12-02-2026 12:54:11 PM

ELECTRICAL AND ELECTRONIC MEASUREMENT **Course Code : 313334**

Programme Name/s : **Electrical Engineering/ Electrical Power System**
Programme Code : **EE/ EP**
Semester : **Third**
Course Title : **ELECTRICAL AND ELECTRONIC MEASUREMENT**
Course Code : **313334**

I. RATIONALE

Industry comprises of a number of electrical, electronic instruments and transducers for measuring precisely various electrical and mechanical parameters. The diploma students passing this course will possess the required knowledge and skill set not only to use but to calibrate and troubleshoot these measuring instruments.

II. INDUSTRY / EMPLOYER EXPECTED OUTCOME

Troubleshoot electrical and electronics measuring instruments used for laboratory and industrial measurements.

III. COURSE LEVEL LEARNING OUTCOMES (COS)

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

- CO1 - Apply the basics of measurement to the measuring instruments.
- CO2 - Measure precisely electrical power and energy using appropriate meters.
- CO3 - Use digital measuring instruments for different applications.
- CO4 - Maintain required pressure for given application using pressure transducer.
- CO5 - Use appropriate transducer for maintaining required flow, level and temperature in given application.

IV. TEACHING-LEARNING & ASSESSMENT SCHEME

Course Code	Course Title	Abbr	Course Category/s	Learning Scheme					Credits	Assessment Scheme											
				Actual Contact Hrs./Week			SLH	NLH		Paper Duration	Theory				Based on LL & TL				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	
313334	ELECTRICAL AND ELECTRONIC MEASUREMENT	EEM	DSC	3	-	4	1	8	4	3	30	70	100	40	25	10	25#	10	25	10	175

Total IKS Hrs for Sem. : 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, *# On Line Examination , @$ Internal Online Examination
Note :

1. FA-TH represents average of two class tests of 30 marks each conducted during the semester.
2. If candidate is not securing minimum passing marks in FA-PR of any course then the candidate shall be declared as "Detained" in that semester.
3. If candidate is not securing minimum passing marks in 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.* 15 Weeks
5. 1 credit 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.

V. THEORY LEARNING OUTCOMES AND ALIGNED COURSE CONTENT

ELECTRICAL AND ELECTRONIC MEASUREMENT **Course Code : 313334**

Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
1	TLO 1.1 Define static and dynamic characteristics of measuring instruments. TLO 1.2 Explain types of errors in a measuring instrument and their compensation. TLO 1.3 Write the classification of measuring instrument. TLO 1.4 Explain different types of torques in measuring instruments. TLO 1.5 Describe the procedure for calibration of given device. TLO 1.6 Describe construction and working of PMMC and PMMI meter. TLO 1.7 Extend the range of given DC/AC ammeter and voltmeter. TLO 1.8 Classify different types of resistance.	**Unit - I Fundamentals of Measurement** 1.1 Measurement: Definition, need and significance. 1.2 Static and dynamic characteristics of measuring instruments. 1.3 Types of errors in measurement and compensation. 1.4 Classification of Instruments. 1.5 Deflecting, controlling and damping torque. 1.6 Calibration: Need, significance and general procedure. 1.7 Construction and working principle of Permanent magnet moving coil (PMMC) and Permanent magnet moving iron (PMMI) meter. 1.8 Range Extension of ammeter and voltmeter- a) Shunt and multiplier (for DC), b) CT and PT (for AC) 1.9 Classification of resistance: Low, Medium and High.	Chalk-Board Flipped Classroom Video Demonstrations Model Demonstration Presentations
2	TLO 2.1 Describe the working of the dynamometer wattmeter with the help of neat sketch. TLO 2.2 Describe the procedure for measuring power using appropriate method. TLO 2.3 Justify the effect of Power factor on wattmeter reading in two wattmeter method. TLO 2.4 Describe the working of MDI and four quadrant meter with neat labelled sketch. TLO 2.5 5 Describe the working of a given type of energy meter with help of block diagram. TLO 2.6 Describe the working of a given digital energy meter and smart energy meter with neat sketch.	**Unit - II Measurement of Power and Energy.** 2.1 Construction and working of dynamometer wattmeter, Multiplying factor. 2.2 Active and reactive power measurement: One, two and three wattmeter methods. 2.3 Effect of Power factor on wattmeter reading in two wattmeter method. 2.4 Construction and working of maximum Demand indicator (MDI), four quadrant meters. 2.5 Construction and working of Induction type single phase energy meter, types of errors and compensation. 2.6 Single and three phase digital energy meter: Block diagram, constructional features and working principle. 2.7 Smart energy meter: Basic concept, block diagram, operation and working principle.	Chalk-Board Flipped Classroom Video Demonstrations Model Demonstration Presentations

ELECTRICAL AND ELECTRONIC MEASUREMENT **Course Code : 313334**

Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
3	TLO 3.1 Explain the merits of digital measuring instruments. TLO 3.2 Describe the construction and working of a given digital meter with neat sketch. TLO 3.3 Describe the construction and working of a given resistance measurement meters with neat sketch. TLO 3.4 Describe the working of a given meter used for synchronization with neat sketch. TLO 3.5 Describe the working of function generator with neat sketch. TLO 3.6 Describe the working of CRO, Digital storage oscilloscope with neat sketch.	**Unit - III Digital Measuring Instruments.** 3.1 Digital measuring instruments-Essentials and advantages. 3.2 Construction and working of digital Meters-Ammeter, Voltmeter and Multimeter, Clamp-on meter, L-C-R meter, Power factor meter and Tachometer (Contact and Non-contact). 3.3 Construction and working of Resistance measurement meters: Ohm meter, Digital Megger, Digital earth tester. 3.4 Construction and working of meter used for synchronization: Frequency meter, Synchroscope and Phase sequence indicator. 3.5 Function generator: Basic block diagram, function of each block and applications. 3.6 CRO: Basic block diagram, function of each block. 3.7 Digital storage Oscilloscope: Basic block diagram, function of each block.	Chalk-Board Flipped Classroom Video Demonstrations Model Demonstration Presentations
4	TLO 4.1 Describe the working of instrumentation system with neat sketch. TLO 4.2 State the difference between sensors and transducer. TLO 4.3 Write the classification of transducer. TLO 4.4 Describe the working of given electrical transducer with neat sketch. TLO 4.5 Describe the working of piezoelectric transducer with neat sketch. TLO 4.6 Classify pressure transducer. TLO 4.7 Describe the working of bourdon tube with LVDT as secondary transducer with neat sketch.	**Unit - IV Transducer and Pressure Measurement** 4.1 Instrumentation System-Block diagram, function of each block. 4.2 Difference between sensors and transducer with examples. 4.3 Classification of transducer. 4.4 Electrical Transducers: a) Resistive transducers- Linear and Angular potentiometers, strain gauge, load cell. b) Capacitive transducer. c) Inductive transducer –LVDT, RVDT. 4.5 Working of piezoelectric transducer, classification, examples. 4.6 Pressure measurement: Pressure and its units, types - Absolute, Gauge, Atmospheric, Vacuum. 4.7 Classification of Pressure measuring devices. 4.8 Method of pressure measurement- Bourdon tube with LVDT as secondary transducer.	Chalk-Board Flipped Classroom Video Demonstrations Model Demonstration Presentations

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Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
5	TLO 5.1 Classify flow transducer. TLO 5.2 Describe the working of given electrical flow meter with neat sketch. TLO 5.3 Classify level transducer. TLO 5.4 Describe the working of given level transducer with neat sketch. TLO 5.5 Classify temperature transducer. TLO 5.6 Describe the working of given temperature transducer with neat sketch.	**Unit - V Flow, Level and Temperature Measurement** 5.1 Flow measurement -Flow and its units, classification of flow transducers -Variable head flow meter, Variable area flow meter. 5.2 Methods of measurement of electrical flow meter: a) Electromagnetic Flow meter. b) Ultrasonic flow meter. 5.3 Level measurement-Level and its units classification of level measurement transducer-Resistive, Inductive and Capacitive. 5.4 Method level measurement: Capacitive, Ultrasonic and Radiation. 5.5 Temperature Measurement-Temperature and its Units, classification -Thermistors, Resistance Temperature Detector (RTD) and Thermocouple. 5.6 Methods of temperature measurement- RTD and thermocouple.	Chalk-Board Flipped Classroom Video Demonstrations Model Demonstration Presentations

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

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 1.1 Identify measuring instruments on the basis of symbols on dial, type, accuracy, class, position and scale.	1	*Identification of measuring instruments on the basis of symbols on dial, type, accuracy, class, position and scale.	2	CO1
LLO 2.1 Identify the components of PMMC and PMMI instruments.	2	*Identification of the components of PMMC and PMMI instruments.	2	CO1
LLO 3.1 Troubleshoot PMMC and MI instruments.	3	Troubleshooting of PMMC and PMMI instruments.	2	CO1
LLO 4.1 Calibrate the ammeter /voltmeter for measurement.	4	Calibration of the ammeter /voltmeter for measurement of electrical parameters.	2	CO1
LLO 5.1 Extend the range of voltmeter and ammeter by using shunt and multiplier.	5	Extension of the range of voltmeter and ammeter using shunt and multiplier.	2	CO1
LLO 6.1 Extend the range of ammeter by using CT, take the safety Precautions while using CT.	6	*Extension of the range of ammeter using Current Transformer (CT).	2	CO1
LLO 7.1 Extend the range of ammeter by using CT, take the safety Precautions while using CT	7	*Extension of the range of ammeter using Current Transformer (CT).	2	CO1
LLO 8.1 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 wattmeter by making changes in the current	8	*Measurement of power in a single-phase circuit using electro-dynamic watt-meter.	2	CO2
LLO 9.1 Carry out troubleshooting of electro-dynamic watt-meter.	9	Troubleshoot of electro-dynamic watt-meter for measurement.	2	CO2
LLO 10.1 Measure active power in three phase balanced load by using one wattmeter method.	10	*One wattmeter method of measurement of active power in a three-phase balanced load.	2	CO2

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Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 11.1 Measure reactive power in three phase balanced load by using one wattmeter method	11	One wattmeter method of measurement of reactive power in a three-phase balanced load.	2	CO2
LLO 12.1 Measure active power in three phase balanced load by using two wattmeter method.	12	*Two watt-meters method of measuring active power in a three-phase balanced load.	2	CO2
LLO 13.1 Calibrate single phase energy meter by direct loading.	13	*Calibration of single-phase energy meter by direct loading.	2	CO2
LLO 14.1 Carry out troubleshooting of single-phase energy meter.	14	Troubleshoot of single-phase energy meter.	2	CO2
LLO 15.1 Demonstrate the working of smart energy meter.	15	*Demonstration of smart energy meter.	2	CO2
LLO 16.1 Measure low resistance by using bridges.	16	Measurement of low resistance using bridges.	2	CO3
LLO 17.1 Measure medium and high resistance by using bridges.	17	Measurement of medium and high resistance using bridges.	2	CO3
LLO 18.1 Measure of supply voltage, frequency, peak value in single-phase circuit by using CRO/DSO.	18	*Measurement of supply voltage, frequency, peak value in single-phase circuit using CRO/DSO.	2	CO3
LLO 19.1 Measure linear displacement by using potentiometer.	19	*Measurement of linear displacement using potentiometer.	2	CO4
LLO 20.1 Measure the angular displacement by using potentiometer.	20	Measurement of angular displacement using potentiometer.	2	CO4
LLO 21.1 Measure displacement by using LVDT.	21	Measurement of displacement using LVDT.	2	CO4
LLO 22.1 Measure weights by using strain gauge.	22	Measurement of weights using strain gauge.	2	CO4
LLO 23.1 Measure pressure by using Bourdon tube pressure gauge.	23	*Measurement of pressure using bourdon tube pressure gauge.	2	CO4
LLO 24.1 Measure flow by using orifice meter.	24	*Measurement of flow using orifice meter.	2	CO5
LLO 25.1 Measure flow by using venturi meter.	25	Measurement of flow by using venturi meter.	2	CO5
LLO 26.1 Measure flow by using rotameter.	26	Measurement of flow using rotameter.	2	CO5
LLO 27.1 Measure level by using capacitance transducer.	27	*Measurement of level using capacitance transducer.	2	CO5
LLO 28.1 Measure temperature by using RTD.	28	*Measurement of temperature using RTD.	2	CO5
LLO 29.1 Measure temperature by using thermocouple.	29	Measurement of temperature using Thermocouple.	2	CO5

Note : Out of above suggestive LLOs -

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

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

Assignment

- Write the industrial applications of level transducer.

- Write the industrial applications of pressure transducer.
- Write the industrial applications of RTD, thermistor and thermocouple.
- Convert a given temperature scale into another scale.
- Compare analog and digital meters.
- Compare PMMC with PMMI meters.
- Determine earth resistance using digital earth tester and compare with the ideal earth resistance.
- Compare analog with digital energy meter.
- Determine multiplying factor of a wattmeter.
- Write the industrial applications of flow meter.

Suggested Student Activity

- Prepare chart showing real-life examples indicating various types of electrical measuring equipment.
- Collect photographs of PMMC and MI instrument showing internal parts.
- Prepare power point presentation for different types of wattmeters.
- Collect photographs of electronic energy meter and prepare report on it.
- Prepare the report on smart energy meter.
- Collect photographs of CRO and see the practical utilization.
- Prepare charts for measurement system using temperature, pressure, flow, level system.
- Prepare specification broad for basic transducers of temperature, level, pressure and flow.

Micro project

- Electronic energy meter: Collect data of power consumption of the equipment in the departmental laboratories/workshops of your polytechnic using electronic energy meter.
- Prepare a report on usage of level, pressure and flow sensors used in industry.
- Prepare a report on usage of IC LM35 temperature sensor.
- Prepare a report on usage of temperature sensors in mobile, laptop, domestic and consumer appliances.
- DMM: Use DMM for measurement of current, voltage, resistance of different range and check the continuity.
- CRO: Draw the front panel of CRO and write the function of each control on the panel.
- 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.
- PMMC and MI instrument: Dismantle any PMMC and MI instrument each available in the laboratory/workshop and identify different parts, material and function i.e. coil, spring, magnets, former, dial scale etc. and again assemble the same.

Note :

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

VIII. LABORATORY EQUIPMENT / INSTRUMENTS / TOOLS / SOFTWARE REQUIRED

Sr.No	Equipment Name with Broad Specifications	Relevant LLO Number
1	Model of PMMC and PMMI type instrument (up to 50A)	1,2,3
2	Energy meter (analog/digital) (15A/230V)	13,14
3	Smart energy meter.	15
4	Wheatstone bridge, Mega ohm bridge	16,17

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Sr.No	Equipment Name with Broad Specifications	Relevant LLO Number
5	CRO (up to 100 MHz)	18
6	Signal Generator (up to 100MHz)/ Function Generator (up to 100MHz)	18
7	Linear potentiometer, angular potentiometer	19,20
8	LVDT trainer kit- Displacement range +/- 20 mm. Accuracy of +/- 2% Primary Excitation 4 KHz and 1 Volt, RMS Output: Digital display of +/- 20mm	21
9	Strain gauge trainer kit: Strain gages of 350 ohms, Accuracy: +/- 1% Power Supply 230 V AC, maximum of 5-kg load, Digital indication	22
10	Bourdon tube pressure gauge: Input pressure range 0 – 50 psi. Accuracy of +/- 2%. Dial gauge indication in the range 0 to 50 psi.	23
11	Orifice meter measurement setup: concentric type, stainless steel, U tube manometer 400 mm height, Range 0-1000LPH, Digital display	24
12	Venturi flow measurement setup: stainless steel, U tube manometer 400 mm height, Range 0-1000LPH, Digital display	25
13	Rotameter flow measurement setup: Range 0-1000 LPH, Glass tube body, Bob Material-stainless steel, mounting inlet bottom top outlet	26
14	Capacitance level measurement: Input range 0 to 500 mm, power supply 230 V AC, 2 wire capacitance type, top mounted, Digital display indication of 0 to 500mm	27
15	RTD temperature measurement: Temp range 0-100^{0}C, temperature bath, RTD Type pt100, accuracy +/- 1%, power supply 230V AC	28
16	Thermocouple temperature measurement: Temp range 0-1260^{0}C, temp bath, Thermocouple K Type, accuracy of +/- 1%, power supply 230V AC, digital indication of temperature	29
17	Voltmeter Range (0-110V), Ammeter (0 to 5A)	4,5
18	Voltmeter, Ammeter, CT (15/5, 25/5), PT (230/110, 440/110)	6,7
19	Wattmeter (5/10A, 110/ 230V), Wattmeter (5/10A, 300/ 600V)	8,9,10,11,12

IX. SUGGESTED 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	7	2	4	4	10
2	II	Measurement of Power and Energy.	CO2	9	4	6	4	14
3	III	Digital Measuring Instruments.	CO3	10	4	6	6	16
4	IV	Transducer and Pressure Measurement	CO4	9	4	4	6	14
5	V	Flow, Level and Temperature Measurement	CO5	10	2	6	8	16
Grand Total				**45**	**16**	**26**	**28**	**70**

X. ASSESSMENT METHODOLOGIES/TOOLS

Formative assessment (Assessment for Learning)

- Two unit tests of 30 marks will be conducted and average of two unit tests considered. For formative assessment of laboratory learning 25 marks. Each practical will be assessed considering appropriate % weightage to process and product and other instructions of assessment.

Summative Assessment (Assessment of Learning)

- End semester summative assessment of 25 marks for laboratory learning. End semester assessment of 70 marks through offline mode of examination.

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

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

XII. SUGGESTED LEARNING MATERIALS / BOOKS

Sr.No	Author	Title	Publisher with ISBN Number
1	A.K.Sawhney	Electrical and Electronic Measurement and Instrumentation	Dhanpai Rai and Sons, New Delhi, 2014; ISBN: 9780000279744
2	J.B.Gupta	Electronics and Electrical Measurements and Instrumentation	S.K.Katariya and Sons, 2013, ISBN: 8188458937
3	Rajput R.K.	Electrical and Electronic Measurement and Instrumentation	S.Chand and Co. New Delhi, 2015, ISBN: 9789385676017
4	A.J.Baowens	Digital Instrumentation	Tata Mc-Graw Hill Publication ISBN: 9780074630488
5	Patranabis D.	Principles of Industrial Instrumentation	Tata Mc-Graw Hill Publication Co. Ltd, New Delhi 2010; ISBN:9780070699717
6	H.S.Kalsi	Electronic Instrumentation and Measurement.	Tata Mc-Graw Hill Publication Co. Ltd, New Delhi 2019; ISBN:9353162513
7	Theraja B.L., TherajaA.K.	A Text Book of Electrical Technology Vol-I (Basic Electrical Engineering)	S.Chand and Co. New Delhi, 2014, ISBN: 9788121924405

XIII . LEARNING WEBSITES & PORTALS

Sr.No	Link / Portal	Description
1	https://www.electrical4u.com/	Digital electronics measurement
2	https://iitb.vlabs.co.in/	Digital measurement concept.
3	https://ndl.iitkgp.ac.in/	Free source of reference books of electrical measurement and instrumentation.
4	www.dreamtechpress.com /ebooks	Free reference books for more practices.
5	https://nptel.ac.in/	Fundamentals of Measurement.
6	https://swayam.gov.in/nc_details/NPTEL	Concepts of electrical and electronics measurements.

