to measure low, medium and high resistances TLO 2.3 Draw the general circuit diagram of the A.C. bridge and obtain its equation for the bridge at balance condition TLO 2.4 Determine inductance and capacitance using Maxwell's inductance bridge and Schering bridge TLO 2.5 Know the precautions & limitations of A.C. bridges	2.1 Classification of electrical resistances based on magnitude range as low, medium & high. 2.2 Potentiometer method used for measurement of low resistance 2.3 Methods and procedure used for measurement of medium resistance by a) Whetstone's bridge method b) Ammeter-voltmeter method 2.4 Measurement of insulation resistance by Megger 2.5 General A.C. bridge circuit and equation for the bridge at balance 2.6 Measurement of Inductance and capacitance using (No derivation, No phasor Diagram, only formula & simple numerical) a) Maxwell's inductance bridge b) Schering bridge for capacitance measurement 2.7 Precautions & limitations of A.C. bridges.	Chalk-Board, Video Demonstrations, Model Demonstration, PowerPoint Presentations, Charts	CO2
UNIT-III MEASUREMENT OF ELECTRICAL POWER (CL Hrs- 08, Marks- 12)				
3	TLO 3.1 Explain the use of dynamometer type wattmeter TLO 3.2 Determine the Error due to pressure coil connections TLO 3.3 Know the construction and operation of polyphase watt-meter TLO 3.4 Select the appropriate method for measurement of power in three-phase circuit	3.1 Construction and Principle of Operation of Dynamometer type wattmeter 3.2 Error due to pressure coil connections 3.3 Low power factor wattmeter (Electrodynamometer type) and its use 3.4 Construction and operation of polyphase watt-meter 3.5 Measurement of active power in three-phase circuits for balanced and unbalanced loads using Two wattmeter method, Calculation of p.f. from wattmeter readings, Effect of p.f. a variation on wattmeter readings 3.6 Measurement of active & reactive power in three three-phase balanced loads by using One wattmeter method 3.7 Simple numerical on-power measurement using the above methods	Chalk-Board, Video Demonstrations, Model Demonstration, PowerPoint Presentations, Charts	CO3

UNIT- IV MEASUREMENT OF ELECTRICAL ENERGY (CL Hrs- 08, Marks- 12)				
4	TLO 4.1 Describe the construction and working of single-phase and three-phase energy meters (Induction Type) TLO 4.2 Know the recent trends in energy meters TLO 4.3 Describe different errors occurring during the measurement of energy. Also, describe the methods for reducing these errors TLO 4.4 Carry out calibration and testing of Energy meter	4.1 Principle of operation and Construction of single-phase and three-phase induction type energy meter 4.2 Errors occurring in induction-type energy meters and their corrective measures 4.3 Digital Energy meter, Smart Energy meter 4.4 Procedure for Calibration of energy meter as per I.S. 4.5 Testing of energy meter as per I.S.	Chalk-Board, Video Demonstrations, Model Demonstration, PowerPoint Presentations, Charts	CO4
UNIT –V SPECIAL MEASURING INSTRUMENTS (CL Hrs-07, Marks-12)				
5	TLO 5.1 Know the special measuring Instruments. Describe the construction, working and applications .	5.1 Digital Multimeter:-Block Diagram, Advantages and Applications 5.2 Clip-on ammeter –construction and working 5.3 Construction and working principle of single phase electrodynamometer type power factor meter 5.4 Weston-type synchroscope 5.5 Phase sequence indicator-Static type and rotating type 5.6 Weston-type frequency meter 5.7 L.C.R. meter	Chalk-Board, Video Demonstrations, Model Demonstration, PowerPoint Presentations, Charts	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 1.1 Identify measuring instruments based on symbols on the dial, type, accuracy, class, position and scale	Identification of measuring instruments based on symbols on dial, type, accuracy, class, position and scale.	02	CO1
2	LLO 2.1 Identify the components of PMMC and MI instruments.	Identification of the components of PMMC and MI instruments.	02	CO1
3	LLO 3.1 Calibrate the ammeter /voltmeter for measurement.	Calibration of the ammeter /voltmeter for measurement of electrical parameters.	02	CO1
4	LLO 4.1 Measure medium resistance by using Whetstone's bridge.	Measurement of medium resistance by Whetstone's bridge.	02	CO2
5	LLO 5.1 Measure insulation resistance by Megger.	Measurement of Insulation Resistance by Megger.	02	CO2
6	LLO 6.1 Extend the range of ammeter and voltmeter by using CT, PT. Take the safety Precautions while using CT.	Extension range of meters using CT and PT.	02	CO1

Sr. No	Practical/Tutorial/Laboratory Learning Outcome (LLO)	Laboratory Experiment / Practical Titles /Tutorial Titles	Number of hrs.	Relevant COs
7	LLO 7.1 Measure power in a single-phase circuit by electro-dynamic watt-meter and determining the multiplying factor of a wattmeter also change the current range of the wattmeter by making changes in the current	Measurement of power in a single-phase circuit using an electrodynamic watt-meter.	02	CO3
8	LLO 8.1 Measure active power in three three-phase balanced loads by using one wattmeter method.	Measurement of active power in three-phase balanced load by one wattmeter method.	02	CO3
9	LLO 9.1 Measure reactive power in three three-phase balanced loads by using one wattmeter method.	Measurement of reactive power in three-phase balanced load by one wattmeter method.	02	CO3
10	LLO 10.1 Measure active power in three three-phase balanced loads by using two wattmeter method.	Measurement of active power in three-phase balanced load by two wattmeter method.	02	CO3
11	LLO 11.1 Calibrate single-phase energy meter by direct loading.	Calibration of single-phase energy meter by direct loading.	02	CO4
12	LLO 12.1 Determine the phase sequence of the phase supply using the Phase Sequence Indicator.	Determination of phase sequence of three-phase supply using phase Sequence Indicator.	02	CO5
13	LLO 13.1 Measure A.C. current by using Clip on ammeter.	Measurement of A.C. current by using Clip on ammeter.	02	CO5

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

Micro project:

- PMMC and MI instrument: Dismantle any PMMC and MI instrument each available in the laboratory/workshop and identify different parts, materials and functions i.e. coil, spring, magnets, former, dial scale etc. and again assemble the same.
- Wattmeter: Dismantle a wattmeter available in the laboratory identify the pressure coil, current coil, spring, magnets, former, dial scale etc. and again assemble the same.
- Electronic energy meter: Collect data on the power consumption of the equipment in the departmental laboratories/workshops of your polytechnic using an electronic energy meter.
- DMM: Use DMM for measurement of current, voltage, and resistance of different ranges and check the continuity.

Assignment: -

- Compare analog and digital meters.
- Compare PMMC with MI meters.
- Determine earth resistance using a digital earth tester and compare it with the ideal earth resistance.
- Determine the multiplying factor of a wattmeter.
- Compare analog energy meter with digital energy meter.

Suggested Student Activity -

- Prepare a chart showing real-life examples indicating various types of electrical measuring equipment.
- Collect photographs of PMMC and MI instruments showing internal parts.
- Prepare a PowerPoint presentation for different types of wattmeters.
- Collect photographs of the electronic energy meter and prepare a report on it.
- Prepare the report on smart energy meters.

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 the task assigned, 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	Different (analog) measuring instruments	1
2	Model of PMMC and PMMI type instrument	2
3	Ammeter / voltmeter - 1 standard and 1 to be calibrated / potentiometer etc.	3
4	Wheatstone's bridge and Kelvin's double bridge, Megger	4,5,6
5	Voltmeter, Ammeter, CT (15A/5A, 25A/5A), PT (230V/110V, 440V/110V)	7
6	Voltmeter, Ammeter, Wattmeter (5/10A, 110/ 230V), Wattmeter (5/10A, 300/ 600V), Balanced load	8, 9, 10, 11
7	Energy meter, wattmeter and stopwatch	12
8	Phase sequence indicator	13
9	Clip on meter	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**	**FUNDAMENTALS OF MEASUREMENT**	CO1	12	6	8	4	18
2	**II**	**MEASUREMENT OF RESISTANCE, INDUCTANCE AND CAPACITANCE**	CO2	10	4	6	6	16
3	**III**	**MEASUREMENT OF ELECTRICAL POWER**	CO3	08	4	4	4	12
4	**IV**	**MEASUREMENT OF ELECTRICAL ENERGY**	CO4	08	4	4	4	12
5	**V**	**SPECIAL MEASURING INSTRUMENTS**	CO5	07	4	4	4	12
			Grand Total	**45**	**26**	**26**	**22**	**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 the 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 summative assessment of 25 marks for laboratory learning. 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	3	--	--	2	2	--	3	--	--	--	2
CO2	3	2	--	2	2	--	3	2	2	--	--
CO3	3	2	--	--	--	--	3	--	--	--	--
CO4	3	--	--	2	2	--	3	2	2	--	2
CO5	2	--	--	--	--	--	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 with ISBN Number
1	A.K.Sawhney	A Course in Electrical and Electronic Measurements and Instrumentation	Dhanpatrai and Co.Pvt.Ltd.Delhi ISBN 9788177001006
2	E.W.Golding & F.C.Widdis	Electrical measurement and Measuring Instruments	AH Wheeler & Company ISBN 9788185614311
3	N.V.Suryanarayana	Electrical Measurements and Measuring Instruments	Tata McGraw-Hill Publishing Company Ltd.ISBN 9780074517512
4	M.L.Anand	Electrical Measurements & Measuring Instruments	S. K. Kataria& Sons ISBN 9789350143636

XII. LEARNING WEBSITES & PORTALS

Sr.No	Link/Portal	Description
1.	https://ndl.iitkgp.ac.in/	Free source of reference books on electrical measurement and instrumentation.
2.	https://nptel.ac.in/	Fundamentals of Measurement.
3.	https://swayam.gov.in/nc_details/NPTEL	Concepts of electrical and electronics measurements.

Name & Signature:

Smt. Sujala Parimal Phadnaik
Lecturer in Electrical Engineering

Smt. Madhuri Hemat Bilgi
Lecturer in Electrical Engineering

(Course Experts)

Name & Signature:

Dr. Sachin. S. Bharatkar
(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	**ELECTRICAL POWER GENERATION AND TRANSMISSION**
COURSE CODE	**EE31204**
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	
EE31204	ELECTRICAL POWER GENERATION AND TRANSMISSION	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:

Electrical power system plays a significant role in the development of the Urban, Rural, Industries and Agriculture sectors. This course aims to develop the basic knowledge and required skills to maintain the proper functioning of the power system.