Note :

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

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MSBTE Approval Dt. 02/07/2024 **Semester - 3, K Scheme**

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ELECTRICAL CIRCUITS AND NETWORK **Course Code : 313332**

Programme Name/s : **Electrical Engineering/ Electrical Power System**
Programme Code : **EE/ EP**
Semester : **Third**
Course Title : **ELECTRICAL CIRCUITS AND NETWORK**
Course Code : **313332**

I. RATIONALE

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

II. INDUSTRY / EMPLOYER EXPECTED OUTCOME

Diagnose and Rectify simple electric circuit and network related problems in industry.

III. COURSE LEVEL LEARNING OUTCOMES (COS)

Students will be able to achieve & demonstrate the following COs 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. TEACHING-LEARNING & ASSESSMENT SCHEME

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															Practical						
				CL	TL	LL					FA-TH	SA-TH	Total		FA-PR		SA-PR		SLA		
											Max	Max	Max	Min	Max	Min	Max	Min	Max	Min	
313332	ELECTRICAL CIRCUITS AND NETWORK	ECN	DSC	4	-	4	-	8	4	3	30	70	100	40	25	10	50#	20	-	-	175

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V. THEORY LEARNING OUTCOMES AND ALIGNED COURSE CONTENT

ELECTRICAL CIRCUITS AND NETWORK **Course Code : 313332**

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1	TLO 1.1 Determine the current, voltage and draw vector 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 resonant frequency, voltage magnification and Q-factor for the given R-L-C series circuit.	**Unit - I Single Phase A.C Series Circuits** 1.1 Generation of alternating voltage, Phasor representation of sinusoidal quantities. 1.2 R, L, C circuit elements it's voltage and current response. 1.3 R-L, R-C, R-L-C series A.C. circuits- vector diagram, active, reactive, apparent power, power triangle and power factor. (Simple Numerical). 1.4 Resonance in R-L-C series circuit- Graphical Representation, Resonance curve, Quality (Q) Factor. (Simple Numerical)	Lecture Using Chalk-Board Video Demonstrations Flipped Classroom Case Study Collaborative learning Presentations
2	TLO 2.1 Determine the current, voltage and draw vector diagram for the given AC parallel circuit. TLO 2.2 Calculate inductive, capacitive reactance and impedance for the given AC parallel circuit. TLO 2.3 Determine active, reactive, apparent power and power factor for the given AC parallel circuit. TLO 2.4 Determine resonant frequency, current magnification and Q-factor for the given R-L-C parallel circuit.	**Unit - II Single Phase A.C Parallel Circuits** 2.1 R-L, R-C and R-L-C parallel combination of A.C. circuits. Impedance, reactance, phasor diagram, impedance triangle. 2.2 R-L, R-C, R-L-C parallel A.C. circuits- vector diagram, active, reactive, apparent power, power triangle and power factor (Simple Numerical). 2.3 Resonance in parallel circuit- Graphical Representation, Resonance curve, Quality (Q) Factor. (Simple Numerical)	Lecture Using Chalk-Board Case Study Video Demonstrations Flipped Classroom Collaborative learning Presentations
3	TLO 3.1 Explain the principle of generation of 3-phase waveform. TLO 3.2 Compare of 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 condition.	**Unit - III Three Phase Circuits** 3.1 Generation of 3-phase alternating emf, Phase Sequence. 3.2 Comparison of 3-phase circuit with single phase circuit. 3.3 Types of three phase connections-star and delta, Relation between phase and line values. 3.4 3-Phase power- active, reactive and apparent power in star and delta connected system. 3.5 Concept of balanced and unbalanced load (Numerical on balanced load only)	Lecture Using Chalk-Board Presentations Video Demonstrations Flipped Classroom Collaborative learning Case Study
4	TLO 4.1 Apply source transformation techniques for the given network. 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.	**Unit - IV Network Reduction Methods for DC Circuits.** 4.1 Source transformation Techniques. 4.2 Star to delta and delta to star transformation. 4.3 Mesh Analysis. 4.4 Node Analysis.	Lecture Using Chalk-Board Presentations Video Demonstrations Flipped Classroom Collaborative learning Case Study

ELECTRICAL CIRCUITS AND NETWORK **Course Code : 313332**

Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
5	TLO 5.1 Apply superposition theorem to determine the current in the given branch of a circuit. TLO 5.2 Draw Thevenin's equivalent circuit and determine load current in the given branch of a circuit. TLO 5.3 Draw Norton's equivalent circuit and determine load current in the given branch of a circuit. TLO 5.4 Apply 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.	**Unit - V 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 5.6 Introduction to AC Network Theorem (No numerical for 5.6)	Lecture Using Chalk-Board Presentations Video Demonstrations Flipped Classroom Collaborative learning Case Study

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

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 1.1 Trace the output waveforms across R L circuit to identify the phase difference and measure the amplitude. LLO 1.2 Observe the nature of current with respect to voltage in R-L series circuit. LLO 1.3 Operate various controls of CRO	1	*Determination of the phase difference between A.C voltage and current in a given R-L series circuit by using dual trace oscilloscope.	2	CO1
LLO 2.1 Trace the output waveforms across R C circuit to identify the phase difference and measure the amplitude. LLO 2.2 Observe the nature of current with respect to voltage in R-C series circuit. LLO 2.3 Operate various controls of CRO	2	Determination of the phase difference between A.C voltage and current in a given R-C series circuit by using dual trace oscilloscope.	2	CO1
LLO 3.1 Trace the output waveforms across R L C circuit to identify the phase difference and measure the amplitude. LLO 3.2 Observe the nature of current with respect to voltage for $X_L > X_C$ or $X_L < X_C$. LLO 3.3 Operate various controls of CRO	3	*Determination of the phase difference between A.C voltage and current in a given R-L-C series circuit by using dual trace oscilloscope.	2	CO1
LLO 4.1 Measure voltage, current and draw phasor diagram to find pf and verify the same.	4	*Determination of voltage, current and pf in a given R-L series circuit. Draw phasor diagram.	2	CO1
LLO 5.1 Measure active power and calculate reactive and apparent power for R-L series circuit and verify the same.	5	Determination of active, reactive and apparent power consumed in given R-L series circuit.	2	CO1

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Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 6.1 Measure active power and calculate reactive and apparent power for R-C series circuit and verify the same.	6	*Determination of voltage, current and pf in a given R-C series circuit. Draw phasor diagram.	2	CO1
LLO 7.1 Measure active power and calculate reactive and apparent power for R-C series circuit and verify the same.	7	Determination of active, reactive and apparent power consumed in a given R-C series circuit.	2	CO1
LLO 8.1 Measure voltage, current and draw phasor diagram to find pf and verify the same. LLO 8.2 Observe the nature of current with respect to voltage for $X_L > X_C$ or $X_L < X_C$and interpret about the nature of the circuit.	8	*Determination of voltage, current and pf in a given R-L-C series circuit. Draw phasor diagram.	2	CO1
LLO 9.1 Measure active power and calculate reactive and apparent power for R-L-C series circuit and verify the same.	9	*Determination of active, reactive and apparent power consumed in given R-L-C series circuit.	2	CO1
LLO 10.1 Measure the resonant frequency and verify it by calculation. LLO 10.2 Using variable frequency supply obtain resonant condition for R-L-C series circuit	10	Resonance in given R-L-C series circuit using variable frequency supply.	2	CO1
LLO 11.1 Measure the inductance and capacitance to obtain the resonant condition. LLO 11.2 Measure current, voltage and draw vector diagram to obtain pf at resonance in R-L-C series circuit	11	*Resonance in given R-L-C series circuit using variable inductor or capacitor.	2	CO1
LLO 12.1 Measure voltage, current and draw phasor diagram to find pf and verify the same. LLO 12.2 Measure active power and calculate reactive and apparent power for R-L-C parallel circuit and verify the same.	12	*Determination of voltage, current, p.f., active, reactive and apparent power for given R-L-C parallel circuit.	2	CO2
LLO 13.1 Measure the resonant frequency and verify it by calculation. LLO 13.2 Obtain resonant condition for R-L-C parallel circuit by varying frequency or inductance and capacitance. LLO 13.3 Measure current, voltage and draw vector diagram to obtain pf at resonance in R-L-C parallel circuit.	13	Resonance in given parallel R-L-C circuit using variable frequency supply or variable inductor and capacitor.	2	CO2
LLO 14.1 Identify phase sequence of the 3-phase supply system and draw the waveforms.	14	*Phase sequence of 3-phase supply system.	2	CO3
LLO 15.1 Measure line and phase values for both balance and unbalance star connected load. LLO 15.2 Draw phasor diagram with the help of phase values and verify the line values.	15	*Determination of line and phase quantities of voltage and current for balanced & unbalanced three phase star connected load. Draw phasor diagram.	2	CO3

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Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 16.1 Measure line and phase values for both balance and unbalance delta connected load. LLO 16.2 Draw phasor diagram with the help of phase values and verify the line values.	16	*Determination of line and phase values of voltage and current for balanced & unbalanced three phase delta connected load. Draw phasor diagram.	2	CO3
LLO 17.1 Measure active, reactive, and apparent power for balanced three phase star connected inductive / capacitive load.	17	*Determination of active, reactive, and apparent power for balanced three phase star connected inductive / capacitive load.	2	CO3
LLO 18.1 Measure active, reactive, and apparent power for balanced three phase delta connected inductive / capacitive load.	18	Determination of active, reactive, and apparent power for balanced three phase delta connected inductive / capacitive load.	2	CO3
LLO 19.1 Measure active, reactive, and apparent power for unbalanced three phase star connected inductive / capacitive load.	19	Determination of active, reactive, and apparent power for unbalanced three phase star connected inductive / capacitive load.	2	CO3
LLO 20.1 Measure active, reactive, and apparent power for unbalanced three phase delta connected inductive / capacitive load	20	Determination of active, reactive, and apparent power for unbalanced three phase delta connected inductive / capacitive load.	2	CO3
LLO 21.1 Measure current through the branch for given electric network and verify by applying mesh analysis.	21	*Verification of Mesh analysis method.	2	CO4
LLO 22.1 Measure current through the branch for given electric network and verify by applying node analysis.	22	*Verification of Node analysis method.	2	CO4
LLO 23.1 Measure current through the branch for a given DC electric network and verify by applying superposition theorem.	23	*Verification of Superposition theorem.	2	CO5
LLO 24.1 Measure Thevenin's equivalent circuit parameter for a given DC circuit and verify by applying Thevenin's theorem. LLO 24.2 Draw the Thevenin's equivalent circuit and verify the load current.	24	*Verification of Thevenin's theorem.	2	CO5
LLO 25.1 Measure Norton's equivalent circuit parameter for a given DC circuit and verify by applying Norton's theorem. LLO 25.2 Draw the Norton's equivalent circuit and verify the load current.	25	*Verification of Norton's theorem.	2	CO5
LLO 26.1 Measure load resistance to transfer maximum power for a given DC circuit and verify by applying maximum power transfer theorem.	26	*Verification of Maximum Power Transfer theorem.	2	CO5
LLO 27.1 Measure current through the branch for a given AC electric network and verify by applying superposition theorem.	27	*Verification of Superposition theorem for AC network.	2	CO5

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Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs

Note : Out of above suggestive LLOs -

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

VII. SUGGESTED MICRO PROJECT / ASSIGNMENT/ ACTIVITIES FOR SPECIFIC LEARNING / SKILLS DEVELOPMENT (SELF LEARNING) : NOT APPLICABLE

VIII. LABORATORY EQUIPMENT / INSTRUMENTS / TOOLS / SOFTWARE REQUIRED

Sr.No	Equipment Name with Broad Specifications	Relevant LLO Number
1	Digital Storage Oscilloscope: Dual Trace 50Mhz	1,2,3
2	Inductor 1.3 H, suitable range	1,3,4,5,8,9,10,12,13,27
3	Variable Frequency Generator	10,13
4	Capacitor Bank 5A, 250 V suitable range	10,13,17,18,19,20
5	Inductor Bank 5A, 250 V suitable range	10,13,17,18,19,20
6	Phase Sequence Indicator as per availability in the lab	14
7	Load Bank: Resistive, 3-Phase, 5 kW, 415 V	15,16
8	Dimmer: 3-Phase, 5 kVA	15,16,17,18,19,20
9	Capacitor 10 µF (micro-Farad) 250 V suitable range	2,3,6,7,9,10,12,13,27
10	DC Regulated Power Supply	21,22,23,24,25,26
11	Trainer Kit for Theorems	23,24,25,26
12	Load Bank: Resistive, 1-Phase, 1 kW, 230 V	26
13	Low Power Factor Wattmeter: Single Phase, 5/10 Amp, 250/500 V	5,17,18,19,20
14	Wattmeter: Single Phase 2.5/5 Amp, 200/400 V, Single Phase 5/10 Amp, 250/500 V	5,7,9,12,17,18,19,20
15	Rheostat- 18 ohm /10A, 250 ohm / 2A, 500 ohm /1 A, 720 ohm / 0.8A, suitable range	All
16	Ammeters MI Type: AC/DC, 0-5-10Amp,0-1.5 Amp,0-2.5Amp,0-0.5-1Amp	All
17	Voltmeter MI Type: AC/DC, 0-150/300V, 0-250/500V,0-75/150V	All
18	Dimmer: 1-Phase,1kVA, 230V	All
19	Multimeter suitable range	All

IX. SUGGESTED 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	14	2	6	8	16
2	II	Single Phase A.C Parallel Circuits	CO2	12	2	4	6	12
3	III	Three Phase Circuits	CO3	8	2	4	6	12
4	IV	Network Reduction Methods for DC Circuits.	CO4	10	2	4	6	12
5	V	Network Theorems	CO5	16	4	4	10	18
Grand Total				**60**	**12**	**22**	**36**	**70**

X. ASSESSMENT METHODOLOGIES/TOOLS

Formative assessment (Assessment for Learning)

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- Two unit tests of 30 marks will be conducted and average of two unit tests considered. For formative assessment of laboratory learning 25 marks. Each practical will be assessed considering appropriate % weightage to process and product and other instructions of assessment.

Summative Assessment (Assessment of Learning)

- End semester assessment of 70 marks through offline mode of examination. End semester summative assessment of 50 marks for laboratory learning.

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

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

XII. 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	Mahmood Nahvi, Joseph Edminister	Schaum online series- Theory and problems of electric circuits	McGraw Hill Education, Newyork, 2013, ISBN: 978-00-701-8999-7
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

XIII . 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

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Sr.No	Link / Portal	Description
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

MSBTE Approval Dt. 02/07/2024 **Semester - 3, K Scheme**

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ELECTRICAL ESTIMATING AND CONTRACTING **Course Code : 314325**

Programme Name/s : **Electrical Engineering/ Electrical Power System**
Programme Code : **EE/ EP**
Semester : **Fourth**
Course Title : **ELECTRICAL ESTIMATING AND CONTRACTING**
Course Code : **314325**

I. RATIONALE

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

II. INDUSTRY / EMPLOYER EXPECTED OUTCOME

Carry out estimation and costing of various electrical wiring installations.

III. COURSE LEVEL LEARNING OUTCOMES (COS)

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

- CO1 - Prepare generic tender document, quotation, comparative statement, and supply order.
- CO2 - Prepare estimate of domestic and commercial electrical installations.
- CO3 - Prepare estimate of industrial electrical installations.
- CO4 - Prepare estimate of public lighting installations.
- CO5 - Prepare estimate of overhead and underground distribution lines.

IV. TEACHING-LEARNING & ASSESSMENT SCHEME

Course Code	Course Title	Abbr	Course Category/s	Learning Scheme					Credits	Assessment Scheme											
				Actual Contact Hrs./Week			SLH	NLH		Paper Duration	Theory				Based on LL & TL				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	
314325	ELECTRICAL ESTIMATING AND CONTRACTING	EEC	DSC	3	-	4	1	8	4	3	30	70	100	40	25	10	25#	10	25	10	175

Total IKS Hrs for Sem. : 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, *# On Line Examination , @$ Internal Online Examination
Note :

1. FA-TH represents average of two class tests of 30 marks each conducted during the semester.
2. If candidate is not securing minimum passing marks in FA-PR of any course then the candidate shall be declared as "Detained" in that semester.
3. If candidate is not securing minimum passing marks in 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.* 15 Weeks
5. 1 credit 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.

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V. THEORY LEARNING OUTCOMES AND ALIGNED COURSE CONTENT

Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
1	TLO 1.1 Apply the principles of NEC 2023 during preparation of the given document. TLO 1.2 State the purpose of preparation of the given type(s) of estimates. TLO 1.3 State the purpose of awarding the given type(s) of contracts. TLO 1.4 Prepare tender documents, quotations, and bills for the specified work.	**Unit - I Estimates and Contracts** 1.1 National Electrical Code 2023 (NEC 2023): Scope and features, Types of electrical installation- Non industrial and industrial, Standard value of voltages and their limits, Fundamental principles for electrical installations, Safety in electrical work, permit to electrical work, safety instruction and safety practices 1.2 Estimating and costing: Purpose, Qualities of good estimator, essential elements of estimating and costing, Meaning and purpose of- Rough estimate, detailed estimate, supplementary estimate, annual maintenance estimate and revised estimate, Factors to be considered while preparation of detailed estimate and economical execution of work. 1.3 Contracts: Concepts, types, roles, and qualities of good contractor 1.4 Tender and Quotation: Types of tenders, tender notice, preparation of tender document, and method of opening of tender, Government e-Market Place (GeM), features and benefits of GeM, Quotation, quotation format, comparison between tender and quotation, Comparative statement, format of comparative statement. Order format, placing of purchasing order, Principles of execution of works, planning, organizing and completion of work, Billing of work.	Lecture Using Chalk-Board Presentations
2	TLO 2.1 Interpret the given electrical installation plan and electrical diagrams. TLO 2.2 Estimate materials required for the given domestic installations. TLO 2.3 Estimate materials required for the given commercial installations. TLO 2.4 Estimate materials required for given type of service connection.	**Unit - II Domestic and Commercial Installations** 2.1 Electrical Drawing: Electrical symbols used in electrical diagrams as per NEC 2023, multiline and single line representation of conductors, Electrical diagrams, their Classification. Methods of representation for the wiring diagram- multiline and single line representation, conversion of multiline representation into single line and vice versa. Necessity and reading of Civil Engineering building drawing. Interpretation of electrical installation plan and electrical diagrams. 2.2 Design of Domestic Installations: Steps to be followed for design and estimation of domestic installations. Design consideration of electrical installation in domestic installations. Design, drawing, estimation, and costing of a domestic installation having maximum 5 kW load. 2.3 Design of Commercial Installations: Steps to be followed for design and estimation of commercial installations. Design consideration of electrical installation in commercial installations. Design electrical installation scheme of small commercial installations of classrooms in educational institutions, small shops, and dispensaries. 2.4 Service Connection: Underground and overhead, it's diagram and description. Calculation of material required for underground and overhead service connection.	Lecture Using Chalk-Board Presentations Case Study Flipped Classroom Site/Industry Visit

ELECTRICAL ESTIMATING AND CONTRACTING **Course Code : 314325**

Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
3	TLO 3.1 Select wiring types for industrial installations. TLO 3.2 Draw an installation plan, wiring diagrams and single line diagrams for the given industrial installations. TLO 3.3 Describe given design considerations of an industrial installation. TLO 3.4 Carry out estimation for the given industrial installations.	**Unit - III Industrial Installations** 3.1 Classification of industrial installations based on fire safety and power consumption, Difference between non-industrial and industrial installations, General characteristics of industrial installation, selection of wiring system. 3.2 Wiring diagram and single line diagram for single phase and three phase motors. Installation plan. 3.3 Design Considerations: Calculation of Motor current, deciding the cable size, deciding the size of Conduit, deciding the fuse rating, deciding distribution board and main switch/MCB, deciding the starter for Motors. 3.4 Design electrical installation scheme and preparation of estimate of agricultural pump, flourmill and small industrial unit having total aggregate three -phase load less than 30 kW.	Lecture Using Chalk-Board Case Study Flipped Classroom Presentations Site/Industry Visit
4	TLO 4.1 Describe given terms related to public lighting installation. TLO 4.2 Select proper materials for streetlights installation. TLO 4.3 Select proper materials for High-mast lighting installation. TLO 4.4 Carry out estimation of streetlights and High-mast lighting.	**Unit - IV Public Lighting Installation** 4.1 Classification of outdoor installations, streetlight/ public lighting installation, Terminology used according to NEC 2023 – Terms related to highway, lighting installation, photometric terms, luminaries etc. Aim of public lighting installation, classification of roads, standard layout of roads. 4.2 Streetlight pole structures. Selection of equipment, sources used in streetlight installations. Cables, recommended types and sizes of cable. On off Control of equipment of streetlight installation. 4.3 High-mast pole structure, selection of equipment, wiring diagram. 4.4 Design, estimation and costing of streetlights and High-mast lighting.	Lecture Using Chalk-Board Presentations Case Study Flipped Classroom Site/Industry Visit
5	TLO 5.1 Compare the given types of distribution lines. TLO 5.2 Describe the given material required for distribution lines. TLO 5.3 Carry out estimates for the specified distribution lines.	**Unit - V Distribution Lines** 5.1 Block Diagram of Electrical Power system, Types of Distribution lines - Primary and Secondary, Overhead and Underground, and it's comparison. 5.2 Materials used for distribution line HT (11kV) and LT (415 V), Cables used for distribution line, factors determining selection of LT/ HT power cables, and cable termination methods. 5.3 Design, estimation and costing of HT (11kV), LT (415 V) overhead line and underground cabling.	Presentations Lecture Using Chalk-Board Flipped Classroom Case Study Site/Industry Visit

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

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 1.1 Prepare a quotation from the given enquiry.	1	*Preparation of a quotation.	2	CO1
LLO 2.1 Prepare a comparative statement from a minimum of three quotations.	2	*Preparation of a comparative statement.	2	CO1
LLO 3.1 Prepare a purchase order from the comparative statement.	3	*Preparation of the purchase order.	2	CO1

ELECTRICAL ESTIMATING AND CONTRACTING **Course Code : 314325**

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 4.1 Prepare tender document for purchase of electrical machines costing more than five lakhs. LLO 4.2 Use GeM portal for searching of software, tools/equipment for procurement.	4	Preparation of the tender document.	2	CO1
LLO 5.1 Calculate total load for given domestic installation. LLO 5.2 Draw electrical installation plan from given civil engineering drawing. LLO 5.3 Calculate number of subcircuits, ratings of main switch and distribution board. LLO 5.4 Draw single line diagram of distribution board for given installation. LLO 5.5 Carry out estimation for above given domestic installation.	5	*Design an electrical installation system for one BHK domestic unit and carry out an estimation.	8	CO2
LLO 6.1 Draw electrical installation plan from given civil engineering drawing using suitable drawing software. LLO 6.2 Draw single line diagram of distribution board for given installation using suitable drawing software.	6	*Domestic installation drawing using suitable software (mentioned in Practical No. 5).	4	CO2
LLO 7.1 Calculate total load for given commercial installation. LLO 7.2 Draw electrical installation plan from given civil engineering drawing. LLO 7.3 Calculate number of subcircuits, ratings of main switch and distribution board. LLO 7.4 Draw single line diagram of distribution board for given installation. LLO 7.5 Carry out estimation for above given commercial installation.	7	*Design an electrical installation system for a commercial unit and carry out an estimation.	8	CO2
LLO 8.1 Draw electrical installation plan from given civil engineering drawing using suitable drawing software. LLO 8.2 Draw single line diagram of distribution board for given installation using suitable drawing software.	8	*Commercial installation drawing using suitable software (mentioned in Practical No. 7).	4	CO2

ELECTRICAL ESTIMATING AND CONTRACTING **Course Code : 314325**

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 9.1 Calculate total load for given industrial installation. LLO 9.2 Draw electrical installation plan from given civil engineering drawing. LLO 9.3 Calculate size of cable, ratings of main switch and distribution board. LLO 9.4 Draw single line diagram of distribution board for given installation. LLO 9.5 Carry out estimation for above given industrial installation.	9	*Design an electrical installation system for small industrial installation and carry out an estimation.	8	CO3
LLO 10.1 Draw single line diagram of distribution board for given installation using suitable drawing software.	10	Commercial installation drawing using suitable software (mentioned in Practical No. 9).	2	CO3
LLO 11.1 Draw a layout diagram for streetlights installation from a given civil engineering drawing. LLO 11.2 Draw the details of a streetlight pole and layout as per NEC 2023. LLO 11.3 Select the size of cable by calculating voltage drop. LLO 11.4 Carry out the estimation for given streetlight installation.	11	*Design an electrical installation system for street lights of small premises and carry out an estimation.	6	CO4
LLO 12.1 Draw layout diagram for low-tension (LT) line from given data. LLO 12.2 Carry out the estimation for low-tension (LT) line.	12	*Design an electrical installation system for a low-tension (LT) distribution line (415 volts) and carry out an estimation.	6	CO5
LLO 13.1 Draw layout diagram for high-tension (HT) line from given data. LLO 13.2 Carry out the estimation for high-tension (HT) line.	13	Design an electrical installation system for a high-tension (HT) distribution line (11 kV) and carry out an estimation.	6	CO5

Note : Out of above suggestive LLOs -

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

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

Micro project

- Carry out market survey of electrical materials for comparison of quality and cost.
- Collect an electrical engineering drawing of the existing electrical installation. Interpret it. Prepare a report on it.
- Collect industrial installation plan and prepare estimation for the same using suitable software.
- Collect existing installation plan of distribution lines and prepare an estimation for the same.
- Collect the existing installation plan of the street lighting scheme and prepare an estimation for the same.
- Collect the existing installation plan of the High-mast lighting scheme and prepare an estimation for the same.
- Collect the existing installation plan of the low-tension (LT) line and prepare an estimation for the same.
- Collect the existing installation plan of the high-tension (HT) line and prepare an estimation for the same.
- Collect any tender document related to electrical installation and fill all related documents.
- Collect list of vendors and specifications of electrical goods from GeM portal.

ELECTRICAL ESTIMATING AND CONTRACTING **Course Code : 314325**

Note :

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

VIII. LABORATORY EQUIPMENT / INSTRUMENTS / TOOLS / SOFTWARE REQUIRED

Sr.No	Equipment Name with Broad Specifications	Relevant LLO Number
1	All In One Computer with following specifications. Processor - 13th Gen Intel® Core™ i5-13500T, OS-Windows 11 Pro, Graphics - Intel® Graphics, Memory - 8 GB: 1 x 8 GB, DDR4 , Storage - 256 GB, M.2 2230, PCIe NVMe, SSD, Class 35 , Display - 60.5-cm. display Full HD (1920X1080)	1,6,8,10
2	Laser jet multifunction printer	1,6,8,10
3	Any proprietary or open-source drawing Software	6,8,10

IX. SUGGESTED 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	Estimates and Contracts	CO1	5	2	4	4	10
2	II	Domestic and Commercial Installations	CO2	12	2	8	8	18
3	III	Industrial Installations	CO3	12	2	8	8	18
4	IV	Public Lighting Installation	CO4	8	2	4	8	14
5	V	Distribution Lines	CO5	8	2	0	8	10
Grand Total				**45**	**10**	**24**	**36**	**70**

X. ASSESSMENT METHODOLOGIES/TOOLS

Formative assessment (Assessment for Learning)

- Two unit tests of 30 marks will be conducted and average of marks obtained in these two unit tests will be considered. Each practical will be assessed for 25 marks and average of all marks obtained will be considered.

Summative Assessment (Assessment of Learning)

- End semester assessment of 70 marks for classroom learning. End semester assessment of 25 marks for laboratory learning.

XI. SUGGESTED COS - POS MATRIX FORM

ELECTRICAL ESTIMATING AND CONTRACTING **Course Code : 314325**

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

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

XII. SUGGESTED LEARNING MATERIALS / BOOKS

Sr.No	Author	Title	Publisher with ISBN Number
1	K.B.Raina, S.K.Bhattacharya	Electrical Design Estimating and Costing	New Age International Publisher, First, Reprint 2010, ISBN:13: 978-8122443585
2	Surjit Singh, Ravi Deep Singh	Electrical Estimating and Costing	Dhanpat Rai and Sons, 2014 New Delhi, ISBN:1234567150995
3	J.B. Gupta	A Course in Electrical Installation Estimating and Costing	S.K. Kataria and Sons; New Delhi Reprint Edition, 2013, ISBN: 13: 978-9350142790
4	BIS	SP-30:2023, National Electrical Code, 2023	Bureau of Indian Standards
5	BIS	IS: 732-1989, Code of Practice for Electrical Wiring Installation	Bureau of Indian Standards

XIII . LEARNING WEBSITES & PORTALS

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

Note :

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

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ELECTRICAL MATERIAL AND WIRING PRACTICE **Course Code : 313015**

Programme Name/s : **Electrical Engineering/ Electrical Power System**
Programme Code : **EE/ EP**
Semester : **Third**
Course Title : **ELECTRICAL MATERIAL AND WIRING PRACTICE**
Course Code : **313015**

I. RATIONALE

Electrical diploma engineers should be able to select relevant electrical materials and accessories for different applications while carrying out new work or maintenance work. They should be well conversant with the specifications of material as per the applications and wiring practices. This course will enable the students to identify and select the material for a particular application and also take up the wiring related work like, selection of material for wiring, carry out the wiring and testing etc.

II. INDUSTRY / EMPLOYER EXPECTED OUTCOME

Carry out wiring and maintenance activities using relevant materials, tools and safety practices.

III. COURSE LEVEL LEARNING OUTCOMES (COS)

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

- CO1 - Follow safe working practices when undertaking electrical work.
- CO2 - Select relevant conducting, electromagnetic and magnetic materials.
- CO3 - Select relevant insulating materials.
- CO4 - Perform different types of electrical wiring and cabling activities.
- CO5 - Implement relevant earthing systems.

IV. TEACHING-LEARNING & ASSESSMENT SCHEME

Course Code	Course Title	Abbr	Course Category/s	Learning Scheme					Credits	Assessment Scheme												
				Actual Contact Hrs./Week			SLH	NLH		Paper Duration	Theory				Based on LL & TL				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	
313015	ELECTRICAL MATERIAL AND WIRING PRACTICE	EMW	SEC	1	-	4	1	6	3	-	-	-	-	-	50	20	25@	10	25	10	100

Total IKS Hrs for Sem. : 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, *# On Line Examination , @$ Internal Online Examination
Note :

1. FA-TH represents average of two class tests of 30 marks each conducted during the semester.
2. If candidate is not securing minimum passing marks in FA-PR of any course then the candidate shall be declared as "Detained" in that semester.
3. If candidate is not securing minimum passing marks in 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.* 15 Weeks
5. 1 credit 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.

ELECTRICAL MATERIAL AND WIRING PRACTICE **Course Code : 313015**

V. THEORY LEARNING OUTCOMES AND ALIGNED COURSE CONTENT

Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
1	TLO 1.1 State safety rules/ standards applicable for the given electrical systems. TLO 1.2 Describe the use of the given tools in the given electrical engineering situation. TLO 1.3 Describe the use of the given safety accessories in the given electrical engineering situation. TLO 1.4 Describe the functions/applications of the given components of wiring.	**Unit - I Wiring Components, Tools and Safety Devices** 1.1 IE rules 1956 (Chapter IV-General safety requirements- No. 29 to 46) 1.2 Applications of Tools used in wiring: Pliers, nose pliers, cutter, screw driver, tester, test lamp, crimping tool, continuity tester, outside micrometer, knife. 1.3 Applications of safety Accessories: hand gloves, helmet, boots, goggles, rubber mats, types of fire extinguishers. 1.4 Components with specifications used in wiring systems: different types of switches (single and double pole), plugs, sockets, DBs, MCBs, MCCBs, RCCBs, holders, wires, cables. (No working only ratings needs to be explained for all these components)	Chalk-Board Presentations Videos Demonstrations, Role play
2	TLO 2.1 Explain the salient features of the given type of conductor with respect to the needed functional properties. TLO 2.2 Explain with justification the applications for the given electrical conductors in specified situations. TLO 2.3 Describe with justification the use of various magnetic materials in the given electrical engineering situation.	**Unit - II Conducting and Electromagnetic Materials** 2.1 Conducting materials: Electrical, Mechanical and Thermal Properties. 2.2 Applications of Conducting materials: copper, aluminium, tungsten, brass, bronze, mercury, silver, lead, nickel and tin. 2.3 Magnetic materials- silicon Steel (CRGO, HRGO) and Amorphous material: properties and their applications	Chalk-Board, Presentations, Demonstration
3	TLO 3.1 Explain the properties of the given electrical insulating materials. TLO 3.2 Classify insulating materials based on working temperature TLO 3.3 Describe the failure phenomena in the given type of insulating material(s). TLO 3.4 Suggest relevant insulating material(s) for the given application(s) with justification.	**Unit - III Electrical Insulating Materials** 3.1 Significance and properties of electrical insulating materials: electrical, mechanical and thermal properties. 3.2 Classification of insulating materials based on working temperature. 3.3 Causes of failure of insulating materials 3.4 Applications of insulating materials in electrical machines and devices.	Chalk-Board, Presentations, Video Demonstration, Model Demonstration

ELECTRICAL MATERIAL AND WIRING PRACTICE **Course Code : 313015**

Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
4	TLO 4.1 Explain with justification the criteria for selecting wire/cable and other electrical components for the given type of installation. TLO 4.2 Describe with sketches the installation of wiring systems for the given type of occupancy. TLO 4.3 Describe with sketches the wiring type as per the functional requirements of the given type of occupancy. TLO 4.4 Explain the process of installing the given type of cable(s).	**Unit - IV Electrical Wiring** 4.1 Types of wires and cables, components and accessories of electrical wiring systems. 4.2 Electrical Wiring systems (PVC casing-capping, conduit and concealed), panel wiring 4.3 Electrical Wiring types (one lamp control, staircase and godown) 4.4 Cable laying, Cable joints (terminations), proper size lugs, crimping of joints.	Chalk-Board, Presentations, Demonstration, Videos
5	TLO 5.1 Recommend with justification the necessity of the type of earthing in the given electrical installation system(s). TLO 5.2 Explain the criteria for recommending the earthing system for the given electrical installation. TLO 5.3 Describe with sketches the installation of the given earthing system. TLO 5.4 Describe the testing procedure for the given earthing systems.	**Unit - V Earthing Systems** 5.1 Types of earthing systems (Rod, pipe, plate, chemical earthing). 5.2 Installation of earthing systems. 5.3 Measurement of earthing resistance by Earth tester, Earth resistance values for various installations as per IEEE standards 5.4 Adverse effects of improper earthing system, methods to reduce the earth resistance	Chalk-Board, Presentations, Videos, Model demonstration

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

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 1.1 Use different electrical safety accessories and follow safe practices.	1	*Use of different electrical safety accessories and follow safe practices.	2	CO1
LLO 2.1 Douse the class ‘A’ type fire with suitable medium.	2	*Dousing of class ‘A’ type fire with suitable medium.	2	CO1
LLO 3.1 Rescue a person and apply respiratory methods.	3	*Rescue a person and practice artificial respiration.	2	CO1
LLO 4.1 Use different types of electrical/electronic tools.	4	*Use of different types of electrical/electronic tools.	2	CO1
LLO 5.1 Test the working of single pole one way and two way switches and MCB.	5	Testing of single pole one way, two way switches and MCB using relevant tools and instruments.	2	CO1
LLO 6.1 Operate the MCCB	6	Demonstration of MCCB	2	CO1
LLO 7.1 Test the working of fuse.	7	Testing of rewirable fuse.	2	CO1
LLO 8.1 Prepare series lamp test board with 2 m wire extention.	8	*Preparation of series lamp test board with 2m wire extention.	2	CO1
LLO 9.1 Test the performance of the RCCB.	9	Testing of the RCCB.	2	CO1
LLO 10.1 Choose the appropriate fuse rating and its location for the given circuit.	10	*Selection of fuses in different lighting circuits.	2	CO2
LLO 11.1 Measure insulation resistance of cables using insulation tester	11	*Measurement of insulation resistance of cables using insulation tester	2	CO3

ELECTRICAL MATERIAL AND WIRING PRACTICE **Course Code : 313015**

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 12.1 Select insulating materials for specific applications.	12	Selection of insulating materials for specific applications from given samples (at least five).	2	CO3
LLO 13.1 Measure insulation resistance of electrical installation using insulation tester	13	*Insulation resistance test on electrical installation.	2	CO3
LLO 14.1 Test insulating oil for its dielectric strength.	14	*Dielectric strength test of given insulating oil sample.	2	CO4
LLO 15.1 Carry out staircase wiring LLO 15.2 Test the working of staircase wiring.	15	Preparation of staircase wiring and its testing.	2	CO4
LLO 16.1 Carry out godown wiring. LLO 16.2 Test the working of godown wiring.	16	Preparation of godown wiring and its testing.	2	CO4
LLO 17.1 Carry out switch board wiring LLO 17.2 Test the working of switch board.	17	*Preparation of switch board containing four switch, four socket arrangements (with MCB, indicator etc.).	4	CO4
LLO 18.1 Fix and test LED tube.	18	LED tube light mounting, testing and fault finding.	2	CO4
LLO 19.1 Trace cable laying.	19	Power cable tracing. (For machine installation in laboratory)	2	CO4
LLO 20.1 Carry out the polarity test of the electrical installation of machine laboratory.	20	*Electrical installation testing.	2	CO4
LLO 21.1 Draw and trace LT cable.	21	LT cable tracing. (from LT substation-transformer of your college to your laboratory.)	2	CO4
LLO 22.1 Carry out electrical wire joints.	22	*Preparation of electrical wire joints (simple twist, married, Tee and western union joints).	2	CO4
LLO 23.1 Carry out electrical wire joints.	23	*Preparation of electrical wire joints (britannia straight, Britannia tee and rat tail joints).	2	CO4
LLO 24.1 Carry out lug crimping for cable.	24	Lug crimping for cable leads.	2	CO4
LLO 25.1 Carry out PVC casing-capping and conduit wiring.	25	*Preparation of PVC casing-capping, conduit wiring for minimum four points of 3m length.	4	CO4
LLO 26.1 Carry out wiring to control lamp from different places.	26	One lamp control from three and/or four different places.	2	CO4
LLO 27.1 Trace and draw electrical schematic drawings of a panel.	27	*Tracing of electrical schematic drawings of a panel of any electrical machine in your laboratory.	2	CO4
LLO 28.1 Carry out plate earthing.	28	*Plate earthing.	2	CO5
LLO 29.1 Carry out chemical earthing.	29	Chemical earthing.	2	CO5
LLO 30.1 Test / measure earthing resistance of electrical installation.	30	Testing and measurement of earthing resistance.	2	CO5

Note : Out of above suggestive LLOs -

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

ELECTRICAL MATERIAL AND WIRING PRACTICE **Course Code : 313015**

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

Assignment

- Prepare chart about the information of different types of magnetic materials (ferromagnetic, paramagnetic, diamagnetic).
- Draw the sketches of plate/pipe/rod/chemical earthing.
- Draw the wiring diagram of Flat/Bunglow 1BHK/2BHK.
- Prepare chart about the information of different types of magnetic materials (ferromagnetic, paramagnetic, diamagnetic).
- Draw the wiring diagram of electrical panel.
- Draw symbols related to electrical accessories and wiring.
- Draw the hysteresis loops for hard steel, wrought iron and alloyed steel.
- Identify various parts of electrical panel.