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

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

CO1 - Know the advancement in technology to generate electrical power commercially using wind and solar energy

CO2 - Maintain the optimized working of the thermal power plant and hydropower plant.
CO3 - Select the relevant power generation technology based on economic operation.
CO4 - Interpret the normal operation and parameters of the electric transmission system.
CO5 - Interpret the parameters of the extra high voltage transmission 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
UNIT- 1: INTRODUCTION (CL HRS- 02, MARKS-04)				
1	TLO 1.1. List the various sources of Energy and give a comparison between them	1.1 Importance of Electrical Energy. 1.2 Sources of Energy: conventional and renewable 1.3 Comparison of Energy Sources 1.4 Types of fuels: solid, liquid and gaseous, their calorific values, advantages and disadvantages of these fuels	. Chalk-Board	.CO1
UNIT - II THERMAL POWER PLANT, HYDRO POWER PLANT AND NUCLEAR POWER PLANT (CL HRS- 13, Marks- 20)				
2	TLO 2.1 Describe the layout of the electric power generating process with a labelled block diagram of the specified power plant. TLO 2.2 State the functions of a given type of major auxiliaries of specified power plants. TLO 2.3 Distinguish between Thermal Power Plant, Hydro Power Plant and Nuclear Power plant. TLO 2.4 Describe the specified safe practices to be followed for a specified power plant.	2.1 Site selection, Layout and working of a typical Thermal Power Plant. 2.2 Functions of the following major auxiliaries used in Thermal Power Plants: Coal-fired boilers: fire tube and water tube and Heat recovery system (Superheater, Economizer and Air pre-heater). 2.3 Site selection, Layout and working of a typical Hydropower plant. 2.4 Classification of hydropower plant: Run off-river Power Plant without Pondage, Runoff River Power Plant with Pondage, Reservoir Power Plant and Pumped Storage Power Plant. 2.5 Site selection, Layout and working of a typical Nuclear Power Plant. 2.6 Functions of all major auxiliaries used in Nuclear Power Plant 2.7 Comparison between Thermal Power Plant, Hydro Power Plant and Nuclear Power plant. 2.8 Locations of these different types of Large and Micro-Hydro Power Plants in Maharashtra. 2.9 Safe Practices of Thermal Power Plants and Hydro Power Plants (Large and Micro)	Chalk-Board Presentations Model Demonstration Demonstration Video Flipped Classroom	CO2
UNIT - III ECONOMICS OF POWER GENERATION AND INTERCONNECTED POWER SYSTEM (CL Hrs.- 12, Marks-18)				
3	TLO 3.1 Interpret the given Load curve, Load duration curve, and Integration duration curve.	3.1 Base load and Peak load Plants: Load curve, Load duration curve, Integrated Load duration curve. Related terms: connected load, firm power, cold reserve, hot reserve,	Chalk-Board Presentations Model Demonstration	CO3

	TLO 3.2 Interpret the given values of the demand factor, plant capacity factor, and plant use factor. TLO 3.3 Interpret the given values of the diversity factor, load factor and plant load factor. TLO 3.4 State the causes and impact of the given grid system fault.	spinning reserve. 3.2 Cost of generation: average demand, maximum demand, demand factor, plant capacity factor, plant use factor, diversity factor, load factor and plant load factor,(Problem-based on it.) 3.3 Choice of size and number of Generator units, the combined operation of the power station. 3.4 Causes, Impact and Reasons of Grid system fault: State Grid, National Grid, brownout and blackout; sample blackouts at National and International level	Video Demonstrations Flipped Classroom	
UNIT --IV TRANSMISSION LINE COMPONENTS, PARAMETERS AND PERFORMANCE (CL HRS 10, Marks-16)				
4	TLO 4.1 Classify the given Transmission Line. TLO 4.2 Describe the construction and functioning of the given Transmission Line Components. TLO 4.3 Explain the concept of the given Transmission Line parameters. TLO 4.4 Evaluate the performance of the short transmission Line based on the given criteria. TLO 4.5 Explain the given method(s) for the representation of the Medium Transmission Line. TLO 4.6 Describe the need for Transposition of Conductors.	4.1 Electric power transmission systems: Single line diagrams. 4.2 Classification of transmission lines: Primary and Secondary transmission; standard voltage level used in India. 4.3 Transmission line Components: Types of Line supports, Line Insulators and Overhead/ Underground Conductors with their function. 4.4 Method of construction of electric supply transmission system – 110 kV, 220 kV, 400 kV. 4.5 Transmission Line Parameters: R, L and C and types of lines. 4.6 Performance of short line: Efficiency, Regulation, Effect of Power Factor. (Simple Numericals on it) 4.7 Introduction of medium and short transmission line(No derivation 4.8 Skin effect and Proximity Effect, Transposition of conductors and its necessity.	Chalk-Board Presentations Model Demonstration Video Flipped Classroom	CO4
UNIT - V EXTRA HIGH VOLTAGE TRANSMISSION (HVAC AND HVDC) (CL Hrs- 08, Marks-12)				
5	TLO 5.1 State the Rating and functions of the given type of transmission line. TLO 5.2 State the Rating and functions of the given High voltage Substation components. TLO 5.3 Explain the specified effects occurring in the given type of high-voltage transmission line . TLO 5.4 Explain the importance of line compensation in High voltage transmission line. TLO 5.5 Describe the layout of	5.1 Extra High Voltage AC (EHVAC) transmission line: 5.2 Necessity of UHV, EHV AC/ DC lines. 5.3 High voltage substation components: Transformers, Bus, Circuit breaker, Reactor, Lightning arrester, Relays, FACTs Devices. 5.4 High-Temperature Low Sag (HTLS) Conductor in High Voltage Transmission Lines: Features. 5.5 Ferranti and Corona effect 5.6 Line compensation: Need and benefits. 5.7 High Voltage DC (HVDC)	Chalk-Board Presentations Model Demonstration Video Demonstrations Flipped Classroom	CO5

	the given HVDC transmission lines with sketches. TLO 5.6 Explain the concept of wireless transmission of electrical power.	Transmission Line: 5.8 Necessity and HVDC Lines in India. 5.9 HVDC Transmission lines: Components, applications, advantages, and limitations 5.10 Monopolar, bi-polar and homo-polar transmission lines: Layout 5.11 EHVAC and HVDC transmission line: Features and Comparison. 5.12 Wireless transmission of electrical power.		

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 Draw layout of the typical Thermal Power Plant LLO 1.2 Identify the different components of a typical Thermal Power Plant LLO 1.3 Observe the operation of the Thermal Power Plant	Demonstration of a Thermal Power Plant using Visit/Animations/ Video programme.	2	CO1
2	LLO 2.1 Identify components of the Heat Recovery System. LLO 2.2 Describe the function of the Components of the Heat Recovery System.	Process of Heat Recovery System in Thermal Power Plant	2	CO1
3	LLO 3.1 Draw layout of the typical Hydro Power Plant. LLO 3.2 Identify the different components of a typical Hydro Power Plant. LLO 3.3 Observe the operation of the Hydro Power Plant.	Demonstration of a Hydro Power Plant using Visit/Animations/ Video programme.	2	CO1
4	LLO 4.1 Draw layout of the typical Pumped Storage Hydro Power Plant	Demonstration of a Pumped Storage Hydro Power Plant using Visit/Animations/ Video programme.	2	CO1
5	LLO 5.1 Draw layout of the typical Hydro Power Plant	Demonstration of Different types of Hydro Power Plant using Animations/ Video programs.	2	CO1
6	LLO 6.1 Draw load curve of Campus/ Institute building(s) LLO 6.2 Calculate various economic factors from the above load curve.	Load curve of Campus/ Institute building(s) and calculation of the following economic factors: Maximum demand, Average load, Load Factor, Reserve capacity, Plant capacity factor, utilization factor, Plant use factor and Diversity factor.	2	CO1 CO2
7	LLO 7.1 Select appropriate power generation technology as per variation in load demand.	Selection of power generation technology as per variation in load demand of a given load curve	2	CO1 CO2
8	LLO 8.1 Draw the Load Duration curve and Integrated load curve from a given load curve.	Load Duration curve and Integrated load curve	2	CO2

Sr. No	Practical/Tutorial/Laboratory Learning Outcome (LLO)	Laboratory Experiment / Practical Titles/Tutorial Titles	Number of hrs.	Relevant COs
9	LLO 9.1 List the components of the electric supply system. LLO 9.2 Prepare a single-line diagram with vertical and horizontal clearances of the Electric supply system.	Single line diagram of the Electric supply system.	2	CO3 CO5
10	LLO 10.1 Prepare a single-line diagram of the 400 kV transmission line substation. LLO 10.2 Prepare a plan and elevation diagram of the 400 kV transmission line substation.	Layout of 400kV transmission line substation.	2	CO3
11	LLO 11.1 Prepare a single-line diagram of the 132 kV transmission line substation. LLO 11.2 Prepare a plan and elevation diagram of the 132 kV transmission line substation	Layout of 132 kV transmission line substation.	2	CO3
12	LLO 12.1 Identify the components of Ultra High Voltage (UHV) Transmission lines.	Demonstration of an Ultra High Voltage (UHV) Transmission line using Animations/ Video Programme.	2	CO4
13.	LLO 13.1 Identify the components of Extra High Voltage (EHV) Transmission lines.	Demonstration of Extra High Voltage (EHV) Transmission lines using Visit/Animations/ Video Programme.	2	CO4
14	LLO 14.1 Prepare a single-line diagram of the HVDC transmission line. LLO 14.2 Prepare a plan and elevation diagram HVDC transmission line.	Layout of HVDC transmission line.	2	CO4
	LLO 15.1 Prepare a list of components of the distribution substation. LLO 15.2 Prepare a single-line diagram of the distribution substation. LLO 15.3 Prepare a plan and elevation diagram with clearances of the distribution substation.	Components of Distribution Substation.	2	CO5
16	LLO 16.1 Calculate load for Commercial and Residential Consumers. LLO 16.2 Prepare a feeder scheme for consumers.	Distribution scheme for Commercial and Residential Consumers.	2	CO5
17	LLO 17.1 Calculate load for Industrial Consumer. LLO 17.2 Prepare a feeder scheme for industrial Consumer	Distribution scheme for Industrial Consumers.	2	CO5

Perform any 12 practicals. All CO's should be covered in the perform practical.

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

Assignment

*Calculate various Economic factors from the given Load Curve.
*Prepare a list of materials used for the Transmission line.
* Calculation on Commercial and Residential Consumers' Load Demand
*Prepare a list of materials used for the Transmission line.
* Prepare a list of materials used for the Distribution line/ substation.
* Prepare a list of materials used for the Transmission line substation.
* Calculation on Industrial Consumers Load Demand.

* Numerical on Economics of Power generation.

Micro project

P*repare a model of a Pumped Storage Hydropower Station.

* Prepare a model of the Hydropower Station.

* Prepare a model of a Thermal Power Station.

* Prepare a comparative chart for UHVAC and HVAC Transmission lines considering their Strength, Limitations, Capital cost

* Involvement, Running Costs, Losses, Voltage regulation, Construction details etc.

* Prepare a comparative chart for HVAC and HVDC Transmission lines on the basis of their Strength, Limitations, Capital cost involvement, Running Cost, Losses, Voltage regulation, Construction details etc.

***** Write Detail complete technical specification of all the elements of Ultra high voltage AC (UHVAC) Transmission line.

*Also write the functions of each element of the UHVAC Transmission line and submit the report.