Visit

- Visit to a nearby construction site and observe the electrification work being carried out and note details of wires, switchgears, earthing practices, safety aspects being followed etc.

Micro project

- Collect the information about distribution substation earthing and submit report on it.
- Collect the sample/information about different types and sizes of wires, cables, and switches available in the market and submit report on it.
- Collect information from internet or otherwise on the different electromagnetic materials along with the forms in which they are available and submit report on it.
- Carry out profile lighting upto 5m length with suitable driver (choke).
- Collect the information about methods of wiring and submit report on it.
- Collect the information about MCBs and MCCBs of different specifications and submit report on it.
- Collect the information about RCCBs of different specifications and submit report on it.

Self learning topics

- Latest tools and techniques in the field of electrical wiring, earthing, materials.

Note :

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

VIII. LABORATORY EQUIPMENT / INSTRUMENTS / TOOLS / SOFTWARE REQUIRED

Sr.No	Equipment Name with Broad Specifications	Relevant LLO Number
1	Various fuse mounting units, fuse wire of different rating, ammeter, lamp bank.	10
2	Insulation tester 500V or 1000V	11,13
3	Insulating materials of different classes, electric iron	12

ELECTRICAL MATERIAL AND WIRING PRACTICE **Course Code : 313015**

Sr.No	Equipment Name with Broad Specifications	Relevant LLO Number
4	Dielectric oil test kit, dielectric oil samples	14
5	Wooden/PVC board, two way switches (6A)- 2 Nos, lamp holder- 1 No., lamp- 1 No.	15
6	Wooden/PVC board, one way switch- 1 No., two way switches (6A)- 2 Nos, lamp holder- 3 No., lamp- 3 No.	16
7	Wooden/PVC board, single pole switches (6A)- 4 Nos., sockets (5 pin-6A), MCB- 2A, red color indicator- 1No.	17
8	18/20 Watt LED tube with mounting brackets and screws	18
9	Bucket filled with water, sand, Class 'A' type fire extinguisher.	2
10	Electric tester, test lamp, multimeter.	20
11	Electrician's knife, stainless steel rule, diagonal cutting plier, combination plier, wooden mallet, bastard flat file, hard vice, wires of various sizes, bare copper wire, GI wire, sand paper, cotton cloth.	22,23
12	Crimping lugs, crimping tool, combination plier, knife.	24
13	PVC casing capping-3 meter, PVC conduit -3 meter, wires, wooden/PVC board, switches and sockets	25
14	Wooden/PVC board, lamp holder, lamp, 2 way switches(6A)- 2 Nos.	26
15	Copper plate, salt, wood coal, copper or GI wire etc.	28
16	Chemical mixture containing Bentonite, salt, charcoal, chemical electrode, Copper or GI strip/conductor	29
17	Wooden stick, rubber mat, chart or videos of rescue procedure and respiratory methods.	3
18	Earth tester (Anolog/Digital)	30
19	Pliers, screw driver set, nose pliers, measuring tape, cutter cum insulation remover, screw driver, tester, test lamp, crimping tool, lugs, continuity tester, outer micrometer, knife, soldering gun	4
20	Single pole one way and two switches (6A) – 1 No. each, MCB 1/2A- 1No. each, MI/Digital type AC Ammeter 0-10 A, Lamp bank- 10A.	5,7
21	MCCB TP- 100A- 1 No. MCCB TPN- 100A- 1No.	6
22	Rewirable Kitkat fuse, fuse wire.	7
23	Wooden/PVC board, lamp holder, lamp, extention wire 2m	8
24	RCCB- 16 A double pole, sensitivity 30mA, lamp bank, switch.	9
25	Safety hand gloves, safety boots, safety goggles, safety rubber mats, safety helmet (All ISI Mark).	All

IX. SUGGESTED 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	Wiring Components, Tools and Safety Devices	CO1	3	0	0	0	0
2	II	Conducting and Electromagnetic Materials	CO2	3	0	0	0	0
3	III	Electrical Insulating Materials	CO3	3	0	0	0	0
4	IV	Electrical Wiring	CO4	3	0	0	0	0
5	V	Earthing Systems	CO5	3	0	0	0	0
Grand Total				**15**	**0**	**0**	**0**	**0**

X. ASSESSMENT METHODOLOGIES/TOOLS

Formative assessment (Assessment for Learning)

ELECTRICAL MATERIAL AND WIRING PRACTICE **Course Code : 313015**

- For formative assessment of laboratory learning 50 marks. Each practical will be assessed considering appropriate % weightage to process and product and other instructions of assessment.

Summative Assessment (Assessment of Learning)

- End semester summative assessment of 25 marks for laboratory learning.

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

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

XII. SUGGESTED LEARNING MATERIALS / BOOKS

Sr.No	Author	Title	Publisher with ISBN Number
1	Bhattacharya S. K.	Electrical Engineering Drawing	New Age International, New Delhi, ISBN: 978-81-224-0855-3.
2	Singh R.P.	Electrical Workshop: Safety, commissioning, maintenance and testing of electrical equipment	I.K. International Publishing House , Pvt. Ltd. New Delhi, ISBN:978-9389447057
3	Gupta J. B.	Electrical Estimating and Costing	S. K. Kataria & Sons, New Delhi, ISBN:978-93-5014-279-0
4	Uppal S.L; Garg G.C.	Electrical Wiring, Estimating and Costing	Khanna Publishers, New Delhi, ISBN-13: 978-81-7409-240-3.
5	Indulkar C.S. & Thiruvengadam S.	An introduction to electrical engineering materials	S Chand & Co., ISBN :978-8121906661

XIII . LEARNING WEBSITES & PORTALS

Sr.No	Link / Portal	Description
1	www.bharatskills.gov.in	Directorate general of training - central repository for skills in NSQF curriculum
2	https://www.osha.gov/sites/default/files/publications/osha3075.pdf	Controlling Electrical Hazards
3	https://nsc.org.in/	National safety council of India
4	https://www.esfi.org/	Electrical safety foundation

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ELECTRICAL MATERIAL AND WIRING PRACTICE **Course Code : 313015**

Sr.No	Link / Portal	Description

Note :

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

MSBTE Approval Dt. 02/07/2024 **Semester - 3, K Scheme**

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ELECTRICAL POWER GENERATION,TRANSMISSION AND DISTRIBUTION **Course Code : 313333**

Programme Name/s : **Electrical Engineering/ Electrical and Electronics Engineering/ Electrical Power System**

Programme Code : **EE/ EK/ EP**

Semester : **Third**

Course Title : **ELECTRICAL POWER GENERATION,TRANSMISSION AND DISTRIBUTION**

Course Code : **313333**

I. RATIONALE

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

II. INDUSTRY / EMPLOYER EXPECTED OUTCOME

Maintain the functioning and operation of the electrical power generation, transmission and distribution systems.

III. COURSE LEVEL LEARNING OUTCOMES (COS)

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

- CO1 - Maintain the optimised working of the thermal power plant and hydro power plant.
- CO2 - Select the relevant power generation technology based on economic operation.
- CO3 - Interpret the normal operation and parameters of the electric transmission system.
- CO4 - Interpret the parameters of the extra high voltage transmission system.
- CO5 - Maintain the functioning and operation of electric power distribution system.

IV. TEACHING-LEARNING & ASSESSMENT SCHEME

Course Code	Course Title	Abbr	Course Category/s	Learning Scheme					Credits	Assessment Scheme											
				Actual Contact Hrs./Week			SLH	NLH		Paper Duration	Theory				Based on LL & TL				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	
313333	ELECTRICAL POWER GENERATION,TRANSMISSION AND DISTRIBUTION	GTD	DSC	4	-	2	2	8	4	3	30	70	100	40	25	10	25@	10	25	10	175

Total IKS Hrs for Sem. : 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, *# On Line Examination , @$ Internal Online Examination

Note :

1. FA-TH represents average of two class tests of 30 marks each conducted during the semester.
2. If candidate is not securing minimum passing marks in FA-PR of any course then the candidate shall be declared as "Detained" in that semester.
3. If candidate is not securing minimum passing marks in 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.* 15 Weeks
5. 1 credit 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.

V. THEORY LEARNING OUTCOMES AND ALIGNED COURSE CONTENT

Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.

ELECTRICAL POWER GENERATION,TRANSMISSION AND DISTRIBUTION **Course Code : 313333**

Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
1	TLO 1.1 Describe the layout of the electric power generating process with a labeled block diagram of the specified power plant. TLO 1.2 State the functions of a given type of major auxiliaries of specified power plant. TLO 1.3 Distinguish between Thermal Power Plant and Hydro Power Plant. TLO 1.4 Describe the specified safe practices to be followed for a specified power plant.	**Unit - I Thermal Power Plant and Hydro Power Plant** 1.1 Classification of various energy sources (Renewable and Non-Renewable). 1.2 Site selection, Layout and working of a typical Thermal Power Plant. 1.3 Functions of the following major auxiliaries used in Thermal Power Plant: Coal fired boilers: fire tube and water tube and Heat recovery system (Super heater, Economiser and Air pre-heater). 1.4 Site selection, Layout and working of a typical Hydro power plant. 1.5 Classification of hydro power plant: Run off river Power Plant without Pondage, Run off river Power Plant with Pondage, Reservoir Power Plant and Pumped Storage Power Plant. 1.6 Comparison between Thermal Power Plant and Hydro Power Plant. 1.7 Locations of these different types of Large and Micro-Hydro Power Plants in Maharashtra. 1.8 Safe Practices of Thermal Power Plants and Hydro Power Plants (Large and Micro)	Chalk-Board Presentations Model Demonstration Demonstration Video Flipped Classroom
2	TLO 2.1 Interpret the given Load curve, Load duration curve, Integration duration curve. TLO 2.2 Interpret the given values of the demand factor, plant capacity factor, plant use factor. TLO 2.3 Interpret the given values of the diversity factor, load factor and plant load factor. TLO 2.4 State the causes and impact of the given grid system fault.	**Unit - II Economics of Power Generation and Interconnected Power System** 2.1 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, spinning reserve. 2.2 Cost of generation: average demand, maximum demand, demand factor, plant capacity factor, plant use factor, diversity factor, load factor and plant load factor. 2.3 Choice of size and number of Generator units, combined operation of power station. 2.4 Causes, Impact and reasons of Grid system fault: State Grid, National Grid, brownout and black out; sample blackouts at National and International level	Chalk-Board Presentations Model Demonstration Video Demonstrations Flipped Classroom
3	TLO 3.1 Classify the given Transmission Line. TLO 3.2 Describe the construction and functioning of the given Transmission Line Components. TLO 3.3 Explain the concept of the given Transmission Line parameters. TLO 3.4 Evaluate the performance of short transmission Line based on the given criteria. TLO 3.5 Explain the given method(s) for representation of Medium Transmission Line. TLO 3.6 Describe the need for Transposition of Conductors.	**Unit - III Transmission Line Components, Parameters and Performance** 3.1 Electric power transmission systems: Single line diagrams. 3.2 Classification of transmission lines: Primary and Secondary transmission; standard voltage level used in India. 3.3 Transmission line Components: Types of Line supports, Line Insulators and Overhead/ Underground Conductors with their function. 3.4 Method of construction of electric supply transmission system – 110 kV, 220 kV, 400 kV. 3.5 Transmission Line Parameters: R, L and C and types of lines. 3.6 Performance of short line: Efficiency, Regulation and its derivation, Effect of Power Factor, Vector Diagram for different Power Factor. 3.7 Representation of medium line: Nominal ‘T’, Nominal ‘Pi’ and End condenser methods. 3.8 Skin effect and Proximity Effect, Transposition of conductors and its necessity.	Chalk-Board Presentations Model Demonstration Demonstration Video Flipped Classroom

ELECTRICAL POWER GENERATION,TRANSMISSION AND DISTRIBUTION **Course Code : 313333**

Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
4	TLO 4.1 State the Rating and functions of the given type of transmission line. TLO 4.2 State the Rating and functions of the given High voltage Substation component(s). TLO 4.3 Explain the specified effects occurring in the given type of high voltage transmission line. TLO 4.4 Explain the importance of line compensation in High voltage transmission line. TLO 4.5 Describe the layout of the given HVDC transmission lines with sketches. TLO 4.6 Explain the concept of wireless transmission of electrical power.	**Unit - IV Extra High Voltage Transmission (HVAC and HVDC)** 4.1 Extra High Voltage AC (EHVAC) transmission line: 4.1.1 Necessity of UHV, EHV AC/ DC lines. 4.1.2 High voltage substation components: Transformers, Bus, Circuit breaker, Reactor, Lightning arrester, Relays, FACTs Devices. 4.1.3 High Temperature Low Sag (HTLS) Conductor in High voltage transmission lines: Features. 4.1.4 Ferranti and Corona effect 4.1.5 Line compensation: Need and benefits. 4.2 High Voltage DC (HVDC) Transmission Line: 4.2.1 Necessity and HVDC Lines in India. 4.2.2 HVDC Transmission lines: Components, applications, advantages, and limitations 4.2.3 Monopolar, bi-Polar and homo-polar transmission lines: Layout 4.3 EHVAC and HVDC transmission line: Features and Comparison. 4.4 Wireless transmission of electrical power.	Chalk-Board Presentations Model Demonstration Video Demonstrations Flipped Classroom
5	TLO 5.1 Classify the given Distribution line. TLO 5.2 Describe the Distribution line erection and functioning of the given components. TLO 5.3 Explain the concept of the given Distribution line Components. TLO 5.4 Elaborate the specified Distribution schemes. TLO 5.5 Evaluate the performance of the Distribution line based on the given criteria. TLO 5.6 Describe the given distribution substation layout and components.	**Unit - V Distribution Line Components, Parameters and Performance** 5.1 Electric power Distribution systems: Single line diagrams 5.2 Classification of Distribution lines: Primary and Secondary Distribution; standard voltage level used in India. 5.3 Distribution line Components: Types of Line supports, Line Insulators and Overhead/ Underground Conductors (ACSR/ Insulated Power Cables) with their function. 5.4 Method of Distribution line erection of electric supply – 220 V, 400V, 11 kV, 33 kV 5.5 Distribution line Feeder and Distributor Schemes: Radial, Ring, and Grid. 5.6 Distribution Performance of Distributor: voltage drop, sending end and receiving end voltage. 5.7 Distribution Substation: classification, site selection, advantages, disadvantages and applications. 5.8 Single Line Diagram (layout) of 33/11kV Sub-Station, 11kV/400V substation, symbols and functions of their components.	Chalk-Board Presentations Model Demonstration Video Demonstrations Flipped Classroom

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

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 1.1 Draw layout of the typical Thermal Power Plant LLO 1.2 Identify the different components of typical Thermal Power Plant LLO 1.3 Observe the operation of Thermal Power Plant	1	*Demonstration of a Thermal Power Plant using Visit/Animations/ Video programme.	2	CO1
LLO 2.1 Identify components of the Heat Recovery System. LLO 2.2 Describe the function of Components of the Heat Recovery System.	2	Process of Heat Recovery System in Thermal Power Plant.	2	CO1

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Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 3.1 Draw layout of the typical Hydro Power Plant. LLO 3.2 Identify the different components of typical Hydro Power Plant. LLO 3.3 Observe the operation of Hydro Power Plant.	3	*Demonstration of a Hydro Power Plant using Visit/Animations/ Video programme.	2	CO1
LLO 4.1 Draw layout of the typical Hydro Power Plant	4	Demonstration of a Pumped storage Hydro Power Plant using Visit/Animations/ Video programme.	2	CO1
LLO 5.1 Draw layout of the typical Hydro Power Plant	5	*Demonstration of Different types of Hydro Power Plant using Animations/ Video Programme.	2	CO1
LLO 6.1 Draw load curve of of Campus/ Institute building(s) LLO 6.2 Calculate various economic factors from the above load curve.	6	*Load curve of Campus/ Institute building(s) and calculation of following economical factors: Maximum demand, Average load, Load Factor, Reserve capacity, Plant capacity factor, utilization factor, Plant use factor and Diversity factor.	2	CO1 CO2
LLO 7.1 Select appropriate power generation technology as per variation in load demand.	7	*Selection of power generation technology as per variation in load demand of a given load curve	2	CO1 CO2
LLO 8.1 Draw Load Duration curve and Integrated load curve from a given load curve.	8	Load Duration curve and Integrated load curve.	2	CO2
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.	9	*Single line diagram of the Electric supply system.	2	CO3 CO5
LLO 10.1 Prepare single line diagram of 400 kV transmission line substation. LLO 10.2 Prepare plan and elevation diagram of 400 kV transmission line substation.	10	*Layout of 400kV transmission line substation.	2	CO3
LLO 11.1 Prepare single line diagram of 132 kV transmission line substation. LLO 11.2 Prepare plan and elevation diagram of 132 kV transmission line substation.	11	Layout of 132 kV transmission line substation.	2	CO3
LLO 12.1 Identify the components of Ultra High Voltage (UHV) Transmission lines.	12	*Demonstration of an Ultra High Voltage (UHV) Transmission lines using Animations/ Video Programme.	2	CO4
LLO 13.1 Identify the components of Extra High Voltage (EHV) Transmission lines.	13	Demonstration of Extra High Voltage (EHV) Transmission lines using Visit/Animations/ Video Programme.	2	CO4
LLO 14.1 Prepare single line diagram of HVDC transmission line. LLO 14.2 Prepare plan and elevation diagram HVDC transmission line.	14	*Layout of HVDC transmission line.	2	CO4

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Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 15.1 Prepare list of components of the distribution substation. LLO 15.2 Prepare a single line diagram of the distribution substation. LLO 15.3 Prepare plan and elevation diagram with clearances of distribution substation.	15	*Components of Distribution Substation.	2	CO5
LLO 16.1 Calculate load for Commercial and Residential Consumers. LLO 16.2 Prepare a feeder scheme for consumers.	16	*Distribution scheme for Commercial and Residential Consumers.	2	CO5
LLO 17.1 Calculate load for Industrial Consumer. LLO 17.2 Prepare a feeder scheme foIndustrial Consumer.	17	Distribution scheme for Industrial Consumer.	2	CO5

Note : Out of above suggestive LLOs -

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

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

Visit

- Visit your Institute or nearby Distribution Substation and observe the Layout and write the technical details about Main transformer, CT, PT, Lightning arrester, Earthing System etc.
- Visit nearby Pumped Storage Hydro Power station (if any) and observe the Layout and write the technical details of Generator, working cycles of Turbine, Reservoir, Penstock etc.
- Visit nearby Hydro Power station and observe the Layout and write the technical details of Generator, working cycles of Turbine, Reservoir, Penstock etc.
- Visit nearby Thermal Power station and observe the Layout and write the technical details of Boiler, generator, Turbine, Super heater, Economiser Air Preheater, Cooling Tower etc.
- Visit nearby Transmission line and observe the Layout and write the technical details about Main transformer, CT, PT, Lightning arrester, Earthing System etc.

Assignment

- Calculate various Economical factors from the given Load Curve.
- Prepare list of material used for Transmission line.
- Calculation on Commercial and Residential Consumers Load Demand
- Prepare list of material used for Transmission line.
- Prepare list of material used for Distribution line/ substation.
- Prepare list of material used for Transmission line substation.
- Calculation on Industrial Consumers Load Demand.
- Numericals on Economics of Power generation.

Micro project

- Prepare a 3D model of Pumped storage Hydro power Station.
- Prepare a 3D model of Hydro power Station.
- Prepare a 3D model of Thermal power Station.
- Prepare a comparative chart for UHVAC and HVAC Transmission line considering their Strength, Limitations, Capital cost involvement, Running Cost, Losses, Voltage regulation, Constructional details etc.
- Prepare a comparative chart for HVAC and HVDC Transmission line on the basis of their Strength, Limitations, Capital cost involvement, Running Cost, Losses, Voltage regulation, Constructional details etc.

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- 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.

Survey

- Collect information and prepare a report on Gas Insulated Substation (GIS).
- Collect information and prepare a report on Hydro Power Plants in Maharashtra/ India.
- Collect information and prepare a report on Thermal Power Plants in Maharashtra/ India.
- Collect information and prepare a report on latest technology used in Transmission Line.
- Collect information and prepare a report on latest technology used in Distribution Substation and Distribution lines.
- Collect information and prepare a report on Nearby Transmission Substation.
- Collect information and prepare a report on High Temperature Low Sag (HTLS) Conductor use in transmission lines.

Note :

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

VIII. 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 Transmission/Distribution Substation.	10,11,15
3	Video Programme/Animation/Demonstration Model of Hydro Power Plant.	3,4,5
4	Video Programme/Animation/Demonstration Model/Chart Demonstration of Electric Power System.	9
5	Video Programme/Animation/Demonstration Model of different Supporting structures / Insulators/ Conductors of Transmission Line.	9,10,13,14,16,17

IX. SUGGESTED 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	Thermal Power Plant and Hydro Power Plant	CO1	12	2	8	6	16
2	II	Economics of Power Generation and Interconnected Power System	CO2	10	2	4	4	10
3	III	Transmission Line Components, Parameters and Performance	CO3	14	2	8	6	16
4	IV	Extra High Voltage Transmission (HVAC and HVDC)	CO4	10	2	6	4	12
5	V	Distribution Line Components, Parameters and Performance	CO5	14	2	6	8	16
Grand Total				**60**	**10**	**32**	**28**	**70**

X. ASSESSMENT METHODOLOGIES/TOOLS

Formative assessment (Assessment for Learning)

- Two unit tests of 30 marks will be conducted and average of two unit tests considered.
- For formative assessment of laboratory learning 25 marks.
- Each practical will be assessed considering appropriate % weightage to process and product and other instructions of assessment.

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Summative Assessment (Assessment of Learning)

- End semester summative assessment of 25 marks for laboratory learning.
- End semester assessment of 70 marks through offline mode of examination.

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

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

XII. SUGGESTED LEARNING MATERIALS / BOOKS

Sr.No	Author	Title	Publisher with ISBN Number
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	Gupta B.R.	Generation of electrical Energy	S.Chand & Co. New Delhi, 2010, ISBN: 9788121901024
5	Sivanagaraju S.; Satyanarayana S.	Electrical Power Transmission and Distribution	Pearson ISBN : 8131707911, 9788131707913
6	Gupta B.R.	Power System Analysis and Design	S.Chand and Co. New Delhi ISBN : 9788121922388
7	Kamraju V.	Electrical Power Distribution System	Tata Mc.GrawHill, New Delhi ISBN : 9780070151413

XIII . LEARNING WEBSITES & PORTALS

Sr.No	Link / Portal	Description
1	www.ntpc.co.in	National Thermal Power Corporation is authority who control 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://www.electrical4u.com/electrical-engineering-articles/transmission/	Information about Electric Power Grid System.
4	www.meda.com	Maharashtra Energy Development Agency working under BEE for spreading Energy conservation awareness in maharashtra.
5	https://energy.gov/sites/prod/files/2013/07/f2/Transmission_Woodall_0.pdf	Transmission Line Basics

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Sr.No	Link / Portal	Description
6	https://www.electrical4u.com/performance-of-transmission-line/	Performance of Transmission Line
7	https://youtu.be/IdPTuwKEfmA?si=CfpZgHlEgrk5_YvW	Thermal Power Plant.
8	https://youtu.be/lidARL1w88Q?si=HXc3J4ISMTwHAMMw	Thermal Power Plant.

Note :

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

Programme Name/s	**: Architecture Assistantship/ Architecture and Interior Design/ Automobile Engineering./ Artificial Intelligence/ Agricultural Engineering/ Artificial Intelligence and Machine Learning/ Automation and Robotics/ Architecture/ Cloud Computing and Big Data/ Civil Engineering/ Chemical Engineering/ Computer Technology/ Computer Engineering/ Civil & Rural Engineering/ Construction Technology/ Computer Software Technology/ Computer Science & Engineering/ Fashion & Clothing Technology/ Dress Designing & Garment Manufacturing/ Digital Electronics/ Data Sciences/ Electrical Engineering/ Electronics & Tele-communication Engg./ Electrical and Electronics Engineering/ Electrical Power System/ Electronics & Communication Engg./ Electronics Engineering/ Food Technology/ Computer Hardware & Maintenance/ Hotel Management & Catering Technology/ Instrumentation & Control/ Industrial Electronics/ Information Technology/ Computer Science & Information Technology/ Instrumentation/ Interior Design & Decoration/ Interior Design/ Civil & Environmental Engineering/ Mechanical Engineering/ Mechatronics/ Medical Laboratory Technology/ Manufacturing Technology/ Medical Electronics/ Metallurgical Engineering/ Production Engineering/ Printing Technology/ Polymer Technology/ Computer Science/ Textile Technology/ Electronics & Computer Engg./ Travel and Tourism/ Textile Manufactures/**
Programme Code	**: AA/ AD/ AE/ AI/ AL/ AN/ AO/ AT/ BD/ CE/ CH/ CM/ CO/ CR/ CS/ CST/ CW/ DC/ DD/ DE/ DS/ EE/ EJ/ EK/ EP/ ET/ EX/ FC/ HA/ HM/ IC/ IE/ IF/ IH/ IS/ IX/ IZ/ LE/ ME/ MK/ ML/ MRT/ MU/ MY/ PG/ PN/ PO/ SE/ TC/ TE/ TR/ TX**
Semester	**: Third**
Course Title	**: ESSENCE OF INDIAN CONSTITUTION**
Course Code	**: 313002**

I. RATIONALE

This course will focus on the basic structure and operative dimensions of Indian Constitution. It will explore various aspects of the Indian political and legal system from a historical perspective highlighting the various events that led to the making of the Indian Constitution. The Constitution of India is the supreme law of India. The document lays down the framework demarcating the fundamental political code, structure, procedures, powers, and sets out fundamental rights, directive principles, and the duties of citizens. The course on constitution of India highlights key features of Indian Constitution that makes the students a responsible citizen. In this online course, we shall make an effort to understand the history of our constitution, the Constituent Assembly, the drafting of the constitution, the preamble of the constitution that defines the destination that we want to reach through our constitution, the fundamental right constitution guarantees through the great rights revolution, the relationship between fundamental rights and fundamental duties, the futurist goals of the constitution as incorporated in directive principles and the relationship between fundamental rights and directive principles.

II. INDUSTRY / EMPLOYER EXPECTED OUTCOME

The aim of this course is to help the student to attain the following industry /employer expected outcome – Abide by the Constitution in their personal and professional life.

III. COURSE LEVEL LEARNING OUTCOMES (COS)

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

- CO1 - List salient features and characteristics of the constitution of India.
- CO2 - Follow fundamental rights and duties as responsible citizen of the country.
- CO3 - Analyze major constitutional amendments in the constitution.

ESSENCE OF INDIAN CONSTITUTION **Course Code : 313002**

- CO4 - Follow procedure to cast vote using voter-id.

IV. TEACHING-LEARNING & ASSESSMENT SCHEME

Course Code	Course Title	Abbr	Course Category/s	Learning Scheme					Credits	Assessment Scheme											
				Actual Contact Hrs./Week			SLH	NLH		Paper Duration	Theory				Based on LL & TL				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	
313002	ESSENCE OF INDIAN CONSTITUTION	EIC	VEC	1	-	-	1	2	1	-	-	-	-	-	-	-	-	-	50	20	50

Total IKS Hrs for Sem. : 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, *# On Line Examination , @$ Internal Online Examination

Note :

1. FA-TH represents average of two class tests of 30 marks each conducted during the semester.
2. If candidate is not securing minimum passing marks in FA-PR of any course then the candidate shall be declared as "Detained" in that semester.
3. If candidate is not securing minimum passing marks in 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.* 15 Weeks
5. 1 credit 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.

V. THEORY LEARNING OUTCOMES AND ALIGNED COURSE CONTENT

Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
1	TLO 1.1 Explain the meaning of preamble of the constitution. TLO 1.2 Explain the doctrine of basic structure of the constitution. TLO 1.3 List the salient features of constitution. TLO 1.4 List the characteristics of constitution.	**Unit - I Constitution and Preamble** 1.1 Meaning of the constitution of India. 1.2 Historical perspectives of the Constitution of India. 1.3 Salient features and characteristics of the Constitution of India. 1.4 Preamble of the Constitution of India.	Presentations Blogs Hand-outs Modules Flipped classrooms Case studies
2	TLO 2.1 Enlist the fundamental rights. TLO 2.2 . Identify fundamental duties in general and in particular with engineering field. TLO 2.3 Identify situations where directive principles prevail over fundamental rights.	**Unit - II Fundamental Rights and Directive Principles** 2.1 Fundamental Rights under Part-III. 2.2 Fundamental duties and their significance under part-IV-A. 2.3 Relevance of Directive Principles of State Policy under part-IV A.	Presentations Blogs Hand-outs Modules Case Study Flipped Classroom

ESSENCE OF INDIAN CONSTITUTION **Course Code : 313002**

Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
3	TLO 3.1 Enlist the constitutional amendments. TLO 3.2 Elaborate the elements of Centre-State Relationship TLO 3.3 Analyze the purposes of various amendments.	**Unit - III Governance and Amendments** 3.1 3.1 Amendment procedure of the Constitution and their types - simple and special procedures. 3.2 The Principle of Federalism and its contemporary significance along with special committees that were setup. 3.3 Major Constitutional Amendment procedure - 1st, 7th, 42nd, 44th, 73rd & 74th, 76th, 86th, 52nd & 91st, 102nd	Cases of Federal disputes with relevant Supreme court powers and Judgements Presentations Blogs Hand-outs Problem based learning
4	TLO 4.1 Explain the importance of electoral rights. TLO 4.2 Write the step by step procedure for process of registration TLO 4.3 Explain the significance of Ethical electoral participation TLO 4.4 Explain the steps to motivation and facilitation for electoral participation TLO 4.5 Enlist the features of the voter's guide TLO 4.6 Explain the role of empowered voter TLO 4.7 Write the steps of voting procedure TLO 4.8 Write steps to create voter awareness TLO 4.9 Fill the online voter registration form TLO TLO 4.10 Follow procedure to cast vote using voter-id.	**Unit - IV Electoral Literacy and Voter's Education** 4.1 Electoral rights , Electoral process of registration 4.2 Ethical electoral participation 4.3 Motivation and facilitation for electoral participation 4.4 Voter's guide 4.5 Prospective empowered voter 4.6 Voting procedure 4.7 Voter awareness 4.8 Voter online registration https:/ /www.ceodelhi.gov.in/ELCdetails.aspx	Presentations Hand-outs Modules Blogs Problem based Learning

VI. LABORATORY LEARNING OUTCOME AND ALIGNED PRACTICAL / TUTORIAL EXPERIENCES : NOT APPLICABLE.

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

Assignment

- Outline the procedure to submit application for Voter-id
- Assignments are to be provided by the course teacher in line with the targeted COs.

A1. Prepare an essay on Constitution of India .
A2 Prepare a comparative chart of Unique features of Indian Constitution of India and Constitution of USA

- Assignments are to be provided by the course teacher in line with the targeted COs. A1. Prepare an essay on Constitution of India . A2 Prepare a comparative chart of Unique features of Indian Constitution of India and Constitution of USA A3. Self-learning topics: Parts of the constitution and a brief discussion of each part Right to education and girl enrollment in schools. GER of Girls and Boys. Right to equality. Social Democracy. Women Representation in Parliament and State Assemblies. LGBTQIA+

Micro project

- 1. Organize a workshop-cum discussions for spreading awareness regarding Fundamental Rights of the citizen of the country

2. Prepare elaborations where directive principle of State policy has prevailed over Fundamental rights with relevant Supreme Court Judgements.
3. Organize a debate on 42nd, 97th and 103rd Constitutional Amendment Acts of Constitution of India.

Seminar

- 1 Differences in the ideals of Social democracy and Political democracy.

2 Democracy and Women's Political Participation in India.
3 Khap Panchayat - an unconstitutional institution infringing upon Constitutional ethos.
4 Situations where directive principles prevail over fundamental rights.

Group discussions on current print articles.

-

- Art 356 and its working in Post-Independent India.
- Women's Resrvation in Panchayat leading to Pati Panchayats - Problems and Solutions.
- Adoption of Article 365 in India.
- Need of Amendments in the constitution.
- Is India moving towards a Unitary State Model ?

Activity

- Arrange Mock Parliament debates.

Prepare collage/posters on current constitutional issues.
i. National (Art 352) & State Emergencies (Art 356) declared in India.
ii. Seven fundamental rights.
iii. Land Reforms and its effectiveness - Case study of West-Bengal and Kerala.

Cases: Suggestive cases for usage in teaching:

- A.K. Gopalan Case (1950) :SC contented that there was no violation of Fundamental Rights enshrined in Articles 13, 19, 21 and 22 under the provisions of the Preventive Detention Act, if the detention was as per the procedure established by law. Here, the SC took a narrow view of Article 21.

Shankari Prasad Case (1951) : This case dealt with the amendability of Fundamental Rights (the First Amendment's validity was challenged). The SC contended that the Parliament's power to amend under Article 368 also includes the power to amend the Fundamental Rights guaranteed in Part III of the Constitution.
Minerva Mills case (1980) :This case again strengthens the Basic Structure doctrine. The judgement struck down 2 changes made to the Constitution by the 42nd Amendment Act 1976, declaring them to violate the basic structure. The judgement makes it clear that the Constitution, and not the Parliament is supreme.
Maneka Gandhi case (1978) :A main issue in this case was whether the right to go abroad is a part of the Right to Personal Liberty under Article 21. The SC held that it is included in the Right to Personal Liberty. The SC also ruled that the mere existence of an enabling law was not enough to restrain personal liberty. Such a law must also be "just, fair and reasonable."
Other cases:
1. Kesavananda Bharati Case (1973) : In this case the Hon. SC laid down a new doctrine of the 'basic structure' (or 'basic features') of the Constitution. It ruled that the constituent power of Parliament under Article 368 does not enable it to alter the 'basic structure' of the Constitution. This means that the Parliament cannot abridge or take away a Fundamental Right that forms a part of the 'basic structure' of the Constitution.
2. Mathura Rape Case(1979) : A tribal woman Mathura (aged 14 to 16 years) was raped in Police Custody. The case raised the questions on the idea of 'Modesty of Woman' and here it was was a tribal woman who succumbs to multiple pattiarchies. Custodial rape was made an offence and was culpable with the detainment of 7 years or more under Section 376 of Indian Penal Code. The weight of proofing the allegations moved from the victim to the offender, once sexual intercourse is established. The publication of the victim's identity was banned and it was also held that rape trials should be conducted under the cameras.
3. Puttswamy vs Union of India (2017) : In this landmark case which was finally pronounced by a 9-judge bench of the Supreme Court on 24th August 2017, upholding the fundamental right to privacy emanating from Article 21. The

court stated that Right to Privacy is an inherent and integral part of Part III of the Constitution that guarantees fundamental rights. The conflict in this area mainly arises between an individual's right to privacy and the legitimate aim of the government to implement its policies and a balance needs to be maintained while doing the same.
4. Navtej Singh Johar & Ors. v. Union of India (2018) : Hon. SC Decriminalised all consensual sex among adults, including homosexual sex by scrapping down section 377 of the Indian penal code (IPC). The court ruled that LGBTQ community are equal citizens and underlined that there cannot be discrimination in law based on sexual orientation and gender.
5. Anuradha Bhasin Judgement (2020) : The Supreme Court of India ruled that an indefinite suspension of internet services would be illegal under Indian law and that orders for internet shutdown must satisfy the tests of necessity and proportionality. The Court reiterated that freedom of expression online enjoyed Constitutional protection, but could be restricted in the name of national security. The Court held that though the Government was empowered to impose a complete internet shutdown, any order(s) imposing such restrictions had to be made public and was subject to judicial review.

Note :

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

VIII. LABORATORY EQUIPMENT / INSTRUMENTS / TOOLS / SOFTWARE REQUIRED : NOT APPLICABLE

IX. SUGGESTED 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	Constitution and Preamble	CO1	4	0	0	0	0
2	II	Fundamental Rights and Directive Principles	CO2	4	0	0	0	0
3	III	Governance and Amendments	CO3	4	0	0	0	0
4	IV	Electoral Literacy and Voter's Education	CO4	3	0	0	0	0
Grand Total				**15**	**0**	**0**	**0**	**0**

X. ASSESSMENT METHODOLOGIES/TOOLS

Formative assessment (Assessment for Learning)

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

Summative Assessment (Assessment of Learning)

XI. SUGGESTED COS - POS MATRIX FORM

ESSENCE OF INDIAN CONSTITUTION **Course Code : 313002**

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

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

XII. SUGGESTED LEARNING MATERIALS / BOOKS

Sr.No	Author	Title	Publisher with ISBN Number
1	P.M.Bakshi	The Constitution of India	Universal Law Publishing, New Delhi 15th edition, 2018, ISBN: 9386515105 (Check the new edition)
2	D.D.Basu	Introduction to Indian Constitution	Lexis Nexis Publisher, New Delhi, 2015, ISBN:935143446X
3	B. K. Sharma	Introduction to Constitution of India	PHI, New Delhi, 6thedition, 2011, ISBN:8120344197
4	MORE READS :	Oxford Short Introductions - The Indian Constitution by Madhav Khosla. The Indian Constitution: Cornerstone of a Nation by Granville Austin. Working a Democratic Constitution: A History by Garnville Austin Founding Mothers of the Indian Republic: Gender Politics of the Framing of the Constitution by Achyut Chetan. Our Parliament by Subhash C. Kashyap. Our Political System by Subhash C. Kashyap. Our Constitution by Subhash C. Kashyap. Indian Constitutional Law by Rumi Pal.	Extra Read
5	B.L. Fadia	The Constitution of India	Sahitya Bhawan,Agra, 2017, ISBN:8193413768

XIII . LEARNING WEBSITES & PORTALS

Sr.No	Link / Portal	Description
1	http://www.legislative.gov.in/constitution-of-india	Constitution overview
2	https://en.wikipedia.org/wiki/Constitution_of_India	Parts of constitution
3	https://www.india.gov.in/my-government/constitution-india	Constitution overview
4	https://www.toppr.com/guides/civics/the-indian-constitution/the-constitution-of-india/	Fundamental rights and duties
5	https://main.sci.gov.in/constitution	Directive principles
6	https://legalaffairs.gov.in/sites/default/files/chapter%203.pdf	Parts of constitution

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ESSENCE OF INDIAN CONSTITUTION **Course Code : 313002**

Sr.No	Link / Portal	Description
7	https://www.concourt.am/armenian/legal_resources/world_constitutions/constit/india/india-e.htm	Parts of constitution
8	https://constitutionnet.org/vl/item/basic-structure-indian-constitution	Parts of constitution

Note :

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

MSBTE Approval Dt. 02/07/2024 **Semester - 3, K Scheme**

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FUNDAMENTALS OF POWER ELECTRONICS **Course Code : 313335**

Programme Name/s : **Electrical Engineering/ Electrical Power System**
Programme Code : **EE/ EP**
Semester : **Third**
Course Title : **FUNDAMENTALS OF POWER ELECTRONICS**
Course Code : **313335**

I. 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 skill sets of operating and testing different power electronic devices and their applications.