VII. LABORATORY EQUIPMENT/INSTRUMENTS/TOOLS/SOFTWARE REQUIRED

Sr. No	Equipment Name with Broad Specifications	Relevant LLO Number
1	Video Programme/Animation/Demonstration Model of Thermal Power Plant.	1,2
2	-Video Programme/Animation/Demonstration Model of Hydro Power Plant.	3,4,5
3	Video Programme/Animation/Demonstration Model/Chart Demonstration of Electric Power System.	9
4	Video Programme/Animation/Demonstration Model of different Supporting Structures / Insulators/ Conductors of Transmission Line.	9,10,13,14,16, 17
5	Video Programme/Animation/Demonstration Model of Transmission Substation.	10,11,15

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

Sr. No	Unit	Unit Title	Aligned COs	Learning Hours	R-Level	U-Level	A-Level	Total Marks
1	**1**	**INTRODUCTION**	**CO1**	**02**	**4**	**--**	**---**	**04**
2	**II**	**THERMAL POWER PLANT, HYDRO POWER PLANT AND NUCLEAR POWER PLANT.**	**CO2**	**13**	**10**	**2**	**8**	**20**
3	**III**	**ECONOMICS OF POWER GENERATION AND INTERCONNECTED POWER SYSTEM**	**CO3**	**12**	**4**	**6**	**8**	**18**
4	**IV**	**TRANSMISSION LINE COMPONENTS, PARAMETERS AND PERFORMANCE**	**CO4**	**10**	**2**	**8**	**6**	**16**
5	**V**	**EXTRA HIGH VOLTAGE TRANSMISSION (HVAC AND HVDC)**	**CO5**	**08**	**2**	**6**	**4**	**12**
			Grand Total	**45**	**10**	**32**	**28**	**70**

X. ASSESSMENT METHODOLOGIES/TOOLS

Formative assessment (Assessment for Learning)	Summative Assessment (Assessment of Learning)
Each practical will be assessed considering - - 60% weightage to process and - 40% weightage to product Continuous assessment based on process and product-related performance indicators, and laboratory experience.	End-of-semester exam based on observations and recording of the particular experiments.

XI. 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	1	2	2	2	2	--	--	--	--
CO2	3	3	2	2	2	2	2	1	--	1	2
CO3	3	2	1	2	2	2	2	1	2	1	2
CO4	3	2	1	2	2	1	2	1	2	1	2
CO5	3	3	1	2	2	1	2	--	2	1	2

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

XII. SUGGESTED LEARNING MATERIALS/BOOKS

Sr. No	Author	Title	Publisher
1	Nag P K	Power Plant Engineering	McGraw Hill, New Delhi, 2017 ISBN: 978-9339204044
2	Gupta J.B.	A course in Electrical Power.	S. K Kataria and Sons, New Delhi. 2014, ISBN: 9789350143742
3	Mehta V.K., Rohit Mehta	Principles of Power System	S.Chand & Co. New Delhi, 2005, ISBN: 9788121924962
4	Sivanagaraju S.; Satyanarayana S.	Electrical Power Transmission and Distribution	Pearson ISBN: 8131707911, 9788131707913
5	Kamraju V.	Electrical Power Distribution System	Tata Mc.McGraw-Hill, New Delhi ISBN: 9780070151413

XII. LEARNING WEBSITES & PORTALS

Sr. No	Link/Portal	Description
1.	www.ntpc.co.in	National Thermal Power Corporation is the authority that controls India's Thermal Power Sector.
2.	https://www.powergrid.in	Power Grid Corporation of India Limited (POWERGRID), a Schedule 'A', 'Maharatna' Public Sector Enterprise of the Government of India.
3.	https://energy.gov/sites/prod/files/2013/07/f2/Transmission_Woodall_0.pdf	Transmission Line Basics
4.	https://www.electrical4u.com/performance-of-transmissionline/	Performance of Transmission Line

Name & Signature:

Shri. M.L. Bhagwat
Lecturer in Electrical Engineering

Smt. N.V.Devarkar
Lecturer in Electrical Engineering

(Course Experts)

Name & Signature:	Name & Signature:
Dr. S. S.Bharatkar (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	**MINI PROJECT**
COURSE CODE	**EE31207**
PREREQUISITE COURSE CODE & TITLE	**NO**
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	
EE31207	**MINI PROJECT**	**SEC**	--	--	**02**	--	**02**	**01**	--	--	--	--	--	**50**	**20**	**50@**	**20**	--	--	**100**

Total IKS Hrs. forSemester:0Hrs.

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, *#On Line Examination, @$-Internal Online Examination.

Note:

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

II. RATIONALE:

A mini project requires comparatively less time than major projects. They are comparatively simpler and have shorter duration. Mini Project helps students to explore and strengthen their understanding of fundamentals through practical application of theoretical concepts. Mini Project can help them to boost their skills and widen their horizon of thinking. It will act like a beginner's guide to undertake the major project/dissertation during the final year and will ensure preparedness of students to undertake major projects/dissertation. Students will be required to select the topic relevant to their specialization and that has value addition. The presentation should be done along with the report on the identification of the topic for the work and the methodology adopted involving scientific research, collection, and analysis of data, and determining solutions highlighting individuals' contributions

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: Illustrate how to identify needs and convert them into the problems.

CO2: Analyse the process of solving the problem in a group.

CO3: Justify the process of applying basic engineering fundamentals to attempt solutions to the problems.

CO4: Remember to utilize the self-learning and research in your projects

IV. THEORY LEARNING OUTCOMES AND ALIGNED COURSE CONTENT

NOT APPLICABLE

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 Select the relevant topic for mini project.	Select the Mini project topic	2	CO1
2	LLO 2.1 Finalize the relevant topic for mini project.	Finalized the mini project	2	CO1
3	LLO 3.1 Collection of literature through Literature survey	Literature survey of mini projects	2	CO4
4	LLO 4.1 Prepare a plan of mini project.	Develop a plan of mini projects	2	CO4
5	LLO 5.1 Prepare a of estimation and costing of mini project.	Estimation and Costing of the mini projects	2	CO2
6	LLO 6.1 Prepare a block diagram of a mini project	Draw a block diagram of mini projects	2	CO2
7	LLO 7.1 Prepare a circuit diagram of a mini project also collect and select of Raw material of a mini project	Draw the circuit diagram and selection of raw materials of mini projects	2	CO2
8	LLO 8.1 Design a circuit diagram of a mini project.	Test the circuit diagram of identified mini project	2	CO2
9	LLO 9. Illustrate of mini projects part I	Perform the Experimentation of mini projects part I	2	CO3
10	LLO 10. Illustrate of mini projects part II	Perform the Experimentation of mini projects part II	2	CO3
11	LLO 11. Evaluate the observation, Results, Conclusion of mini projects	Write observation, Results and Conclusion of mini projects	2	CO3
12	LLO 12.1 Develop the report related to mini project.	Write the report on mini projects	2	CO3
13	LLO 13.1 Prepare a report based on mini project	Finalized the mini project report.	2	CO3
14	LLO 14.1 Prepare a presentation based on mini project	Make a mini project presentation	2	CO3

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

Micro project:

Mini projects Titles (Perform any one of the following)

1) Solar panel with sun position tracking
2) RPM Display for BLDC motor with speed control
3) Home and Industrial Safety using fire and gas detection system
4) Power supply with Auto Switching
5) Clap-based fan-switching system
6) Design of windmill
7) Design a Solar system to supply a room (only lighting load)
8) Battery Charger
9) Substation Model
10) Model of Switchgear Devices
11) Water level indicator with alarm
12) Design of PM Generator
13) Transformer overload protection
14) Speed control of Induction motor using any one control method
15) EV working model
16) Electrical lab Maintenance as per the mentor instruction

(Other than the suggested mini-project topics, Students can also select one electrical engineering branch related mini project under the guidance of the mentor . A Maximum of seven students are allowed in each group)

- **Suggestion content of the mini-project reports**

- Title page (With individual name and mentor teacher)
- Certificate
- Acknowledgement
- Abstract
- Content page

Chapters

Chapter 1 :- Introduction
Chapter 2 :- Literature survey
Chapter 3:- Scope of mini projects
Chapter 4:- Methodology
Chapter 5:- Details of the design, working and processes
Chapter 6:- Results and Application
Chapter 7:- Conclusion & Future scope

- **Mini project Diary: -**

Mini project duration (Mention dates)

1) Activity planned
2) Activity Executed
3) Reason for delay if any
4) Corrective measures adopted
5) Remark and Signature of guide

- **Instruction for students: -**

1) The reports should be neatly typed on white A4 size paper. The typing should be of normal spacing and only on one side of the paper.
2) Use font Times New Roman, for the title font size 14 for normal typing font size 12.
3) A project work approval sheet by mentor in the form of a certificate, duly signed, should be included.
4) Follow all the instructions given by the mentor from time to time.

- **Submission of Mini Project report: -**

The students should submit a detailed report based on his/ her mini-project work at the time of submission. It should include relevant circuits, diagrams, graphs, Specification sheets etc. Mentor will able to talk about the content addition to relative mini projects.

VII. LABORATORY EQUIPMENT/INSTRUMENTS/TOOLS/SOFTWARE REQUIRED

NOT APPLICABLE

VIII. SUGGESTED FOR WEIGHTAGE TO LEARNING EFFORTS & ASSESSMENT PURPOSE

Sr. No.	Criteria	Marks
1	Mini project proposal / Identification	10
2	Punctuality and overall performance	
3	Mini Project Diary / Daily Performance Report	
4	Execution of plan during the semester	20
5	Project report including documentation	15
6	Presentation	05
	Total	**50**

IX. ASSESSMENT METHODOLOGIES/TOOLS

Formative assessment (Assessment for Learning)	Summative Assessment (Assessment of Learning)
Assignment, Self-learning, and Terms work Seminar/Presentation	----------

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	--	2	2				
CO2	2	--	--	2	--	2	2				
CO3	2	--	--	2	--	2	2				
CO4	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
1	S.K. Bhattacharya and S. Chatterjee	Projects in Electrical, Electronics, instrumentation, and Computer Engineering.	S. Chand publication ISBN: 81-219-3090-1
2	Nikhil Shukla	Electrical and Electronics projects	V&S Publisher ISBN: 9789350578339, 9789350578339
3	Nikhil Shukla	Electrical projects for beginners	V&S Publisher ISBN: 13-9789350578322 ISBN:10- 9789350578322

XII. LEARNING WEBSITES & PORTALS

Sr.No.	Link/Portal	Description
1	https://nevonprojects.com	Provide the Electrical based projects and mention the procedure to make mini projects
2	https://elprocus.com	To get electrical project ideas on the latest topics
3	https://electricalprojectsguide.com	Various electrical projects provided and some research work for reference
4	https://eeweb.com	Provide the Electrical based mini project with explanation

Name & Signature:

Dr. S.S. Bharatkar
HOD in Electrical Engg.

Shri. Ravi B. Chauthmal
Lecturer in Electrical Engg.

(CourseExperts)

Name &Signature:-

Dr. S.S.Bharatkar
(Program Head)

Name & Signature:

Shri. S.B. Kulkarni
(CDC In Inharge)

GOVERNMENT POLYTECHNIC, PUNE

'120 – NEP' SCHEME

PROGRAMME	**DIPLOMA IN ELECTRICAL ENGINEERING**
PROGRAMME CODE	**02**
COURSE TITLE	**FUNDAMENTAL OF POWER ELECTRONICS**
COURSE CODE	**EE41201**
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	
EE41201	FUNDAMENTAL OF POWER ELECTRONICS	DSC	3	--	4	1	8	4	3	30	70	100	40	25	10	25@	10	25	10	175

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:

Power Electronics finds extensive applications in domestic, commercial, industrial front and electric utilities particularly in terms of efficient conversion, control and conditioning of electric power from its available input into the desired electrical output form. This course will enable the diploma students to develop the knowledge and skillsets of operating and testing different power electronic devices and their applications.