II. INDUSTRY / EMPLOYER EXPECTED OUTCOME

Test the Performance of Power Electronic Devices and Circuits.

III. COURSE LEVEL LEARNING OUTCOMES (COS)

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 a thyristor.
- CO3 - Test the performance of given controlled converter.
- CO4 - Test the performance of given chopper.
- CO5 - Use suitable power electronic circuit for given application.

IV. TEACHING-LEARNING & ASSESSMENT SCHEME

Course Code	Course Title	Abbr	Course Category/s	Learning Scheme					Credits	Assessment Scheme											Total Marks
				Actual Contact Hrs./Week			SLH	NLH		Paper Duration	Theory				Based on LL & TL				Based on SL		
															Practical						
				CL	TL	LL					FA-TH	SA-TH	Total		FA-PR		SA-PR		SLA		
											Max	Max	Max	Min	Max	Min	Max	Min	Max	Min	
313335	FUNDAMENTALS OF POWER ELECTRONICS	FPE	SEC	3	-	4	1	8	4	3	30	70	100	40	25	10	25@	10	25	10	175

Total IKS Hrs for Sem. : 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, *# On Line Examination , @$ Internal Online Examination
Note :

1. FA-TH represents average of two class tests of 30 marks each conducted during the semester.
2. If candidate is not securing minimum passing marks in FA-PR of any course then the candidate shall be declared as "Detained" in that semester.
3. If candidate is not securing minimum passing marks in 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.* 15 Weeks
5. 1 credit 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.

V. THEORY LEARNING OUTCOMES AND ALIGNED COURSE CONTENT

FUNDAMENTALS OF POWER ELECTRONICS **Course Code : 313335**

Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
1	TLO 1.1 Illustrate the power electronic system using block diagram. TLO 1.2 Solve simple numerical on 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 Flipped Classroom
2	TLO 2.1 Explain the need of 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	**Unit - II Protection and Firing Circuit of Thyristor** 2.1 di/dt protection: need, 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 Presentations Video Demonstrations Flipped Classroom

FUNDAMENTALS OF POWER ELECTRONICS **Course Code : 313335**

Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
3	TLO 3.1 Define the given term(s) related to 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 on the basis of the given criteria. TLO 3.5 Explain working of the given single phase inverter. TLO 3.6 Explain working principle of sinusoidal pulse width modulation.	**Unit - III Controlled Converters** 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: 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 Presentations Video Demonstrations Flipped Classroom
4	TLO 4.1 Explain the given terminology related to chopper. TLO 4.2 Explain control strategies of chopper. TLO 4.3 Illustrate working of the given chopper. TLO 4.4 Calculate output voltage of the given chopper.	**Unit - IV DC-DC Converters** 4.1 Basic terminologies: duty ratio, turn on period, turn off period, chopping period 4.2 Control strategies of 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 Presentations Video Demonstrations Flipped Classroom
5	TLO 5.1 Explain the operation of charge controller used in the photovoltaics (PV) system. TLO 5.2 Explain speed control of ceiling fan using TRIAC. TLO 5.3 Explain AC to AC converter used in Wind Power Generation. TLO 5.4 Explain the function of converter station in HVDC.	**Unit - V Applications of Power Electronics** 5.1 Charge Controller: Concept, types, applications in Photovoltaics (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 Presentations Video Demonstrations Site/Industry Visit Case Study

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

FUNDAMENTALS OF POWER ELECTRONICS **Course Code : 313335**

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 1.1 Identify given power electronic device	1	*Power Electronic Devices.	2	CO1
LLO 2.1 Test the performance of SCR.	2	*V-I Characteristics of SCR.	2	CO1
LLO 3.1 Test the proper functioning of the power MOSFET.	3	*Testing of power MOSFET	2	CO1
LLO 4.1 Test the proper functioning of the IGBT.	4	*Testing of IGBT	2	CO1
LLO 5.1 Test the proper functioning of the TRIAC.	5	Testing of TRIAC.	2	CO1
LLO 6.1 Test the performance of Snubber circuit.	6	*Performance of Snubber circuit.	2	CO2
LLO 7.1 Test the effect of variation of resistance in R triggering circuit on the firing angle of SCR.	7	*Resistance triggering circuit of SCR.	2	CO2
LLO 8.1 Test the effect of variation of resistance and capacitance in RC triggering circuit on the firing angle of SCR.	8	RC triggering circuit of SCR	2	CO2
LLO 9.1 Perform the triggering of SCR using Pulse transformer	9	Triggering of SCR using Pulse transformer	2	CO2
LLO 10.1 Perform the operation of Class A commutation circuit.	10	*Class A (Load Commutation) commutation circuit.	2	CO2
LLO 11.1 Perform the operation of Class F commutation circuit.	11	Class F (Line Commutation) commutation circuit	2	CO2
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/DSO	12	*Operation of single phase half wave controlled rectifier with resistive load.	2	CO2 CO3
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/DSO	13	Operation of single phase half wave controlled rectifier with RL load without freewheeling diode.	2	CO2 CO3
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/DSO	14	*Operation of single phase half wave controlled rectifier with RL load with freewheeling diode.	2	CO2 CO3
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/DSO	15	Operation of single phase full wave controlled rectifier with R load.	2	CO2 CO3
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	16	*Operation of single phase full wave controlled rectifier with RL load.	2	CO2 CO3
LLO 17.1 Measure output voltage of three phase full wave controlled rectifier by using CRO/DSO. LLO 17.2 Use various controls of the CRO/DSO	17	Operation of three phase full wave controlled rectifier with R load.	2	CO2 CO3

FUNDAMENTALS OF POWER ELECTRONICS **Course Code : 313335**

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 18.1 Measure the output voltage with different firing angles of the controlled rectifier available in your laboratory	18	*Voltage control using controlled rectifier.	2	CO2 CO3
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	19	*Operation of single phase half wave bridge inverter with resistive load.	2	CO2 CO3
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	20	Operation of single phase full wave bridge inverter with resistive load.	2	CO2 CO3
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	21	Operation of single phase half wave bridge inverter with RL load.	2	CO2 CO3
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	22	Operation of single phase full wave bridge inverter with RL load	2	CO2 CO3
LLO 23.1 Measure the output voltage of chopper by varying duty cycle. LLO 23.2 Use various controls of the CRO/DSO	23	Operation of step-up chopper.	2	CO2 CO4
LLO 24.1 Measure the output voltage of chopper by varying duty cycle. LLO 24.2 Use various controls of the CRO/DSO	24	*Operation of step-down chopper.	2	CO2 CO4
LLO 25.1 Test the performance of charge controller in PV system.	25	Charge controller in PV system	2	CO4 CO5
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).	26	*Demonstration of AC to AC converter (with DC link) used in wind power plant.	2	CO3 CO4 CO5
LLO 27.1 Control the speed of fan using TRIAC.	27	*Speed control of fan using TRIAC.	2	CO3 CO5

Note : Out of above suggestive LLOs -

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

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

Micro project

- Build a power electronic circuit to produce variable voltage for a given application using following steps. 1) Identify voltage range for a given application. 2) Select circuit components suitable for the identified voltage range. 3)

Connect circuit components to build 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.

- Prepare a report on commercial or industrial applications of power electronics devices by performing following activities. 1) Identify 3 to 5 relevant applications. 2) Visit site and understand role of power electronic devices in identified applications. 3) Write the specifications of major components in the applications. 4) Prepare block diagram or process flow diagram of the applications.
- 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' site or official websites of power electronic devices 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.
- Build a circuit of charge controller for a given battery using following steps. 1) Write specifications of a given battery. 2) Select circuit components required for charge controller circuit suitable for given battery. 3) Connect circuit components to build charge controller. 4) Test change controller for controlling power flow through battery. 5) Prepare a report on the charge controller and submit the same.
- Any other relevant microproject assigned by subject teacher.

Assignment

- Numerical on losses in power electronic device.
- Prepare a report on evolution of power electronic devices.
- Numerical on 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 given by subject teacher.

Note :

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

VIII. LABORATORY EQUIPMENT / INSTRUMENTS / TOOLS / SOFTWARE REQUIRED

Sr.No	Equipment Name with Broad Specifications	Relevant LLO Number
1	SCR: Irms = 16A, IH = 100mA, IL = 200mA, IGT = 90 to 35 mA, VGT = 3 to 1 V, Vrms = 1600V	1,2,6,7,8,10,11,9,12,13,14,15,16,17,18
2	Power MOSFET: Vds-400V, ID-10A-6.3A Pd-125W	1,3,23,24
3	IGBT: Vces = 1200V, VGE = 20V, IC = 139 to 93A, PD = 650 to 300W	1,4,19,20,21,22
4	TRIAC: It = 4A, IGT = 10mA, Vt = 600V.	1,5
5	Rheostat: Nicrome 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

FUNDAMENTALS OF POWER ELECTRONICS **Course Code : 313335**

Sr.No	Equipment Name with Broad Specifications	Relevant LLO Number
11	Multimeter: 2000 count digital display, 1000V DC/750 V AC ranges, 10 A AC/DC ranges	All

IX. SUGGESTED 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**

X. ASSESSMENT METHODOLOGIES/TOOLS

Formative assessment (Assessment for Learning)

- 30 Marks of Theory FA shall be obtained from an average mark of two unit tests (each of 30 marks) held in the semester. At least 2 COs should be covered in each unit test.
- Continuous assessment shall be based on process and product related performance indicators and laboratory experiences. Each practical shall be assessed for 25 marks considering 60% weightage to process and 40% weightage to product.
- Rubrics of continuous assessment of practical, including performance indicators, shall be designed by concerned course teacher.

Summative Assessment (Assessment of Learning)

- End semester, theory summative assessment of 70 marks shall be based on offline mode of written examination.
- End semester, practical summative assessment of 25 marks shall be based on student's performance in end semester practical exam.

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

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

FUNDAMENTALS OF POWER ELECTRONICS **Course Code : 313335**

XII. SUGGESTED LEARNING MATERIALS / BOOKS

Sr.No	Author	Title	Publisher with ISBN Number
1	P S. Bimbhra	Power Electronics	KHANNA PUBLISHERS, ISBN:978-8174092793
2	Muhammad H. Rashid	Power Electronics Handbook	Butterworth-Heinemann Inc, ISBN:978-0128114070
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

XIII . 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 Opencourseware
5	https://youtube.com/playlist?list=PLSnw1KE0TFkVu05Ws0Ax143gZYmxPMCoY&si=FWLw-jfnLxC_l-4j	Laboratory course on Power Electronics by RGUKT Basar
6	https://www.youtube.com/playlist?list=PL4emuJKx0B8aREwkC5BEOw2OZ48puPyOG	Videos on Power Electronics
7	https://3dcircuits.engineering.dartmouth.edu/powani.html	Animation on Chopper and Rectifier

Note :

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

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Maharashtra State Board Of Technical Education, Mumbai

Learning and Assessment Scheme for Post S.S.C Diploma Courses

Programme Name	**: Diploma In Electrical Engineering / Electrical Power System**		
Programme Code	**: EE / EP**	**With Effect From Academic Year**	**: 2023-24**
Duration Of Programme	**: 6 Semester**	**Duration**	**: 16 WEEKS**
Semester	**: Third** **NCrF Entry Level : 3.5**	**Scheme**	**: K**

Sr No	Course Title	Abbrevation	Course Type	Course Code	Total IKS Hrs for Sem.	Learning Scheme					Credits	Assessment Scheme											
						Actual Contact Hrs./Week			Self Learning (Activity/ Assignment /Micro Project)	Notional Learning Hrs /Week		Paper Duration (hrs.)	Theory				Based on LL & TL				Based on Self Learning		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	
(All Compulsory)																							
1	ELECTRICAL CIRCUITS AND NETWORK	ECN	DSC	313332	-	4	-	4	-	8	4	3	30	70	100	40	25	10	50#	20	-	-	175
2	ELECTRICAL POWER GENERATION,TRANSMISSION AND DISTRIBUTION	GTD	DSC	313333	-	4	-	2	2	8	4	3	30	70	100	40	25	10	25@	10	25	10	175
3	ELECTRICAL AND ELECTRONIC MEASUREMENT	EEM	DSC	313334	-	3	-	4	1	8	4	3	30	70	100	40	25	10	25#	10	25	10	175
4	FUNDAMENTALS OF POWER ELECTRONICS	FPE	SEC	313335	-	3	-	4	1	8	4	3	30	70	100	40	25	10	25@	10	25	10	175
5	ESSENCE OF INDIAN CONSTITUTION	EIC	VEC	313002	-	1	-	-	1	2	1	-	-	-	-	-	-	-	-	-	50	20	50
6	ELECTRICAL MATERIAL AND WIRING PRACTICE	EMW	SEC	313015	-	1	-	4	1	6	3	-	-	-	-	-	50	20	25@	10	25	10	100
Total						**16**		**18**	**6**		**20**		**120**	**280**	**400**		**150**		**150**		**150**		**850**

Abbreviations : CL- Classroom Learning , TL- Tutorial Learning, LL-Laboratory Learning, 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 semester.
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 marks in 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.* 15 Weeks
5. 1 credit 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.

Course Category : Discipline Specific Course Core (DSC) , Discipline Specific Elective (DSE) , Value Education Course (VEC) , Intern./Apprenti./Project./Community (INP) , AbilityEnhancement Course (AEC) , Skill Enhancement Course (SEC) , GenericElective (GE)

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ELECTRICAL ESTIMATING AND CONTRACTING **Course Code : 314325**

Programme Name/s : **Electrical Engineering/ Electrical Power System**
Programme Code : **EE/ EP**
Semester : **Fourth**
Course Title : **ELECTRICAL ESTIMATING AND CONTRACTING**
Course Code : **314325**

I. RATIONALE

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

II. INDUSTRY / EMPLOYER EXPECTED OUTCOME

Carry out estimation and costing of various electrical wiring installations.

III. COURSE LEVEL LEARNING OUTCOMES (COS)

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

- CO1 - Prepare generic tender document, quotation, comparative statement, and supply order.
- CO2 - Prepare estimate of domestic and commercial electrical installations.
- CO3 - Prepare estimate of industrial electrical installations.
- CO4 - Prepare estimate of public lighting installations.
- CO5 - Prepare estimate of overhead and underground distribution lines.

IV. TEACHING-LEARNING & ASSESSMENT SCHEME

Course Code	Course Title	Abbr	Course Category/s	Learning Scheme					Credits	Assessment Scheme											
				Actual Contact Hrs./Week			SLH	NLH		Paper Duration	Theory				Based on LL & TL				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	
314325	ELECTRICAL ESTIMATING AND CONTRACTING	EEC	DSC	3	-	4	1	8	4	3	30	70	100	40	25	10	25#	10	25	10	175

Total IKS Hrs for Sem. : 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, *# On Line Examination , @$ Internal Online Examination
Note :

1. FA-TH represents average of two class tests of 30 marks each conducted during the semester.
2. If candidate is not securing minimum passing marks in FA-PR of any course then the candidate shall be declared as "Detained" in that semester.
3. If candidate is not securing minimum passing marks in 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.* 15 Weeks
5. 1 credit 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.

ELECTRICAL ESTIMATING AND CONTRACTING **Course Code : 314325**

V. THEORY LEARNING OUTCOMES AND ALIGNED COURSE CONTENT

Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
1	TLO 1.1 Apply the principles of NEC 2023 during preparation of the given document. TLO 1.2 State the purpose of preparation of the given type(s) of estimates. TLO 1.3 State the purpose of awarding the given type(s) of contracts. TLO 1.4 Prepare tender documents, quotations, and bills for the specified work.	**Unit - I Estimates and Contracts** 1.1 National Electrical Code 2023 (NEC 2023): Scope and features, Types of electrical installation- Non industrial and industrial, Standard value of voltages and their limits, Fundamental principles for electrical installations, Safety in electrical work, permit to electrical work, safety instruction and safety practices 1.2 Estimating and costing: Purpose, Qualities of good estimator, essential elements of estimating and costing, Meaning and purpose of- Rough estimate, detailed estimate, supplementary estimate, annual maintenance estimate and revised estimate, Factors to be considered while preparation of detailed estimate and economical execution of work. 1.3 Contracts: Concepts, types, roles, and qualities of good contractor 1.4 Tender and Quotation: Types of tenders, tender notice, preparation of tender document, and method of opening of tender, Government e-Market Place (GeM), features and benefits of GeM, Quotation, quotation format, comparison between tender and quotation, Comparative statement, format of comparative statement. Order format, placing of purchasing order, Principles of execution of works, planning, organizing and completion of work, Billing of work.	Lecture Using Chalk-Board Presentations
2	TLO 2.1 Interpret the given electrical installation plan and electrical diagrams. TLO 2.2 Estimate materials required for the given domestic installations. TLO 2.3 Estimate materials required for the given commercial installations. TLO 2.4 Estimate materials required for given type of service connection.	**Unit - II Domestic and Commercial Installations** 2.1 Electrical Drawing: Electrical symbols used in electrical diagrams as per NEC 2023, multiline and single line representation of conductors, Electrical diagrams, their Classification. Methods of representation for the wiring diagram- multiline and single line representation, conversion of multiline representation into single line and vice versa. Necessity and reading of Civil Engineering building drawing. Interpretation of electrical installation plan and electrical diagrams. 2.2 Design of Domestic Installations: Steps to be followed for design and estimation of domestic installations. Design consideration of electrical installation in domestic installations. Design, drawing, estimation, and costing of a domestic installation having maximum 5 kW load. 2.3 Design of Commercial Installations: Steps to be followed for design and estimation of commercial installations. Design consideration of electrical installation in commercial installations. Design electrical installation scheme of small commercial installations of classrooms in educational institutions, small shops, and dispensaries. 2.4 Service Connection: Underground and overhead, it's diagram and description. Calculation of material required for underground and overhead service connection.	Lecture Using Chalk-Board Presentations Case Study Flipped Classroom Site/Industry Visit

ELECTRICAL ESTIMATING AND CONTRACTING **Course Code : 314325**

Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
3	TLO 3.1 Select wiring types for industrial installations. TLO 3.2 Draw an installation plan, wiring diagrams and single line diagrams for the given industrial installations. TLO 3.3 Describe given design considerations of an industrial installation. TLO 3.4 Carry out estimation for the given industrial installations.	**Unit - III Industrial Installations** 3.1 Classification of industrial installations based on fire safety and power consumption, Difference between non-industrial and industrial installations, General characteristics of industrial installation, selection of wiring system. 3.2 Wiring diagram and single line diagram for single phase and three phase motors. Installation plan. 3.3 Design Considerations: Calculation of Motor current, deciding the cable size, deciding the size of Conduit, deciding the fuse rating, deciding distribution board and main switch/MCB, deciding the starter for Motors. 3.4 Design electrical installation scheme and preparation of estimate of agricultural pump, flourmill and small industrial unit having total aggregate three -phase load less than 30 kW.	Lecture Using Chalk-Board Case Study Flipped Classroom Presentations Site/Industry Visit
4	TLO 4.1 Describe given terms related to public lighting installation. TLO 4.2 Select proper materials for streetlights installation. TLO 4.3 Select proper materials for High-mast lighting installation. TLO 4.4 Carry out estimation of streetlights and High-mast lighting.	**Unit - IV Public Lighting Installation** 4.1 Classification of outdoor installations, streetlight/ public lighting installation, Terminology used according to NEC 2023 – Terms related to highway, lighting installation, photometric terms, luminaries etc. Aim of public lighting installation, classification of roads, standard layout of roads. 4.2 Streetlight pole structures. Selection of equipment, sources used in streetlight installations. Cables, recommended types and sizes of cable. On off Control of equipment of streetlight installation. 4.3 High-mast pole structure, selection of equipment, wiring diagram. 4.4 Design, estimation and costing of streetlights and High-mast lighting.	Lecture Using Chalk-Board Presentations Case Study Flipped Classroom Site/Industry Visit
5	TLO 5.1 Compare the given types of distribution lines. TLO 5.2 Describe the given material required for distribution lines. TLO 5.3 Carry out estimates for the specified distribution lines.	**Unit - V Distribution Lines** 5.1 Block Diagram of Electrical Power system, Types of Distribution lines - Primary and Secondary, Overhead and Underground, and it's comparison. 5.2 Materials used for distribution line HT (11kV) and LT (415 V), Cables used for distribution line, factors determining selection of LT/ HT power cables, and cable termination methods. 5.3 Design, estimation and costing of HT (11kV), LT (415 V) overhead line and underground cabling.	Presentations Lecture Using Chalk-Board Flipped Classroom Case Study Site/Industry Visit

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

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 1.1 Prepare a quotation from the given enquiry.	1	*Preparation of a quotation.	2	CO1
LLO 2.1 Prepare a comparative statement from a minimum of three quotations.	2	*Preparation of a comparative statement.	2	CO1
LLO 3.1 Prepare a purchase order from the comparative statement.	3	*Preparation of the purchase order.	2	CO1

ELECTRICAL ESTIMATING AND CONTRACTING **Course Code : 314325**

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 4.1 Prepare tender document for purchase of electrical machines costing more than five lakhs. LLO 4.2 Use GeM portal for searching of software, tools/equipment for procurement.	4	Preparation of the tender document.	2	CO1
LLO 5.1 Calculate total load for given domestic installation. LLO 5.2 Draw electrical installation plan from given civil engineering drawing. LLO 5.3 Calculate number of subcircuits, ratings of main switch and distribution board. LLO 5.4 Draw single line diagram of distribution board for given installation. LLO 5.5 Carry out estimation for above given domestic installation.	5	*Design an electrical installation system for one BHK domestic unit and carry out an estimation.	8	CO2
LLO 6.1 Draw electrical installation plan from given civil engineering drawing using suitable drawing software. LLO 6.2 Draw single line diagram of distribution board for given installation using suitable drawing software.	6	*Domestic installation drawing using suitable software (mentioned in Practical No. 5).	4	CO2
LLO 7.1 Calculate total load for given commercial installation. LLO 7.2 Draw electrical installation plan from given civil engineering drawing. LLO 7.3 Calculate number of subcircuits, ratings of main switch and distribution board. LLO 7.4 Draw single line diagram of distribution board for given installation. LLO 7.5 Carry out estimation for above given commercial installation.	7	*Design an electrical installation system for a commercial unit and carry out an estimation.	8	CO2
LLO 8.1 Draw electrical installation plan from given civil engineering drawing using suitable drawing software. LLO 8.2 Draw single line diagram of distribution board for given installation using suitable drawing software.	8	*Commercial installation drawing using suitable software (mentioned in Practical No. 7).	4	CO2

ELECTRICAL ESTIMATING AND CONTRACTING **Course Code : 314325**

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 9.1 Calculate total load for given industrial installation. LLO 9.2 Draw electrical installation plan from given civil engineering drawing. LLO 9.3 Calculate size of cable, ratings of main switch and distribution board. LLO 9.4 Draw single line diagram of distribution board for given installation. LLO 9.5 Carry out estimation for above given industrial installation.	9	*Design an electrical installation system for small industrial installation and carry out an estimation.	8	CO3
LLO 10.1 Draw single line diagram of distribution board for given installation using suitable drawing software.	10	Commercial installation drawing using suitable software (mentioned in Practical No. 9).	2	CO3
LLO 11.1 Draw a layout diagram for streetlights installation from a given civil engineering drawing. LLO 11.2 Draw the details of a streetlight pole and layout as per NEC 2023. LLO 11.3 Select the size of cable by calculating voltage drop. LLO 11.4 Carry out the estimation for given streetlight installation.	11	*Design an electrical installation system for street lights of small premises and carry out an estimation.	6	CO4
LLO 12.1 Draw layout diagram for low-tension (LT) line from given data. LLO 12.2 Carry out the estimation for low-tension (LT) line.	12	*Design an electrical installation system for a low-tension (LT) distribution line (415 volts) and carry out an estimation.	6	CO5
LLO 13.1 Draw layout diagram for high-tension (HT) line from given data. LLO 13.2 Carry out the estimation for high-tension (HT) line.	13	Design an electrical installation system for a high-tension (HT) distribution line (11 kV) and carry out an estimation.	6	CO5

Note : Out of above suggestive LLOs -

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

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

Micro project

- Carry out market survey of electrical materials for comparison of quality and cost.
- Collect an electrical engineering drawing of the existing electrical installation. Interpret it. Prepare a report on it.
- Collect industrial installation plan and prepare estimation for the same using suitable software.
- Collect existing installation plan of distribution lines and prepare an estimation for the same.
- Collect the existing installation plan of the street lighting scheme and prepare an estimation for the same.
- Collect the existing installation plan of the High-mast lighting scheme and prepare an estimation for the same.
- Collect the existing installation plan of the low-tension (LT) line and prepare an estimation for the same.
- Collect the existing installation plan of the high-tension (HT) line and prepare an estimation for the same.
- Collect any tender document related to electrical installation and fill all related documents.
- Collect list of vendors and specifications of electrical goods from GeM portal.

ELECTRICAL ESTIMATING AND CONTRACTING **Course Code : 314325**

Note :

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

VIII. LABORATORY EQUIPMENT / INSTRUMENTS / TOOLS / SOFTWARE REQUIRED

Sr.No	Equipment Name with Broad Specifications	Relevant LLO Number
1	All In One Computer with following specifications. Processor - 13th Gen Intel® Core™ i5-13500T, OS-Windows 11 Pro, Graphics - Intel® Graphics, Memory - 8 GB: 1 x 8 GB, DDR4 , Storage - 256 GB, M.2 2230, PCIe NVMe, SSD, Class 35 , Display - 60.5-cm. display Full HD (1920X1080)	1,6,8,10
2	Laser jet multifunction printer	1,6,8,10
3	Any proprietary or open-source drawing Software	6,8,10

IX. SUGGESTED 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	Estimates and Contracts	CO1	5	2	4	4	10
2	II	Domestic and Commercial Installations	CO2	12	2	8	8	18
3	III	Industrial Installations	CO3	12	2	8	8	18
4	IV	Public Lighting Installation	CO4	8	2	4	8	14
5	V	Distribution Lines	CO5	8	2	0	8	10
Grand Total				**45**	**10**	**24**	**36**	**70**

X. ASSESSMENT METHODOLOGIES/TOOLS

Formative assessment (Assessment for Learning)

- Two unit tests of 30 marks will be conducted and average of marks obtained in these two unit tests will be considered. Each practical will be assessed for 25 marks and average of all marks obtained will be considered.

Summative Assessment (Assessment of Learning)

- End semester assessment of 70 marks for classroom learning. End semester assessment of 25 marks for laboratory learning.

XI. SUGGESTED COS - POS MATRIX FORM

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ELECTRICAL ESTIMATING AND CONTRACTING **Course Code : 314325**

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

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

XII. SUGGESTED LEARNING MATERIALS / BOOKS

Sr.No	Author	Title	Publisher with ISBN Number
1	K.B.Raina, S.K.Bhattacharya	Electrical Design Estimating and Costing	New Age International Publisher, First, Reprint 2010, ISBN:13: 978-8122443585
2	Surjit Singh, Ravi Deep Singh	Electrical Estimating and Costing	Dhanpat Rai and Sons, 2014 New Delhi, ISBN:1234567150995
3	J.B. Gupta	A Course in Electrical Installation Estimating and Costing	S.K. Kataria and Sons; New Delhi Reprint Edition, 2013, ISBN: 13: 978-9350142790
4	BIS	SP-30:2023, National Electrical Code, 2023	Bureau of Indian Standards
5	BIS	IS: 732-1989, Code of Practice for Electrical Wiring Installation	Bureau of Indian Standards

XIII . LEARNING WEBSITES & PORTALS

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

Note :

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

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COMPUTER AIDED DRAWING AND SIMULATION **Course Code : 314008**

Programme Name/s : **Electrical Engineering/ Electrical Power System**
Programme Code : **EE/ EP**
Semester : **Fourth**
Course Title : **COMPUTER AIDED DRAWING AND SIMULATION**
Course Code : **314008**

I. RATIONALE

It is the need of the industry to draw electrical engineering drawings and use CAD software effectively as per the requirement. In this course, students will practice to interpret drawings, communicate ideas, and turn concepts into practical designs. They gain skills in navigating CAD software and using its tools efficiently to draw electrical drawings. This course is designed in such a way that practical performed in this course will enhance their skills to compete in fast growing electrical industry and understand different circuits by simulation.

II. INDUSTRY / EMPLOYER EXPECTED OUTCOME

Draw electrical drawings using CAD and simulate basic Electrical circuits using simulation software(s).

III. COURSE LEVEL LEARNING OUTCOMES (COS)

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

- CO1 - Comprehend Electrical Drawings.
- CO2 - Locate various components of CAD software.
- CO3 - Use relevant CAD Tools and Commands for Electrical Drawings.
- CO4 - Draw different Electrical Drawings using CAD software.
- CO5 - Simulate Basic Electrical and Electronic circuits.

IV. TEACHING-LEARNING & ASSESSMENT SCHEME

Course Code	Course Title	Abbr	Course Category/s	Learning Scheme					Credits	Assessment Scheme											
				Actual Contact Hrs./Week			SLH	NLH		Paper Duration	Theory				Based on LL & TL				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	
314008	COMPUTER AIDED DRAWING AND SIMULATION	CDS	SEC	-	-	4	-	4	2	-	-	-	-	-	25	10	25@	10	-	-	50

COMPUTER AIDED DRAWING AND SIMULATION **Course Code : 314008**

Total IKS Hrs for Sem. : 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, *# On Line Examination , @$ Internal Online Examination
Note :

1. FA-TH represents average of two class tests of 30 marks each conducted during the semester.
2. If candidate is not securing minimum passing marks in FA-PR of any course then the candidate shall be declared as "Detained" in that semester.
3. If candidate is not securing minimum passing marks in 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.* 15 Weeks
5. 1 credit 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.

V. THEORY LEARNING OUTCOMES AND ALIGNED COURSE CONTENT

Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
1	TLO 1.1 Sketch the electrical symbols as per requirement in electrical drawings. TLO 1.2 Interpret given electrical power/control wiring diagram. TLO 1.3 Identify types of electrical panel. TLO 1.4 Sketch GA Diagram of Electrical control panel (Assume suitable dimensions).	**Unit - I Electrical Drawings.** 1.1 Symbols: Electrical and Electronic as per SP 30: 2023 Part 1, section 3. 1.2 Types of electrical drawings (a) Power wiring diagram (single line diagram (SLD) or Multiline diagram) (b) Control wiring diagram (Schematic diagram) (c) Block diagrams (d) Pictorial diagrams. 1.3 Types of Electrical panels (a) MCC (Motor control center) Panel (b) PCC (Power control center) panel (c) APFC (Automatic Power Factor Controller) Panel (d) PLC (Programmable logic controller) Panel. 1.4 General Arrangement (GA) diagram of Electrical control panel.	Hands-on Presentations Lecture Using Chalk-Board
2	TLO 2.1 Identify the function of the given components of CAD classic screen. TLO 2.2 Identify the given components of CAD screen. TLO 2.3 Identify the given toolbar and commands.	**Unit - II Computer Aided Design (CAD) Introduction.** 2.1 Components of CAD classic screen. 2.2 Menu bar and status bar. 2.3 Open and Save file. 2.4 CAD Toolbars. 2.5 Command Box. 2.6 Zoom in and Zoom out.	Hands-on Presentations Demonstration

COMPUTER AIDED DRAWING AND SIMULATION **Course Code : 314008**

Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
3	TLO 3.1 Use the coordinate methods and practice basic commands. TLO 3.2 Practice Draw, Modify and Annotation toolbar commands. TLO 3.3 Practice Important CAD Modes.	**Unit - III CAD Tools and Commands.** 3.1 Coordinate Method: Absolute, Relative, Polar. Basic commands: Limits, Units. 3.2 Draw Toolbar: Line, Polyline, Circle, Arc, Rectangle, Ellipse, Polygon, Hatch. 3.3 Modify Toolbar: Move, Rotate, Trim, Erase, Copy, Cut, Mirror, Fillet, Chamfer, Offset, Explode, Strech, Scale. 3.4 Annotation Toolbar: Multiline Text, Single Line Test, Linear dimension, Aligned dimension, Angular Dimension, Arc Length Dimension, Radius Dimension, Diameter Dimension 3.5 Important CAD Modes : Grid, Ortho, Snap, Polar Tracking, Object Snap Tracking.	Hands-on Demonstration Presentations
4	TLO 4.1 Sketch the power wiring diagram, control wiring diagram and GA Diagram of Electrical control panel using CAD TLO 4.2 Sketch the Single line diagram (SLD) of the 11 kV/433 V distribution substation using CAD TLO 4.3 Sketch the Single line diagram (SLD) of residential/commercial unit using CAD TLO 4.4 Sketch the Single line diagram (SLD) of any industrial plant using CAD	**Unit - IV Use of CAD in Real World Electrical Engineering Drawings.** 4.1 Applications of electrical CAD software to: (a)Draw power wiring diagram of electrical control panel. (b)Draw control wiring diagram of electrical control panel. (c)Draw GA diagram of electrical control panel. 4.2 Applications of electrical CAD software to Single line diagram (SLD) of the 11 kV/433 V distribution substation. 4.3 Prepare Single line diagram (SLD) of residential/commercial unit using CAD. 4.4 Draw the Single line diagram (SLD) of any industrial electrical installation using CAD.	Hands-on Demonstration Presentations
5	TLO 5.1 Select and use softwares for Electrical and electronic circuit simulations. TLO 5.2 Build, Simulate and Test Basic electric circuits. TLO 5.3 Build, Simulate and Test Basic electronic circuits. TLO 5.4 Measure various electrical parameters and Generate or plot relevant Waveforms/Graphs. TLO 5.5 Develop P.C.B. layout for a given electrical circuit using software.	**Unit - V Simulation of Electrical and Electronic Circuits.** 5.1 Voltage, current, power across (a)Series R-L circuit (b)Series R-C circuit (c)Series R-L-C circuit. 5.2 Rectifier circuit, KVL and KCL simulation. 5.3 Triac Lamp Dimmer Circuit simulation. 5.4 Basic Logic Gate and adder circuit simulation. 5.5 Printed Circuit Board (PCB) preparation basic information.	Hands-on Demonstration Presentations

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

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 1.1 Draw symbols of different electrical and electronic components using drawing instruments.	1	*Symbols of Electrical and Electronic Components as per SP 30: 2011(NEC 2011) part 1, section 3 or new equivalent IS on sketch book.	2	CO1
LLO 2.1 Draw Power and control wiring diagram for DOL starter.	2	*Power and Control wiring diagram of DOL Starter on sketch book.	2	CO1

COMPUTER AIDED DRAWING AND SIMULATION **Course Code : 314008**

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 3.1 Draw Power and control wiring diagram for Star Delta starter.	3	*Power and Control wiring diagram of Star Delta Starter on sketch book.	2	CO1
LLO 4.1 Draw General Arrangement (GA) Diagram for DOL/Star delta starter panel or any other electrical panel.	4	General Arrangement Diagram for Electrical Panel on sketch book (Assume suitable dimensions).	2	CO1
LLO 5.1 Install CAD software. LLO 5.2 Create new drawing. LLO 5.3 Locate components of CAD Classic Screen (CAD screen layout, Drawing area, Menu and Toolbars, Status bar).	5	*Different components of CAD classic screen.	2	CO2
LLO 6.1 Create and Save drawing. LLO 6.2 Set the drawing Limits and Units of the file. LLO 6.3 Perform Zoom in and Zoom out functionality.	6	*CAD file operations and Limits & Units of Drawing.	2	CO2
LLO 7.1 Use Draw Toolbar of CAD for drawing basic geometrical shapes.	7	* Basic geometrical shapes using Draw Toolbar commands (Line, Polyline, Circle, Arc, Rectangle, Ellipse, Polygon, Hatch).	2	CO2 CO3
LLO 8.1 Use Modify Toolbar of CAD for modifying or editing CAD drawing.	8	Modifying or editing basic geometrical shapes using modify commands (Move, Rotate, Trim, Erase, Copy, Cut, Mirror, Fillet, Chamfer, Offset, Explode, Stretch, Scale).	2	CO2 CO3
LLO 9.1 Use Annotation Toolbar of CAD for writing Text and measuring dimensions.	9	*Annotation Toolbar commands (Multiline Text, Single Line Test, Linear dimension, Aligned dimension, Angular Dimension, Arc Length Dimension, Radius Dimension, Diameter Dimension).	2	CO2 CO3
LLO 10.1 Use Important CAD modes for drawing: Grid, Ortho, Snap, Polar Tracking, Object Snap Tracking.	10	*Important CAD Modes for drawing: Grid, Ortho, Snap, Polar Tracking, Object Snap Tracking.	2	CO2 CO3
LLO 11.1 Draw symbols of different electrical and electronic components using CAD.	11	*Symbols of Electrical and Electronic Components as per SP 30: 2011(NEC 2011) part 1, section 3 or new equivalent IS using CAD.	2	CO1 CO2 CO3
LLO 12.1 Draw Power and control wiring diagram for DOL starter using CAD.	12	*Power and Control wiring diagram of DOL Starter using CAD.	2	CO2 CO3
LLO 13.1 Draw Power and control wiring diagram for Star Delta starter using CAD.	13	*Power and Control wiring diagram of Star Delta Starter using CAD.	2	CO2 CO3
LLO 14.1 Draw General Arrangement (GA) Diagram for DOL/Star delta starter panel or any other electrical panel using CAD.	14	*General Arrangement Diagram for Electrical Panel (Assume suitable dimensions) using CAD.	2	CO2 CO3
LLO 15.1 Draw Single Line Diagram (SLD) of the 11kV/433V distribution substation using CAD software.	15	*Single Line Diagram (SLD) of the 11kV/433V distribution substation using CAD.	2	CO2 CO3 CO4