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

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

- CO1 - Test the functionality of a given power electronic device.
- CO2 - Test the switching performance of thyristors.
- CO3 - Test the performance of the given controlled converter.
- CO4 - Test the performance of the given chopper.
- CO5 - Use a suitable power electronic circuit for a given 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 POWER ELECTRONIC DEVICES (CL Hrs-08, MARKS-12)				
1	TLO 1.1 Illustrate the power electronic system using a block diagram. TLO 1.2 Solve simple numerical losses in the given switch. TLO 1.3 Explain the general characteristics of the given power electronic switch. TLO 1.4 Describe the construction of the given power electronic device. TLO 1.5 Explain the working principle of the given power electronic device. TLO 1.6 State the applications of the given power electronic device.	Unit - I Power Electronic Devices 1.1 Power electronic system: general block diagram, need, advantages and disadvantages 1.2 Switching in power electronic circuit: Need and its importance; Ideal switch and practical switch: concept, general characteristics, conduction losses, switching losses 1.3 SCR: Construction, working principle, Static V-I characteristics, switching characteristics, and applications 1.4 IGBT: Construction, working principle, Static V-I characteristics, switching characteristics, and applications 1.5 Power MOSFET: Construction, working principle, Static V-I characteristics, and applications 1.6 TRIAC: Construction, working principle, Static V-I characteristics, and applications	Lecture Using Chalk-Board Demonstration Video presentations	**CO1**
UNIT - II PROTECTION AND FIRING CIRCUIT OF THYRISTOR (CL HRS-11, MARKS-18)				
	TLO 2.1 Explain the need for the given protection for SCR TLO 2.2 Describe the given protection scheme of SCR TLO 2.3 Explain the given turn-on method of SCR TLO 2.4 Illustrate the given firing circuit of SCR TLO 2.5 Explain the given commutation technique of SCR	2.1 di/dt protection: need, a snubber circuit 2.2 dv/dt protection: need, snubber circuit 2.3 Overvoltage protection: need, internal & external overvoltage, voltage clamping device 2.4 Overcurrent protection: need, electronic crowbar circuit 2.5 Thermal Protection of SCR: Need, thermal resistance, and heat sink specification 2.6 Firing circuit: Features and general layout of firing scheme 2.7 SCR turn-on methods: forward voltage triggering, gate triggering, dv/dt triggering, temperature triggering, and light triggering 2.8 SCR Firing circuit: resistance firing circuit (no derivation), RC firing circuit (no derivation), pulse transformer-based triggering 2.9 SCR commutation techniques: load commutation(Class A), line commutation (Class F)	Lecture Using Chalk-Board Demonstration Video presentations	**CO2**

UNIT-III CONTROLLED CONVERTERS (CL HRS-14, MARKS-22)				
	TLO 3.1 Define the given term(s) related to the controlled converter. TLO 3.2 Illustrate the working of the given single-phase controlled rectifier. TLO 3.3 Derive equation of DC output voltage of the given controlled converter. TLO 3.4 Compare voltage source inverter and current source inverter based on the given criteria. TLO 3.5 Explain the working of the given single-phase inverter. TLO 3.6 Explain the working principle of sinusoidal pulse width modulation.	3.1 Basic terminologies: conduction angle, firing angle, output voltage, output current, voltage across switch, source current, source voltage 3.2 Single phase half wave controlled rectifier with R, RL load: Circuit diagram, working, input-output waveforms, derivation for average output voltage, equations for output currents, voltages & power, and effect of freewheeling diode 3.3 Single phase full wave controlled bridge rectifier with R, RL load: Circuit diagram, working, input-output waveforms, derivation for average output voltage, equations for output currents, voltages & power 3.4 Three-phase full wave controlled bridge rectifier: working principle with R load, input-output waveforms 3.5 Inverters: the concept of voltage source inverter and current source inverter 3.6 Single phase half wave bridge inverter with R, RL load: Circuit diagram, working, input-output waveforms 3.7 Single phase full wave bridge inverter with R, RL load: Circuit diagram, working, input-output waveforms 3.8 Pulse width modulation: importance/need, types; Sinusoidal pulse width modulation: concept, working principle and waveforms	Lecture Using Chalk-Board Demonstration Video presentations	**CO3**
UNIT - IV DC-DC CONVERTERS (CL HRS-07, MARKS-10)				
	TLO 4.1 Explain the given terminology related to chopper. TLO 4.2 Explain the control strategies of the chopper. TLO 4.3 Illustrate the working of the given chopper. TLO 4.4 Calculate the output voltage of the given chopper	4.1 Basic terminologies: duty ratio, turn-on period, turnoff period, chopping period 4.2 Control strategies of the chopper: Constant frequency system, variable frequency system 4.3 Step up chopper: circuit diagram, working, waveforms and output voltage equation 4.4 Step-down chopper: circuit diagram, working, waveforms and output voltage equation 4.5 Buck-Boost chopper: circuit diagram, working, waveforms and output voltage equation.	Lecture Using Chalk-Board Demonstration Video presentations	**CO4**

UNIT- V APPLICATIONS OF POWER ELECTRONICS (CL HRS-05, MARKS-08)				
	TLO 5.1 Explain the operation of the charge controller used in the photovoltaic (PV) system. TLO 5.2 Explain the speed control of the ceiling fan using TRIAC. TLO 5.3 Explain AC to AC converter used in Wind Power Generation. TLO 5.4 Explain the function of the converter station in HVDC	5.1 Charge Controller: Concept, types, applications in Photovoltaic (PV) system with block diagram 5.2 Speed control of ceiling fan using TRIAC: Working, Block Diagram, advantages 5.3 AC to AC converter using DC link: Concept, applications in Wind Power Generation 5.4 HVDC converter station: Concept, Circuit Diagram	Lecture Using Chalk-Board Demonstration Video presentations	**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 1.1 Identify the given power electronic device	Power Electronic Devices.	2	CO1
2	LLO 2.1 Test the performance of SCR.	Experiment to plot the V –I characteristics of forward-biased SCR for different gate currents	2	CO1
3	LLO 3.1 Test the proper functioning of the power MOSFET.	Testing of power MOSFET	2	CO1
4	LLO 4.1 Test the proper functioning of the IGBT.	Testing of IGBT	2	CO1
5	LLO 5.1 Test the proper functioning of the TRIAC	Testing of TRIAC.	2	CO1
6	LLO 6.1 Test the performance of the Snubber circuit.	Performance of Snubber circuit.	2	CO2
7	LLO 7.1 Test the effect of variation of resistance in the R triggering circuit on the firing angle of SCR.	Resistance triggering circuit of SCR.	2	CO2
8	LLO 8.1 Test the effect of variation of resistance and capacitance in RC triggering circuit on the firing angle of SCR.	RC triggering circuit of SCR	2	CO2
9	LLO 9.1 Perform the triggering of SCR using the Pulse transformer	Triggering of SCR using Pulse transformer	2	CO2
10	LLO 10.1 Perform the operation of the Class A commutation circuit	Class A (Load Commutation) commutation circuit.	2	CO2
11	LLO 11.1 Perform the operation of the Class F commutation circuit	Class F (Line Commutation)commutation circuit	2	CO2
12	LLO 12.1 Measure output voltage of single phase half wave controlled rectifier by using CRO/DSO. LLO 12.2 Use various controls of the CRO	Operation of single phase half wave controlled rectifier with resistive load	2	CO2

Sr. No	Practical/Tutorial/Laboratory Learning Outcome (LLO)	Laboratory Experiment / Practical Titles/Tutorial Titles	Number of hrs.	Relevant COs
13	LLO 13.1 Measure output voltage of single phase half wave controlled rectifier by using CRO/DSO. LLO 13.2 Use various controls of the CRO	Operation of single phase half wave controlled rectifier with RL loads without freewheeling diode.	2	CO2, CO3
14.	LLO 14.1 Measure output voltage of single phase half wave controlled rectifier by using CRO/DSO. LLO 14.2 Use various controls of the CRO	Operation of single phase half wave controlled rectifier with RL load with freewheeling diode	2	CO2, CO3
15	LLO 15.1 Measure output voltage of single phase full wave controlled rectifier by using CRO/DSO. LLO 15.2 Use various controls of the CRO	Operation of single phase full wave controlled rectifier with R load.	2	CO2, CO3
16	LLO 16.1 Measure output voltage of single-phase full wave controlled rectifier by using CRO/DSO. LLO 16.2 Use various controls of the CRO/DSO	Operation of single phase full wave controlled rectifier with RL load.	2	CO2, CO3
17	LLO 17.1 Measure the output voltage of three three-phase full wave-controlled rectifiers by using CRO/DSO. LLO 17.2 Use various controls of the CRO/DSO	Operation of three phase full wave controlled rectifier with R load	2	CO2 CO3
18	LLO 18.1 Measure the output voltage with different firing angles of the controlled rectifier available in your laboratory	Voltage control using a controlled rectifier	2	CO2, CO3
19	LLO 19.1 Measure output voltage of single phase half wave bridge inverter by using CRO/DSO. LLO 19.2 Use various controls of the CRO/DSO	Operation of single phase half wave bridge inverter with resistive load	2	CO2, CO3
20	LLO 20.1 Measure output voltage of single phase full wave bridge inverter by using CRO/DSO. LLO 20.2 Use various controls of the CRO/DSO	Operation of single phase full wave bridge inverter with resistive load	2	CO2, CO3
21	LLO 21.1 Measure output voltage of single phase half wave bridge inverter by using CRO/DSO. LLO 21.2 Use various controls of the CRO/DSO	Operation of single phase half wave bridge inverter with RL load.	2	CO2, CO3
22	LLO 22.1 Measure output voltage of single phase full wave bridge inverter by using CRO/DSO. LLO 22.2 Use various controls of the CRO/DSO	Operation of single phase full wave bridge inverter with RL load	2	CO2, CO3
23	LLO 23.1 Measure the output voltage of the chopper by varying duty cycles. LLO 23.2 Use various controls of the CRO/DSO	Operation of step-up chopper	2	CO2, CO4
24	LLO 24.1 Measure the output voltage of the chopper by varying duty cycles. LLO 24.2 Use various controls of the CRO/DSO	Operation of step-down chopper	2	CO2, CO4
25	LLO 25.1 Test the performance of the charge controller in the PV system.	Charge controller in PV system	2	CO4, CO5
26	LLO 26.1 Observe the operation of AC to AC converter (with DC link). LLO 26.2 Interpret the input and output profile of the AC to AC converter (with DC link).	Demonstration of AC to AC converter(with DC link) used in wind power plant	2	CO3, CO4, CO5
27	LLO 27.1 Control the speed of the fan using TRIAC.	Speed control of fan using TRIAC	2	CO3, CO5

Perform any 20 Practical. All CO's should be covered in the 20 Practical.

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

Micro project

i) Build a power electronic circuit to produce variable voltage for a given application using the following steps.

1) Identify the voltage range for a given application.
2) Select circuit components suitable for the identified voltage range.
3) Connect circuit components to build a power electronic circuit controlling voltage.
4) Test the circuit for the production of variable voltage.
5) Prepare a report on the circuit built and submit the same.

ii) Prepare a report on commercial or industrial applications of power electronics devices by performing the following activities.

1) Identify 3 to 5 relevant applications.
2) Visit the site and understand the role of power electronic devices in identified applications.
3) Write the specifications of major components in the applications.
4) Prepare a block diagram or process flow diagram of the applications.

iii) Prepare a report on the ratings/specifications and applications of various power electronic devices.

1) Select any 3 to 5-power electronic devices.
2) Visit manufacturers' sites or official websites of power electronic device manufacturers and note the specifications or ratings of the selected power electronic devices.
3) Compare selected power electronics devices based on collected information along with their applications.

iv) Build a circuit of charge controller for a given battery using the following steps.

1) Write the specifications of a given battery.
2) Select circuit components required for the charge controller circuit suitable for the given battery.
3) Connect circuit components to build a charge controller.
4) Test change controller for controlling power flow through the battery.
5) Prepare a report on the charge controller and submit the same.

Any other relevant micro project assigned by the subject teacher.

Assignment

- Numerical on losses in power electronic device.
- Prepare a report on the evolution of power electronic devices.
- Numerical on the output voltage of given controlled converter.
- Numerical on DC output voltage of given chopper.
- Prepare a report on testing the performance of GTO.
- Any other relevant assignment was given by the subject teacher.

VII. LABORATORY EQUIPMENT/INSTRUMENTS/TOOLS/SOFTWARE REQUIRED

Sr. No	Equipment Name with Broad Specifications	Relevant LLO Number
1	Multimeter: 2000 count digital display, 1000V DC/750 V AC ranges, 10 A AC/DC ranges	ALL
2	Power MOSFET: Vds-400V, ID-10A-6.3A Pd-125W	1,3,23,24
3	SCR: Irms = 16A, IH = 100mA, IL = 200mA, IGT = 90 to 35 mA,VGT = 3 to 1 V, Vrms = 1600V	1,2,6,7,8,10,11, 9,12,13,14,15,1 6,17,18
4	IGBT: Vces = 1200V, VGE = 20V, IC = 139 to 93A, PD = 650 to300W	1,4,19,20,21,22
5	Rheostat: Nichrome wire, 300ohm, 10A, 400V	12,13,14,15,16, 17,19,20,21,22
6	Variable inductive load: Single phase,250V, 2.5kW continuously variable core type	12,13,14,15,16, 17,19,20,21,22
7	CRO/Digital Oscilloscope with probes: 20MHz, dual channel, sensitivity = 1mV/div., Max Input = 400V, Power supply =230VAC.	12,13,14,15,16, 17,19,20,21,22
8	Clamp-on meter: Current = 0 to 400A, Voltage = 0 to 600V	2,3,4,5,25,27
9	AC and DC Ammeter: Range = 0 to 20A, Sensitivity = 0.5A/div	25,27
10	AC and DC Voltmeter: 0 to 300V, Sensitivity = 1V/div.	25,27
11	TRIAC: It = 4A, IGT = 10mA, Vt = 600V.	1,5

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	POWER ELECTRONIC DEVICES	CO1	8	2	6	4	12
2	II	PROTECTION AND FIRING CIRCUIT OF THYRISTOR	CO1,CO2	11	4	10	4	18
3	III	CONTROLLED CONVERTERS	CO2,CO3	14	2	14	6	22
4	IV	DC-DC CONVERTERS	CO2,CO4	7	2	4	4	10
5	V	APPLICATIONS OF POWER ELECTRONICS	CO3,CO4,CO5	5	2	4	2	8
Grand Total				**45**	**12**	**38**	**20**	**70**

IX. ASSESSMENT METHODOLOGIES/TOOLS

Formative assessment (Assessment for Learning)	Summative Assessment (Assessment of Learning)
Each practical will be assessed considering - - 60% weightage to process and - 40% weightage to product Continuous assessment based on process and product-related performance indicators, and laboratory experience.	End-of-semester exam based on observations and recording of the particular experiments.

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**	1	**--**	**--**	**--**
CO2	**3**	**2**	**1**	**2**	**--**	**--**	**2**	**--**	1	**--**	1
CO3	**3**	**2**	**2**	**2**	**--**	**1**	**2**	**--**	1	**--**	**--**
CO4	**3**	**2**	**2**	**2**	**--**	**1**	**2**	1	1	1	**--**
CO5	**2**	**3**	**2**	**2**	**2**	**2**	**2**	**--**	1	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	Muhammad H. Rashid	Power Electronics Handbook	Butterworth-Heinemann Inc, ISBN:978-0128114070
2	P S. Bimbhra	Power Electronics	KHANNA PUBLISHERS, ISBN:978-8174092793
3	Muhammad H. Rashid	Power Electronics: Devices, Circuits, and Applications	Pearson Education, ISBN:978-8120345317
4	M D Singh, K B Khanchnadani	Power Electronics	McGraw Hill Education, ISBN:9780070583894

XII. LEARNING WEBSITES & PORTALS

Sr. No	Link/Portal	Description
1.	https://nptel.ac.in/courses/108102145	Course on Power Electronics by IIT Delhi
2.	https://nptel.ac.in/courses/108105066	Course on Power Electronics by IIT Kharagpur
3.*	https://nptel.ac.in/courses/108101038	Course on Power Electronics by IIT Bombay
4.	https://ocw.mit.edu/courses/6-334-power-electronics-spring-2007/	Course on Power Electronics by MIT Open courseware
5.	https://www.youtube.com/playlist?list=PL4emuJKx0B8aREwkC5BEOw2OZ48puPyOG	Videos on Power Electronics
6.	https://3dcircuits.engineering.dartmouth.edu/powani.html	Animation on Chopper and Rectifier

Name & Signature:

Smt. A. A. Patole
Lecturer in Electrical Engineering

Smt N.V.Devarkar
Lecturer in Electrical Engineering

(Course Experts)

Name & Signature:	Name & Signature:
Dr. S. S.Bharatkar (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 SAFETY**
COURSE CODE	**EE41204**
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	
EE41204	ELECTRICAL SAFETY	DSC	2	--	--	--	2	1	1	15	35*#	50	20	--	--	--	--	25	10	75

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:

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

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

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

CO1- Describe the terms related to electrical safety.
CO2. Identify the type of electrical hazard, causes & effects.
CO3. Follow various safe working practices to be adopted while working as per electrical safety standards/ norms & statutory provisions.

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 BASICS OF ELECTRICAL SAFETY (CL Hrs-10, Marks-13)			
1.	**TLO1.1** Explain the importance of electrical safety. **TLO1.2** Explain the issues (statistics associated) with poor electrical safety in the workplace. **TLO1.3** Define key electrical terms which are essential to understanding	**1.1 Electrical Safety:** Introduction To Electrical Safety, Hazard, Shocks And Their Prevention. **1.2**. Introduction To Electrical Safety, Shocks And Their Prevention. The safe limit of current and voltage. **1.3.** Circuit protection devices. Overloading in an electrical circuit. Overhead lines, static electricity, Hazards from static electricity and prevention. **1.4** CEA (Central Electricity Authority), BIS, IEC, IEEE, NFPA, CEI, EI, Electricity Act, Regulations.	Chalkboard Demo video Presentation	**CO1**
	UNIT - II ELECTRICAL SAFETY IN RESIDENTIAL, COMMERCIAL AND INDUSTRIAL INSTALLATIONS (CL HRS-10, MARKS-12)			
2.	**TLO2.1** Describe safety provisions in Residential, Commercial and Industrial Installations **TLO2.2** Avoiding situations leading to hazards due to electric fire. **TLO2.3** Describe the effects of fire. **TLO2.4** Describe probable places prone to hazard due to electric fire.	**2.1**.water tap giving shock –shock from the wet wall – fan firing shock –multi-storied building –Temporary installations. Dos and Don'ts for safety in the use of domestic electrical appliances. **2.2** Fire Prevention. Fire triangle. Classification of fire .stages of fire. Causes of industrial fire. **2.3** Fire precaution through building design and construction. Fire detection. Automatic fire detection and alarm system. Optical detectors, smoke detectors, ionization type of detectors, thermal detectors, flame detectors. **2.4** fire extinguisher: I)fixed firefighting system II) portable fire extinguisher, soda acid type, dry chemical powder type, carbon dioxide type, foam type.	Chalkboard Demo video Presentation	**CO2**

UNIT – III PREVENTION AND SAFETY LAW (CL HRS-10, MARKS- 10)				
3.	**TLO3.1** Interpret how to implement safety measures for protection in different stages of working conditions such as domestic, industries, & other commercial workplaces. **TLO3.2 K**now the law related to safety. **TLO3.3** State various safe working practices to be adopted while working in industry or at residence **TLO3.4** Study Various Policies and Regulations.	**3.1 Safety in the use of hand tools:** Tool accident, safe practices, correct use of the tool. Safety in portable tools: precaution and care**.** **3.2** Personal protective equipment: parts human body needs protection,(hand, foot, head. eye, face, skin body, protection against fall, hearing, noise, respiratory protection.) **3.3** Law related to safety in the workplace: The people, The machine, The working conditions, The working facilities, and The working environment. **3.4** Accident appraisal system: reporting, recording, investigation and analysis. **3.5** Norms and standard, safety policy Emergency Control Plan. Emergency management plan. Work permit system **3.6** Principle of accident prevention, safety training, the role of supervisor achieving a high standard of safety. Safety suggestion scheme, safety committee, safety competition, contest, safety drive, exhibition, poster	Chalkboard Demo video Presentation	**CO3**

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

NOT APPLICABLE

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

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

1. Prepare the report on Fire Precautions in Residential Area.
2. Prepare the Fire Safety Precautions Against Electricity.
3. Prepare the Fire Protections in Industries.
4. Prepare the report on different types of fire extinguishers.
5. Prepare the report on Electrical safety act in India.
6. Prepare the report on safety drive.
7. Prepare the report on safety policy in Industries.

VII. LABORATORY EQUIPMENT/INSTRUMENTS/TOOLS/SOFTWARE REQUIRED

NOT APPLICABLE

VIII. SUGGESTED FOR WEIGHTAGE TO LEARNING EFFORTS & ASSESSMENT PURPOSE

Sr. No	Unit	Unit Title	Aligned COs	Learning Hours	R-Level	U-Level	A-Level	Total Marks
1	I	**BASICS OF ELECTRICAL SAFETY**	CO1	10	4	5	4	13
2	II	**TYPES OF HAZARDS AND THEIR EFFECTS**	CO2	10	4	4	4	12
3	III	**PREVENTION & SAFETY LAW**	CO3	10	4	2	4	10
			Grand Total	**30**	**12**	**11**	**12**	**35**

IX. ASSESSMENT METHODOLOGIES/TOOLS

NOT APPLICABLE

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**	**1**	**1**	**2**	**1**	**1**	**3**	**2**	**2**	**2**	**2**
CO2	**2**	**1**	**1**	**2**	**2**	**2**	**3**	**1**	**1**	**2**	**2**
CO3	**2**	**2**	**1**	**2**	**3**	**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
1	K.T.Kulkarni	Introduction to Industrial Safety	Pradish mudran
2	N.K.Tarafdar K.J.Tarafdar	Industrial safety Management	Dhanpat Rai & CO
3	Sunil S. Rao, R. K. Jain, H.L.Saluja	Electrical Safety, Fire Safety Engineering and Safety Management	Khanna Publication
4	D.R . Nagpal	Electrical Safety	Standard Publishers Distributors

XII. LEARNING WEBSITES & PORTALS

Sr. No	Link/Portal	Description
1.	https://www.esfi.org/	Electrical Safety, workplace safety, disaster safety
2.	https://www.nfpa.org/Public-Education/Fire-causes-and-risks/Top-fire-causes/Electrical	Fire & life safety
3.	https://www.lanl.gov/safety/electrical/docs/elec_hazard_awareness_study_guide.pdf	Hazard Awareness
4.	www.greenwgroup.co.in	Electrical Safety course
5	https://www.worksafe.qld.gov.au/laws-and-compliance/electrical-safety-laws	Electrical safety laws

Name & Signature:

Smt. N.V.Devarkar
Lecturer in Electrical Engineering

Smt. A.A.Patole
Lecturer in Electrical Engineering

(Course Experts)

Name & Signature:	Name & Signature:
Dr. S. S.Bharatkar (Programme 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	**INDIAN CONSTITUTION: CORE CONCEPTS AND VALUES**
COURSE CODE	**HU21203**
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 Practical				Based on LL & TSL Practical				Based on SL		Total Marks
			CL	TL	LL					FA-TH	SA-TH	Total		FA-PR		SA-PR		SLA		
										Max	Max	Max	Min	Max	Min	Max	Min	Max	Min	
HU21203	INDIAN CONSTITUTION : CORE CONCEPTS AND VALUES	VEC	1	--	--	1	2	1	--	--	--	--	--	--	--	--	--	50	20	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:

1. **FA-TH** represents an average of two class tests of 30 marks each conducted during the semester.
2. 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.
3. 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**
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:

Introducing a course on the Indian Constitution can provide students with a comprehensive understanding of the country's legal framework and democratic principles. Such a course could cover the historical context of its creation, the structure and functions of the government it establishes, and the fundamental rights and duties of citizens. It could also explore the significant amendments and judicial interpretations that have shaped its evolution over time. This foundational knowledge is not only for fostering informed and engaged citizens who can contribute to the nation's democratic processes but also enriches the educational experience by fostering a sense of national identity and ethical responsibility among future engineers. Furthermore, embedding Electoral Literacy and Voter Education in diploma engineering programs strategically empowers these future professionals with an awareness of their electoral privileges and the workings of democracy.

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: Foster comprehension of the fundamental principles and goals embedded in the Indian constitution.
CO2: Elaborate on the core rights and duties conferred upon Indian citizens by the Constitution.
CO3: Comprehend the distribution of legislative, executive, and financial powers between the Union and the States.
CO4: Understand the functioning of Indian democracy, encompassing its frameworks and mechanisms at local, state, and national levels.
CO5: Cultivate the skills and perspectives required for active participation in electoral processes, the conscientious exercise of voting rights, and the promotion of informed democratic participation within society.

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 INTRODUCTION TO INDIAN CONSTITUTION(CL Hrs-03, Marks-NIL)				
1.	**TLO 1.1** Understand the historical context and events leading to the drafting of the Indian Constitution. **TLO 1.2** Comprehend the essential features and understand the significance of the Indian Constitution in shaping India's democratic governance and societal ethos. **TLO 1.3** Analyze the vision and ideals articulated in the Preamble and their relevance in contemporary Indian society.	1.1 Historical background and making of the Indian Constitution 1.2 Salient features and significance of the Indian Constitution 1.3 Preamble: Vision and Ideals of the Indian Constitution	Presentations Case Studies and Analysis Role-Playing and Simulations Project-Based Learning	**CO1**
UNIT - II FUNDAMENTAL RIGHTS, FUNDAMENTAL DUTIES AND DIRECTIVE PRINCIPLES (CL Hrs-04, Marks-NIL)				
2	**TLO2.1** Understand the introduction and structure of Fundamental Rights in Part Ill of the Indian Constitution. **TLO2.2** Understand the principles of the Right to Equality, Right to Freedom, and Right to Life.	**2.1** Fundamental Rights: Introduction & its Scheme under Part -III **2.2** Right to Equality (Article 14-18) **2.3** Right to Freedom (Article 19-22) **2.4** Right to Life (Article 21) **2.5** Fundamental Duties and their Significance under Part IV-A **2.6** Directive Principles of State Policy under Part – IV: importance and	Presentations Case Studies and Analysis Role-Playing and Simulations Project-Based Learning	**CO2**

	TLO2.3 Identify fundamental duties in general and in particular with the engineering field. **TLO2.4**: Grasp the significance and practical application of Directive Principles of State Policy outlined in Part IV of the Indian Constitution.	implementation.		
UNIT- III UNION AND STATE EXECUTIVE(CL Hrs-03, Marks-NIL)				
3	**TLO 3.1** 3.1: Gain insight into the structure and functions of the Union executives and the jurisdiction of the Supreme Court. **TLO 3.2** 3.2: Understand the organization and responsibilities of the State Executives and the functions of the State Judiciary(High Courts).	**3.1** Union Government, Union Legislature (Parliament), Lok Sabha and Rajya Sabha (with Powers and Functions), Union Executive, President of India (with Powers and Functions), Prime Minister of India (with Powers and Functions), Union Judiciary (Supreme Court), Jurisdiction of the Supreme Court. **3.2** State Government, State Legislature (Legislative Assembly/ Vidhan Sabha, Legislative Council / Vidhan Parishad), Powers and Functions of the State Legislature, State Executive, Governor Of the State (with Powers and Functions), The Chief Minister Of the State (With Powers and Functions) State Judiciary (High Courts).	Presentations Case Studies and Analysis Role-Playing and Simulations Project-Based Learning	**CO3**
UNIT-IV AMENDMENTS AND EMERGENCY PROVISIONS(CL Hrs-03, Marks-NIL)				
4	**TLO 4.1** Comprehend the meaning and significance of constitutional amendments, as well as the procedural rules detailed in Article 368 of the Indian Constitution. **TLO 4.2** Recognize the roles of various branches of government in the amendment process, **TLO 4.3** Examine the significant procedures and historical context of major constitutional amendments	**4.1 Introduction to Constitutional Amendments:** Definition and significance of constitutional amendments. Constitutional provisions governing the amendment procedure (Article 368). **4.2 Types of Amendments:** Simple majority amendments, Special majority amendments, Amendments requiring ratification by states. **4.3 Role of the Executives Amendments**: Role of Parliament: Lok Sabha and Rajya Sabha, Role of President: Assent to amendments, Role of State Legislatures: Ratification of certain amendments. **4.4 Major Constitutional**	Presentations Case Studies and Analysis Role-Playing and Simulations Project-Based Learning	**CO4**

		Amendment procedures: Major Constitutional Amendment procedures - 1st, 7th,42nd, 44th, 73rd & 74th, 76th, 86th, 52nd & 91st, 102nd		
UNIT –V ELECTORAL LITERACY (CL Hrs-02, Marks-NIL)				
5	**TLO5.** Electoral Literacy: Develop understanding and proficiency in electoral processes, voter registration, rights and responsibilities of voters, electoral reforms, and initiatives promoting electoral literacy.	**5.1 Understanding the Electoral Process :** Overview of the electoral process: registration, voting, counting, and declaration of results, Role and functions of the Election Commission of India Types of elections: Lok Sabha, Rajya Sabha, State Legislative Assembly, Local Body elections **5.2 Voter Registration and Electoral Rolls:** Importance of voter registration Eligibility criteria for voter registration Process of voter registration: online, offline, and special drives Checking and updating voter details in electoral rolls **5.3 Rights and Responsibilities of Voters:** Understanding fundamental rights related to elections Responsibilities of voters towards ensuring free and fair elections Consequences of electoral malpractices and non-participation **5.4 Electoral Reforms and Initiatives:** Overview of electoral reforms aimed at enhancing transparency, inclusivity, and integrity of elections Role of technology in improving electoral processes: Voter Verifiable Paper Audit Trail (VVPAT), Online voter registration, e-voting Initiatives by the Election Commission and civil society organizations to promote electoral literacy	Presentations Case Studies and Analysis Role-Playing and Simulations Project-Based Learning	**CO5**

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

NOT APPLICABLE

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

i) **Case Study Analysis:** Select a few landmark Supreme Court cases related to Fundamental Rights (e.g., Kesavananda Bharati v. State of Kerala, Maneka Gandhi v. Union of India) and analyze the court's interpretation and impact on these rights.

ii) Comparative Analysis: Compare the provisions of the Right to Equality under Articles 14-18 with similar provisions in the constitutions of other countries. Highlight similarities, differences, and the reasoning behind them.

iii) Public Awareness Campaign: Design a public awareness campaign to educate citizens about their Fundamental Rights and Duties. Create informative posters, social media content, and interactive workshops to engage people in discussions about constitutional rights and responsibilities.

iv) Write a reflective essay discussing the historical context and debates surrounding the inclusion of Fundamental Rights in the Indian Constitution.

v) Create a visual timeline depicting the evolution of laws related to equality in India, from independence to the present day. Include major legislative reforms and judicial decisions.

vi) Conduct a comparative analysis of the implementation of Directive Principles in different states of India, identifying successful initiatives and areas needing improvement.

vii) **Case Study Analysis:** Choose a recent constitutional or political issue that has been debated in Parliament. Analyze the roles played by the Loksabha and Rajya Sabha in addressing the issue and the impact of their decisions.

viii) Case Study Analysis: Analyze a landmark constitutional amendment in India (e.g., the 42nd Amendment) and its impact on governance, fundamental rights, and the balance of power between different branches of government.

ix) **Infographic Creation:** Create an infographic illustrating the process of amending the Indian Constitution as outlined in Article 368. Highlight key steps and requirements for different types of amendments.

x**) Timeline Project:** Create a timeline highlighting major constitutional amendments in India, such as the 1st, 7th, 42nd, 44th, 73rd & 74th, 76th, 86th, 52nd & 91st, and 102nd amendments. Include key provisions and the political context surrounding each amendment.

xi) **Debate:** Organize a debate on the topic "Should the President have the power to refuse assent to constitutional amendments?" Encourage students to research and present arguments from legal, political, and ethical perspectives.

xi**) Campaign Design:** Design a social media campaign to raise awareness about the importance of voter participation and responsible voting. Create visually engaging posters, infographics, and videos highlighting the consequences of electoral malpractices and non-participation.

xii) **Online Tutorial:** Create a step-by-step tutorial video or guide demonstrating the voter registration process, both online and offline. Include instructions for checking and updating voter details in electoral rolls.

xiii**) Survey Project:** Conduct a survey to assess the awareness and accessibility of voter registration

facilities among different demographic groups in your locality. Analyze the results and propose strategies to improve voter registration rates.

VII. LABORATORY EQUIPMENT/INSTRUMENTS/TOOLS/SOFTWARE REQUIRED

NOT APPLICABLE

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)
Assignment, Self-learning and Terms work Seminar/Presentation	—

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
CO1	--	--	--	--	2	--	2		
CO2	--	--	--	--	3	--	2		
CO3	--	--	--	--	3	--	2		
CO4	--	--	--	--	3	--	2		
CO5	--	--	--	--	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	M. Laxmikanth	"Indian Polity"	McGraw Hill Education: ISBN-13: 978-9352603633
2	D. D. Basu	Introduction to the Constitution of India	LexisNexis: ISBN-13: 978-8180386477
3	Subhash C. Kashyap	Our Constitution: An Introduction to India's Constitution and Constitutional Law	National Book Trust, India ISBN-13: 78-8123748462
4	Arun K. Thiruvengadam	The Constitution of India: A Contextual Analysis	Oxford University Press ISBN-1 3:978-0199467078
5	Oxford University Press	The Making of India's Constitution	Oxford University Press Oxford University Press

XI. LEARNING WEBSITES & PORTALS

Sr.No.	Link/Portal	Description
1	https://prsindia.org/.	In-depth analysis of parliamentary affairs, legislative processes, and policy Issues in India.
2	https://awmin.gov.in	Official repository providing access to the full text of the Indian Constitution.
3	https://constitution.org.in	Interactive platform offering the text of the Constitution along with annotations and historical context.
4	https://indiankanoon.org	Legal search engine offering a vast database of Indian case law, including constitutional judgments.
5	https://nptel.ac.in	Offers video lectures and course materials on studies of law and the constitution.

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

GOVERNMENT POLYTECHNIC, PUNE

'120 – NEP' SCHEME

PROGRAMME	**DIPLOMA IN EE/ME/MT**
PROGRAMME CODE	**02/04/05**
COURSE TITLE	**FUNDAMENTALS OF PYTHON PROGRAMMING**
COURSE CODE	**ME41202**
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	
ME41202	FUNDAMENTALS OF PYTHON PROGRAMMING	AEC	1	-	2	1	4	2	--	--	--	--	--	25	10	25@	10	25	10	75

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:

Python's reputation as a powerful programming language is well-deserved. Its high-level data structures and object-oriented approach streamline complex software development, making it accessible for beginners and efficient for seasoned programmers. The simplicity and readability of Python code, alongside its intuitive nature, contribute to its widespread use in teaching computing and problem-solving concepts. Moreover, Python's elegant syntax and dynamic typing, combined with its interpreted nature, facilitate scripting and rapid application development across diverse fields and platforms, solidifying its position as a versatile tool in the developer's toolkit.

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: Acquire fundamental Python programming skills, empowering them to create simple scripts and grasp essential concepts including variables and data types.

CO2: Develop Python programs using control flow statements.

CO3: Perform operations on various data structures in Python.

CO4: Develop functions, and modules to solve given problems using Python.

CO5: Represent data visually using a wide range of charts, plots, and graphs, including bar charts, line plots, scatter plots, and histograms.

THEORY LEARNING OUTCOMES AND ALIGNED COURSE CONTENT

Sr. No	Theory Learning Outcomes (TLO's) aligned to COs.	Learning content mapped with TLO's.	Suggested Learning Pedagogies	Relevant COs
	UNIT-I INTRODUCTION TO PYTHON			
1.	**TLO 1.1** Explain the given features of Python. **TLO 1.2** Write a Python program to perform basic input-output operations. **TLO 1.3** Write a Python program to solve a given expression. **TLO 1.4** Implement the given decision-making statements and looping statements in the Python program.	**1.1 Introduction:** Features, History and Applications of Python, Python IDE's **1.2 Python Environment Setup:** Installation and working of IDE **1.3 Python building blocks:** Indentation, Identifiers, Variable, Comments, Keywords. **1.4 Python Data Types:** Numbers, String, Tuples, Lists, Dictionary. Declaration and use of data types. **1.5 Basic input-output operations:** input(), print(). **1.6** Running Simple Python scripts to display the given text messages.	Chalk-Board, Demonstration Presentations, Hands-on	**CO1**
	UNIT-II PYTHON OPERATORS AND CONTROL FLOW STATEMENTS			
2	**TLO 2.1** Write a simple Python program for the given arithmetic expressions. **TLO 2.2** Write a Python program to manipulate tuples. **TLO 2.3** Write a Python program to manipulate sets. **TLO 2.4** Write a Python program to manipulate dictionaries.	**2.1 Operators:** Arithmetic, Relational, Assignment, Logical, Bitwise, Membership and Identity Operator. **2.2 Control flow statements:** **2.2.1** Conditional Statements (if, if ... else, nested if) **2.2.2** Looping in Python (while loop, for loop, nested loops) **2.2.3** loop manipulation using continue, pass, break, or else.	Chalk-Board Demonstration Presentations, Hands-on	**CO2**
	UNIT- III DATA STRUCTURES IN PYTHON			
	TLO 3.1 Write a Python program to use and manipulate lists for the given problem **TLO 3.2** Write a Python program to use and manipulate Tuples for the given problem **TLO 3.3** Write a Python program to use and manipulate Sets for the given problem **TLO 3.4** Write a Python	**3.1 Lists:** Defining Lists, Accessing values in lists, deleting values from lists, updating lists. Basic List Operations, Built-in List Functions. **3.2 Tuples:** Accessing values in Tuples, deleting values from Tuples and updating Tuples. Basic Tuple operations, Built-in Tuple Functions. **3.3 Sets:** Accessing values in Set, deleting values from Set and updating Sets. Basic Set operations, Built-in Set Functions. **3.4 Dictionaries:** Accessing values in Dictionary, deleting values from Dictionary	Chalk-Board Demonstration Presentations, Hands-on	**CO3**

	program to use and manipulate Dictionaries for the given Problem	and updating Dictionary. Basic Dictionary operations, Built-in Dictionary Functions.		
UNIT-IV PYTHON FUNCTIONS, MODULES				
3	**TLO 4.1** Write relevant user-defined functions for the given problem. **TLO 4.2** Write a relevant user-defined module for the given problem. **TLO 4.3** Write packages for the given problem	**4.1 Use of Python built-in functions** (e.g. type/data conversion functions, math functions etc.). **4.2 User-defined functions:** Function definition, Function call, function arguments and parameter passing, return statement, scope of variable: Global variable and Local variable. **4.3 Modules:** Writing modules, importing modules, importing objects from modules, python built-in modules, (e.g. Numeric and mathematical module, Functional programming module), Namespace and Scoping.	Chalk-Board Demonstration Presentations, Hands-on	**CO4**
UNIT–V GRAPHICS HANDLING IN PYTHON				
5	**TLO 5.1** Proficient in using Python libraries such as Matplotlib and Plotly for creating static and interactive visualizations. **TLO 5.2** Representing data visually using various types of charts, plots, and graphs, including bar charts, line plots, scatter plots, histograms, and more **TLO 5.3** Customizing and styling visualizations to enhance readability, including adjusting colours, fonts, labels, axes, legends, and annotations.	5.1 Introduction to Graphics handling in Python involves various libraries and tools for creating, manipulating, and displaying graphical content. **5,2 Matplotlib:** Matplotlib is a comprehensive library for creating static, interactive, and animated visualizations in Python. It provides a MATLAB-like interface and supports a wide range of plot types, including line plots, scatter plots, bar charts, histograms, and more. **5.3 Plotly:** Plotly is a library for creating interactive plots and dashboards in Python. It supports a wide range of plot types, including scatter plots, line plots, bar charts, 3D plots, and more. **5.4 Numpy:** NumPy is a fundamental package for scientific computing with Python. It provides support for large, multi-dimensional arrays and matrices, along with a collection of mathematical functions to operate on these arrays efficiently.	Chalk-Board Demonstration Presentations, Hands-on	**CO5**

IV. 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** Install the given Python IDE.	Install the given Python IDE.	2	CO1
2	**LLO 2.1** Write a Python program for performing basic input and output operations in a given problem.	1. Write a Python program to display a welcome message on the screen. 2. Implement the Python program to read data from the user and display data on the screen. **Practical Tasks:** i) Write a Python program to display a welcome message on the screen. ii) Write a Python program to read data from the user and then print it on the screen.	2	CO1
3	**LLO 3.1** Write a Python program to solve a given expression.	Implement a Python program using the following operators: 1. Arithmetic 2. Relational & Logical 3. Assignment 4. Bitwise 5. Membership 6. Identity **Practical Tasks ((ANY ONE)** i) Write down a Python program which will find the average (Percentage) of marks in three subjects. ii) Write down a Python program which will ask two numbers to the user, store them in two variables a and b then interchange their values. iii) Write a Python program to find Gross salary when basic is entered. Gross Salary = Basic + HRA+DA. (Given HRA=15% of basic, DA=25% of basic)	2	CO2
4	**LLO 4.1** Write a Python program for solving a given problem using various If statements. Implement a Python program to demonstrate the use of the following conditional	Implement a Python program to demonstrate the use of the following conditional statements: 1. if statement 2. if..else statement	2	CO2

	statements: 1. if statement 2. if..else statement 3. if..elif..else statement 4. nested if statement	3. if..elif..else statement 4. nested if statement **Practical Tasks: (ANY TWO)** i) Write a program to find out if any integer is input through the keyboard. whether it is an odd number or an even number. ii) Write a program to determine whether the year is a leap year or not for any year is input through the keyboard. iii) Write down a program to find the biggest of three numbers. iv) Write a program to check whether a triangle is valid or not, when the three angles of the triangle are entered through the keyboard. v) If the three sides of a triangle are entered through the keyboard, write a program to check whether the triangle is an isosceles, equilateral, scalene or right-angled triangle. vi) Percentage marks obtained by a student are input through the keyboard. The student gets a division as per the following rules: 1) Percentage above or equal to 60 - First division 2) Percentage between 50 and 59 - Second division 3) Percentage between 40 and 49 - Third division 4) Percentage less than 40 - Fail Write a program to calculate the division obtained by the student.		
5	**LLO 5.1** Write a Python program for solving given problems using a while loop. **LLO 5.2** Write a Python program for solving a given problem using a for loop.	Implement a Python program to showcase the utilization of the following looping statements: 1. while loop 2. for loop 3. nested loop **Practical Tasks: (ANY TWO)** i) Program to find the factorial value of	2	CO2

		any number entered through the keyboard. ii) Program to print all prime numbers from 1 to 100. iii) Program to print the first 25 odd numbers. iv) The program calculates and prints the sum of the digits of the number input through the keyboard. v) Program to calculate the sum of all numbers from 1 to a given number. vi) Program to calculate the sum of all the odd numbers within the given range. vii) Program to count the total number of digits in a number. viii) Program to print all the even numbers within the given range.		
6	**LLO 6.1** Use loop control statements in Python to solve a given problem.	Implement a Python program to showcase the application of loop control statements, including continue, pass, break, and else. **Practical Tasks: (ANY TWO)** i) Write a program that continuously prompts the user to enter a password until the correct password is entered. If the entered password is correct, it prints a message and exits the loop. Otherwise, it displays an error message and continues prompting for the password. (Hint: use break) ii) Write down a program to find whether a given number is prime or not. (Hint: use break and if..else) iii) Write down a program which will repeatedly accept a number and display its square root till the user enters 0. (Hint: Use break and continue)	2	CO2
7	**LLO 7.1** Write a Python program to perform operations on a list.	Implement a Python program to showcase different list operations including appending elements, inserting elements at specific positions, removing elements, reversing the list, sorting the list, finding the index and count of elements, and clearing the list.	2	CO3

		Practical Tasks:(ANY ONE) i) Write a program to perform the following operations on a list of names. a) Create a list of 5 names - 'Anil', 'Amol', 'Aditya', 'Avi', 'Alka' b) Insert the name 'Anuj' before 'Aditya' c)Append the name 'Zulu' d)Delete 'Avi' from the list -e)Replace 'Anil' with 'AnilKumar' Alka' f) Sort all the names in the list g) Print reversed sorted list ii) Write a program to perform the following operations on a list of numbers. a) Create a list of 5 odd numbers b) Create a list of 5 even numbers c) Combine the two lists d) Add prime numbers 11, 17, and 29 at the beginning of the combined list e) Report how many elements are present in the list f) Replace the last 3 numbers in the list with 100, 200, 300 g) Delete all the numbers in the list h) Delete the list iii) Suppose a list contains positive and negative numbers. Write a program to create two lists—one containing positive numbers and another containing negative numbers.		
8	**LLO 8.1** Write a Python program to perform operations on a tuple.	Implement a Python program to illustrate various operations on a tuple, such as accessing elements, slicing, concatenating, repeating, determining length, checking element existence, finding index, counting occurrences, and converting between tuple and list. **Practical Tasks:(ANY ONE)** i) Given the following tuple ('F', 'a', 'b', 'b', 'e', 'r', 'g', 'a', Is', 't', 'd')	2	CO3

		Write a Python program to carry out the following operations: a) Add an ! at the end of the tuple Convert a tuple to a string Extract (lb', 'b') from the tuple b) Find out the number of occurrences of 'e' in the tuple Check whether 'r' exists in the tuple c) Convert the tuple to a list Delete characters 'b, 'e', and 'r' from the tuple. ii) Write a Python program that simulates a grade where student names and their corresponding grades are stored in a tuple of tuples. It performs various operations like accessing elements, determining length, checking element existence, finding index, and counting occurrences. iii) Write a Python program to manage an inventory of books using a tuple of dictionaries. It performs operations like accessing elements, slicing, and converting between tuples and lists. iv) Write a Python program to manage a list of employee details using a tuple of tuples. It performs operations like repeating and concatenating.		
9	**LLO 9.1** Write a Python program to manipulate the set.	Implement a Python program to demonstrate various operations on sets, such as union, intersection, difference, symmetric difference, checking subset and superset, adding and removing elements, discarding elements, and clearing the set. **Practical Tasks:(ANY ONE)** i. Given the following two sets engineers = {'Vijay', 'Sanjay', 'Ajay', 'Sujay', 'Dinesh'} managers = {'Aditya', 'Sanjay'} Write a program to perform union, intersection and difference operations that can be carried out on any two sets. ii) Write a python program for product	2	CO3

		inventory management where, we have two sets representing available products in two different stores. We can use set operations such as Union, Intersection, Difference, Symmetric difference and Checking if one store's products are subset/superset of the other in products to manage the inventory.		
10	**LLO 10.1** Write a Python program to perform operations on the dictionary.	Implement a Python program to demonstrate various operations on dictionaries, such as accessing values, adding and modifying key-value pairs, removing key-value pairs, checking for key existence, getting keys and values, and clearing the dictionary. **Practical Tasks:(ANY ONE)** i) Write a Python program where users can register by providing a username and password. The program stores the user credentials in a dictionary. After the registration process, it performs the basic operations on dictionaries, including accessing values, adding and modifying key-value pairs, removing key-value pairs, checking for key existence, getting keys and values, and clearing the dictionary. ii) Write a Python program where the teacher can enter student grades. The program stores the student's grades in a dictionary. After the student grade process, it performs the basic operations on dictionaries operations on a nested dictionary, including accessing values and modifying key-value pairs. iii) Write a Python program where the store manager can enter the inventory of products. The program stores the inventory of products in a dictionary After the inventory of products process, how to iterate over a dictionary to perform various operations such as Accessing values and keys using a loop, adding a prefix to all string values, Removing key-value pairs based on a condition.	2	CO3

11	**LLO 11.1** Write a Python program to use built-in functions on the list.	Implement Python program to demonstrate the use of various built-in functions on a list, including len() to get the length of the list, sum() to calculate the sum of elements,•min() and •max() to find the minimum and maximum elements, •sorted() to sort the list, and •reversed() to reverse the list. **Practical Tasks:(ANY ONE)** i) Write a Python program which analyzes student grades stored in a list. It uses built-in functions like len( ) sum( ), min( ), max( ), sorted( ), and reversed( ) to perform various operations. ii) Write a Python program which manages an inventory of products stored in a list. It uses built-in functions like len( ) sum( ), min( ) , max( ) , sorted( ) , and reversed( ) for inventory analysis. iii)Write a Python program which manages a list of employee salaries. It utilizes built-in functions like len( ) sum( ), min( ), max( ), sorted( ), and reversed( ) to analyze employee salaries.	2	CO4
12	**LLO 12.1** Write functions to solve a given problem.	Write a user define function to implement the following features: 1. Function without argument 2. Function with argument 3. Function returning value **Practical Tasks:(ANY ONE)** i) Write down a program which will use a function to find the value of $y=x^2+3x+5$; when the value of x is entered through the keyboard. ii) Write down a program which will use a function to display values of squares of numbers between 1 to 25. iii) Write down a program which will accept marks in three different subjects and show the result as pass or fail. Use	2	CO4

		functions to find the average and minimum		
13	**LLO 13.1** Write a user-defined module to solve a given problem.	Implement a Python program to create and use a user-defined module for a given problem. **Practical Tasks:(ANY ONE)** i) Write a Python program to create a module that contains functions to calculate the area and perimeter of a rectangle. ii) Write a Python program to define a module named temperature_ converter that contains functions to convert temperature between Celsius and Fahrenheit scales. iii) Write a Python program to define a module named basic calculator that contains functions to perform basic arithmetic operations.	2	CO4
14	**LLO 14.1** Developing a program that employs parametric equations to compute and visualize coordinates on a specified curve.	Implement a program that employs parametric equations to compute and visualize coordinates on a specified curve. **Practical Tasks:(ANY ONE)** i) Develop a Python program to calculate and plot the coordinates of points on an ellipse using parametric equations and Matplotlib, based on inputs of semi-major axis (a) and semi-minor axis (b). ii) Develop a Python program that computes and plots the This program plots a parametric spiral using parametric equations for a spiral curve. using Matplotlib, the coordinates of points on an involute curve based on the radius of the base circle and the number of points. Adjust the radius and num_points parameters according to your requirements.	2	CO5

		iii) Develop a Python program that computes and plots an Archimedean spiral using parametric equations for a spiral curve using Matplotlib, the coordinates of points on a spiral curve based on the constant determining the distance between each turn. and values of t from 0 to 10pi Adjust the distance between each turn. and values of t from 0 to 10pi according to your requirements.		

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

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

1. Develop a Python program to calculate the shear force at a given distance along the simple supported beam and the bending moment at the same distance. The input parameters include the point load magnitude, beam length and the distance of the point load from the left support. Adjust these parameters according to your specific beam configuration and point load.

2. Develop a Python program that computes the frictional force acting on an object on an inclined plane. The program's function should accept parameters such as the object's mass, acceleration due to gravity, angle of the inclined plane, and coefficient of friction. It should then calculate the normal force, maximum frictional force, and weight parallel to the inclined plane. By comparing the weight with the maximum frictional force, it determines the frictional force. Finally, the program should print the calculated frictional force. Adjust the input parameters as per your specific scenario.

3. Develop an Arithmetic Calculator Python program capable of executing fundamental arithmetic operations (addition, subtraction, multiplication, division) according to user input.

4. Develop a Python program that utilizes a dictionary for storing book details, comprising titles and authors. Enable users to search for books based on either title or author.

5. Develop a Python program featuring a module specifically designed to sort a list of numbers using diverse algorithms (e.g., bubble sort, insertion sort, selection sort).

6. **Develop a Student Grade Calculator Python program:**
   - Obtain input marks for various subjects from the user and compute the total score, average score, and grade according to predefined criteria (e.g., A, B, C, D).
   - Utilize functions to segment the code for calculating the total score; average score, and grade.
   - Incorporate error handling to validate input marks and furnish suitable feedback to the user.

7. Develop a simple Contact Management System:

- Construct a user-friendly contact management system allowing users to add, delete, search, and display contacts.
- Utilize dictionaries to store contact information, including name, phone number, and email**.**

(**Note:** Faculty members can opt to choose and assign Microprojects/assignments from their specific programs instead of the aforementioned tasks.)

VI. LABORATORY EQUIPMENT/INSTRUMENTS/TOOLS/SOFTWARE REQUIRED

Sr.No	Equipment Name with Broad Specifications	Relevant LLO Number
1	a) Computer System with all necessary Peripherals and Internet connectivity. b) Any Open Office Software c) Any Browser (Any General Purpose Computer available in the Institute)	ALL

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

NOT APPLICABLE

VIII. ASSESSMENT METHODOLOGIES/TOOLS

Formative assessment (Assessment for Learning)	Summative Assessment (Assessment of Learning)
Lab performance, Assignment, Self-learning and Seminar/Presentation	Lab. Performance, viva voce

IX. 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
CO1	2	3	2	3	--	--	2		
CO2	2	3	2	3	--	--	2		
CO3	2	3	2	3	--	--	2		
CO4	2	3	2	3	--	--	2		
CO5	2	3	2	3	--	--	2		

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

X. SUGGESTED LEARNING MATERIALS/BOOKS

Sr.No	Author	Title	Publisher
1	Kenneth A. Lambert	Fundamentals of Python: First Programs 2E	Cengage Learning India Private Limited, ISBN:9789353502898
2	Yashavant Kanetkar, Aditya Kanetkar	Let Us Python - 6th Edition	BPB Publications, ISBN: 9789355515414
3	K. Nageswara Rao,Shaikh Akbar	Python Programming	Scitech Publications (India) Pvt. Ltd. ISBN:9789385983450
4	Mark Lutz	Learning Python	O'Reilly Publication, 5th Edition ISBN13:9781449355739
5	David Beazley	Python Essential Reference	Addison-Wesley Professional 4th Edition ISBN:9780672329784

XI. LEARNING WEBSITES & PORTALS

Sr.No	Link/Portal	Description
1	https://www.w3schools.com/python	The website provides comprehensive resources for learning Python programming language. It includes tutorials, examples, and exercises covering various Python topics such as syntax, data types, control structures, functions, and modules.
2	https://www.tutorialspoint.com/index.htm	The website offers a comprehensive guide to Python programming, covering essential topics such as syntax, data types, control structures, functions, modules, and advanced concepts like object-oriented programming and exception handling.
3	https://www.python.org/	The website serves as the official resource for the Python programming language. Users can access Python documentation, tutorials, guides, and references to learn about Python's syntax, features, and libraries. Additionally, the website provides downloads for the latest Python releases, including the Python interpreter and standard library, as well as links to community forums, events, and development resources.,
4	https://realpython.com	The website is a comprehensive platform dedicated to providing high-quality tutorials, articles, and resources for Python programmers of all levels. The website covers a wide range of topics,
5	https://www.geeksforgeeks.org/python-programming-language/	Tutorials, articles, and coding challenges focused on Python programming, suitable for beginners and advanced learners.
6	https://stackoverflow.com/	Community-driven Q&A platform where you can find answers to common Python questions, seek help with programming challenges, and learn from experienced developers.

Name & Signature:

Mr.S.B.Kulkarni
Lecturer in Mechanical Engineering

Mr. A.M.Joshi
Lecturer in Mechanical Engineering

(Course Experts)

Name & Signature:

Dr. Sachin. S. Bharatkar
(Programme Head)

Name & Signature:

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