COMPUTER AIDED DRAWING AND SIMULATION **Course Code : 314008**

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 16.1 Draw Single Line Diagram (SLD) of any Industrial Electrical Installation using CAD Software. LLO 16.2 Plot and print drawings to produce hard copies or digital outputs.	16	*Single Line Diagram (SLD) of any Industrial Electrical Installation using CAD Part I.	2	CO2 CO3 CO4
LLO 17.1 Draw Single Line Diagram (SLD) of any Industrial Electrical Installation using CAD Software. LLO 17.2 Plot and print drawings to produce hard copies or digital outputs.	17	*Single Line Diagram (SLD) of any Industrial Electrical Installation using CAD Part II.	2	CO2 CO3 CO4
LLO 18.1 Install simulation software. LLO 18.2 Create new simulation worksheet. LLO 18.3 Use different tools available in software.	18	*Use of simulation software.	2	CO5
LLO 19.1 Build ohms law, series & parallel circuit using simulation software. LLO 19.2 Measure different electrical parameters using software tools.	19	*Simulation for verification of Ohm's law and series & parallel resistances in circuit.	2	CO5
LLO 20.1 Build KCL and KVL Circuit using software. LLO 20.2 Measure electrical parameters using software.	20	*Simulation of Kirchoff's Current Law and Kirchoff's Voltage Law.	2	CO5
LLO 21.1 Build R-L series circuit using software. LLO 21.2 Measure electrical parameters using software. LLO 21.3 Observe Relevant waveforms across each components.	21	*Simulation of R-L series circuit.	2	CO5
LLO 22.1 Build R-C series circuit using software. LLO 22.2 Measure electrical parameters using software . LLO 22.3 Observe Relevant waveforms across each components.	22	Simulation of R-C series circuit.	2	CO5
LLO 23.1 Build PN junction diode circuit using software. LLO 23.2 Observe Diode characteristics.	23	Simulation of VI Characteristics of diode.	2	CO5

COMPUTER AIDED DRAWING AND SIMULATION **Course Code : 314008**

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 24.1 Build half-wave rectifier circuit using software. LLO 24.2 Measure different parameters using software. LLO 24.3 Develop P.C.B. layout for a given electrical circuit using software.	24	*Simulation of single phase half-wave rectifier circuit.	2	CO5
LLO 25.1 Build full-wave rectifier circuit using software. LLO 25.2 Measure different parameters using software. LLO 25.3 Develop P.C.B. layout for a given electrical circuit using software.	25	Simulation of single phase full-wave rectifier circuit.	2	CO5
LLO 26.1 Build basic logic gates circuit using software. LLO 26.2 Observe different parameters using software.	26	*Simulation of Basic Logic Gates.	2	CO5
LLO 27.1 Build Triac Lamp Dimmer circuit using software. LLO 27.2 Observe different parameters using software.	27	*Simulation of Triac Lamp Dimmer circuit.	2	CO5
LLO 28.1 Build Half and Full Adder Logic circuit using software. LLO 28.2 Observe different parameters using software. LLO 28.3 Develop P.C.B. layout for a given electrical circuit using software.	28	Simulation of Half and Full Adder Logic circuit.	2	CO5
LLO 29.1 Build Half and Full Subtractor circuit using software. LLO 29.2 Observe different parameters using software.	29	Simulation of Half and Full Subtractor circuit.	2	CO5
LLO 30.1 Build any circuit using software. LLO 30.2 Develop P.C.B. layout for a given electrical circuit using software.	30	P.C.B. Layout Preparation for electrical circuit using software.	2	CO5

Note : Out of above suggestive LLOs -

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

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

Assignment

- Simulate stair case wiring circuit
- Simulate one switch one bulb house wiring diagram circuit
- Simulate Op-Amp integrator circuit design
- Simulate & Measure average power and power factor with a wattmeter

- Simulate series and parallel RLC circuit
- Study EPLAN software

Note :

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

VIII. LABORATORY EQUIPMENT / INSTRUMENTS / TOOLS / SOFTWARE REQUIRED

Sr.No	Equipment Name with Broad Specifications	Relevant LLO Number
1	A4 Sketch Book Drawing Material	1,2,3,4
2	Simulation Software List 1) Any Open-Source Software like Scilab. 2) Multisim Educational Version 14.3 3) PSIM 11.1	18,19,20,21,22,23,24,25,26,27,28,29,30
3	CAD Software List 1) Any Open-Source Computer Aided Design (CAD) Software. 2) LibreCAD. 3) AutoCAD Electrical Student Version.	5,6,7,8,9,10,11,12,13,14,15,16,17
4	Computer Sysytem Operating System: 64-bit Windows 8 or higher Processor: 2.5–2.9 Ghz processor / Recommended: 3+ Ghz processor RAM: 8 GB as a minimum, with 16GB being recommended GPU: 1GB of VRAM as a minimum with DirectX 11 support; Recommended: 4 GB of VRAM with DirectX 12 support Storage: 10 GB.	All

IX. SUGGESTED WEIGHTAGE TO LEARNING EFFORTS & ASSESSMENT PURPOSE (Specification Table) : NOT APPLICABLE

X. ASSESSMENT METHODOLOGIES/TOOLS

Formative assessment (Assessment for Learning)

- Teacher should prepare rubrics for Formative assessment
- Each Practical will be assessed for 25 Marks and average of all marks obtained will be considered.

Summative Assessment (Assessment of Learning)

- End Semester assessment of 25 marks for laboratory learning.
- Teacher should prepare rubrics for Summative Assessment.

XI. SUGGESTED COS - POS MATRIX FORM

COMPUTER AIDED DRAWING AND SIMULATION **Course Code : 314008**

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

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

XII. SUGGESTED LEARNING MATERIALS / BOOKS

Sr.No	Author	Title	Publisher with ISBN Number
1	Cornel Barbu	Electrician's Book how to Read Electrical Drawings	Lulu.com, ISBN-13: 9781435713208
2	Prof. Sham Tickoo	AutoCAD Electrical 2021: A Tutorial Approach, 2nd Edition	CADCIM Technologies, ISBN-13 9781640571006, 1640571000
3	John Reeder, Reeder	Using Multisim 9 Troubleshooting DC/AC Circuits	Delmar Cengage Learning, ISBN-13 9781111322137, 1111322139

XIII . LEARNING WEBSITES & PORTALS

Sr.No	Link / Portal	Description
1	https://www.kicad.org/	Kicad : This link download Open Source PCB Design Kicad Software
2	https://www.autodesk.com/education/students	AutoCAD : Register and get free student version of LATEST AutoCAD software
3	https://law.resource.org/pub/in/bis/S05/is.sp.30.2011.pdf	This link downloads IS SP:30 2011 (NEC 2011)
4	https://powersimtech.com/products/	PSIM : This link downloads PSIM software demo version
5	https://powersimtech.com/wp-content/uploads/2021/01/PSIM-User-Manual.pdf	This link downloads PSIM software user Manual
6	https://scilab.in/DownloadScilab	Scilab : This link downloads Scilab software
7	https://librecad.org/	LibreCAD : This link downloads Open Source LibreCAD software
8	https://www.falstad.com/circuit/	Falstad : This is an electronics circuit simulator applet
9	https://www.ni.com/en/support/downloads/software-products/download.multisim.html#452133	NI Multisim : This is an electrical and electronics circuit simulator
10	https://www.youtube.com/watch?v=GH-JFXbOcZg&t=71s	Hartley Oscillator circuit simulation on Multisim software

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COMPUTER AIDED DRAWING AND SIMULATION **Course Code : 314008**

Sr.No	Link / Portal	Description
11	https://www.youtube.com/watch?v=mzglU-tMgXY	Simulating halfwave and full wave rectifier circuit in multisim
12	https://www.youtube.com/watch?v=szfgbN0GD5A	AutoCAD practice exercise
13	https://www.youtube.com/watch?v=_2d_Tb9bzsQ&t=10s	Series RLC Circuit Simulation using Multisim
14	https://www.youtube.com/watch?v=UKpIGwto47U	Triac Lamp Dimmer Circuit
15	https://youtu.be/9m8ABCSKTec?si=Kuf6ryURVs9hpK49	VI Characteristics of PN junction diode 1N4007

Note :

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

MSBTE Approval Dt. 21/11/2024 **Semester - 4, K Scheme**

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D.C. MACHINES AND TRANSFORMERS **Course Code : 314322**

Programme Name/s	**: Electrical Engineering/ Electrical and Electronics Engineering/ Electrical Power System**
Programme Code	**: EE/ EK/ EP**
Semester	**: Fourth**
Course Title	**: D.C. MACHINES AND TRANSFORMERS**
Course Code	**: 314322**

I. RATIONALE

Despite advancements in electrical technology, D.C. machines still find applications in various industries and commercial sectors. Further the Transformers are essential components of power systems. This course is to equip students with fundamental knowledge, practical skills and a strong foundation in electrical power system and related fields.

II. INDUSTRY / EMPLOYER EXPECTED OUTCOME

Maintain D.C. Machines and Transformers used in Industry and related field.

III. COURSE LEVEL LEARNING OUTCOMES (COS)

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

- CO1 - Test the performance of D.C. Generators.
- CO2 - Test the performance of D.C. Motors
- CO3 - Test the performance of Single phase transformers
- CO4 - Use three phase transformer for different applications.
- CO5 - Use relevant special purpose transformers for different applications.

IV. TEACHING-LEARNING & ASSESSMENT SCHEME

Course Code	Course Title	Abbr	Course Category/s	Learning Scheme					Credits	Assessment Scheme											
				Actual Contact Hrs./Week			SLH	NLH		Paper Duration	Theory				Based on LL & TL				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	
314322	D.C. MACHINES AND TRANSFORMERS	DMT	DSC	4	-	4	-	8	4	3	30	70	100	40	25	10	25#	10	-	-	150

Total IKS Hrs for Sem. : 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, *# On Line Examination , @$ Internal Online Examination

Note :

1. FA-TH represents average of two class tests of 30 marks each conducted during the semester.
2. If candidate is not securing minimum passing marks in FA-PR of any course then the candidate shall be declared as "Detained" in that semester.
3. If candidate is not securing minimum passing marks in 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.* 15 Weeks
5. 1 credit 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.

D.C. MACHINES AND TRANSFORMERS **Course Code : 314322**

V. THEORY LEARNING OUTCOMES AND ALIGNED COURSE CONTENT

Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
1	TLO 1.1 Describe the constructional details of the D.C. Machine. TLO 1.2 Explain the principle of working of the given D.C. Generator. TLO 1.3 Derive EMF equation and calculate the parameters of the given D.C. Generator. TLO 1.4 Identify the given type of D.C. Generator. TLO 1.5 Interpret the characteristics of the given D.C. Generator.	**Unit - I D.C. Generator** 1.1 D.C. Machine: construction, parts-function and material, types of winding (lap and wave) 1.2 D.C. Generator: Principle of operation, Faraday's law of electromagnetic induction, Fleming's right hand rule. 1.3 E. M. F. equation of D.C. Generator (derivation) 1.4 Types of D.C. Generator and it's applications. 1.5 Characteristics -internal and external.	Chalk-Board Flipped Classroom Video Demonstrations Model Demonstration Presentations
2	TLO 2.1 Explain the working principle of D.C. Motor. TLO 2.2 Apply the back emf equation in the given situation. TLO 2.3 Select relevant D.C. Motor for given application with justification. TLO 2.4 Calculate the torque, speed, output power and efficiency of the given D.C. Motor. TLO 2.5 Explain the various speed control methods of the given D.C. Motor. TLO 2.6 Describe with sketch the working of the starter for the given type of D.C. Motor. TLO 2.7 Describe the procedure of testing a D.C. Motor for the given condition. TLO 2.8 Explain with a diagram the working of the brushless D.C. Motor.	**Unit - II D.C. Motor** 2.1 D.C. Motor: Principle of operation, Lorentz force, Fleming's Left hand rule, Back emf and it's significance, Armature reaction. 2.2 Types of D.C. Motors, Torque: armature torque, shaft torque, Break Horse Power (BHP). 2.3 D. C. Motor characteristics- speed-armature current, torque- armature current, speed-torque. 2.4 Speed control: D.C. shunt and series motor- flux and armature control. 2.5 Starters, necessity of starters, two-point starters, three-point starters and four-point starters. 2.6 Testing: Break load test, Different types of losses, efficiency. 2.7 D.C. Motors applications, advantages and disadvantages 2.8 Brushless D.C. Motor: construction working, applications, advantages and disadvantages	Chalk-Board, Flipped Classroom Video, Demonstrations Model, Demonstration Presentations.

D.C. MACHINES AND TRANSFORMERS **Course Code : 314322**

Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
3	TLO 3.1 Describe the constructional details of the single-phase transformer. TLO 3.2 Explain the working principle of single-phase transformer. TLO 3.3 Derive the EMF equation of transformer and calculate parameter for the given situations. TLO 3.4 Identify the type of single-phase transformer based on the given criterion. TLO 3.5 Interpret the name plate rating of the given transformer. TLO 3.6 Explain phasor diagram for no load/on load condition for the given type of transformer. TLO 3.7 Calculate regulation and efficiency by O.C. / S.C. tests and direct loading for the given type of transformer.	**Unit - III Single Phase Transformer** 3.1 Single phase transformer: Introduction, construction, parts-functions and material. 3.2 Principle of operation, EMF equation, voltage transformation ratio, turns ratio. 3.3 Types and losses, significance of transformer ratings. 3.4 No-load and On-load test on transformer and it's phasor diagram, Leakage reactance. 3.5 Equivalent circuit of transformer with equivalent resistances and reactances. 3.6 Voltage regulation and Efficiency: Direct loading. O.C. / S.C. method. All day efficiency, applications.	Chalk-Board, Flipped Classroom Video, Demonstrations Model, Demonstration Presentations.
4	TLO 4.1 Describe the constructional details of the three -phase transformer. TLO 4.2 Identify the given type of transformer. TLO 4.3 Describe with diagrams various connections of the given three phase transformers. TLO 4.4 Select appropriate transformer on the given application. TLO 4.5 Describe the requirements for the parallel operation of the transformer. TLO 4.6 Describe the procedure for the given type of test on three phase transformer. TLO 4.7 Explain the importance of 'K' factor of transformers.	**Unit - IV Three Phase Transformer** 4.1 Three phase transformer: Introduction, construction, bank of three single phase transformers. Single unit of three phase transformer. 4.2 Working principle of three phase transformer. Types of transformers. 4.3 Connections as per IS: 2026 (part IV)-1977. Three phase to two phase conversion (Scott Connection). 4.4 Selection criteria as per IS: 10028 (Part I)-1985 of distribution transformer and power transformer, amorphous core type distribution transformer, specifications of three-phase distribution transformers as per IS:1180 (part I)-1989. 4.5 Need of parallel operation, conditions for parallel operation. 4.6 Polarity tests on mutually inductive coils, Phasing out test on Three- phase transformer. 4.7 Harmonics and their effects on transformer operation. 4.8 'K' factor of transformers: overheating due to non-linear loads and harmonics.	Chalk-Board Flipped Classroom Video, Demonstrations Model, Demonstration Presentations.

D.C. MACHINES AND TRANSFORMERS **Course Code : 314322**

Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
5	TLO 5.1 Describe the constructional details of the given type of special purpose transformer. TLO 5.2 Explain the Working principle of the given type of special purpose transformer. TLO 5.3 State the applications of the given type of special purpose transformer.	**Unit - V Special Purpose Transformer** 5.1 Auto transformer: Construction, working and applications for single and three phases. 5.2 Instrument Transformers: Construction, working and applications of current transformer and potential transformer. 5.3 Isolation transformer: Construction, features and applications. 5.4 Single phase welding transformer: Construction, features and applications. 5.5 Pulse transformer: Construction, features and applications.	Chalk-Board, Flipped Classroom Video, Demonstrations Model, Demonstration Presentations.

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

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 1.1 Identify different parts of the D.C. machine.	1	*Dismantling of a D.C. machine.	2	CO1
LLO 2.1 Verify generated output of the D.C. Shunt Generator.	2	*Measurement of D.C. Shunt Generator voltage by changing flux and speed.	2	CO1
LLO 3.1 Test the performance of D.C. Shunt generator.	3	*Load test on D.C. Shunt Generator.	2	CO1
LLO 4.1 Test the performance of D.C. Compound generator.	4	Load test on D.C. Compund Generator.	2	CO1
LLO 5.1 Test the performance of D.C. Shunt generator by Hopkinson's Test .	5	Testing the performance of D.C. Shunt generator by Hopkinson's Test .	2	CO1
LLO 6.1 Reverse the direction of rotation of the D.C. shunt motor.	6	*Reversal of rotation of D.C. shunt motor.	2	CO2
LLO 7.1 Perform brake test on D.C. shunt motor.	7	*Speed torque characteristics of D.C. shunt motor.	2	CO2
LLO 8.1 Control the speed of D.C. shunt motor by different methods.	8	*Speed control of D.C. shunt motor using Armature control & flux control method.	2	CO2
LLO 9.1 Reverse the direction of rotation of the D.C. series motor.	9	*Reversal of rotation of D.C. series motor.	2	CO2
LLO 10.1 Control the speed of the D.C. series motor by different methods.	10	Speed control of D.C. series motor using Armature control & flux control method.	2	CO2
LLO 11.1 Perform brake test on a D.C. series motor.	11	Brake test on D.C. series motor.	2	CO2
LLO 12.1 Reverse the direction of rotation of the D.C. compound motor.	12	*Reversal of rotation of D.C. compound motor.	2	CO2
LLO 13.1 Identify different parts of a three point starter of a D.C. Shunt Motor. LLO 13.2 Check the function of the various parts of three point starter.	13	*Demonstration of operating mechanism of three point starter of a D.C. Shunt Machine.	2	CO2
LLO 14.1 Identify different parts of a four point starter of a D.C. Compound Motor. LLO 14.2 Check the function of the various parts of four point starter.	14	*Demonstration of operating mechanism of four point starter of a D.C. Compound Machine.	2	CO2

D.C. MACHINES AND TRANSFORMERS **Course Code : 314322**

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 15.1 Identify different parts of a two point starter of a DC series Motor. LLO 15.2 Check the function of the various parts of two point starter.	15	*Demonstration of operating mechanism of two point starter of a DC series Machine.	2	CO2
LLO 16.1 Identify the different parts of single phase & Three phase transformer.	16	*Demonstration of a single phase & Three phase transformer construction.	2	CO3 CO4
LLO 17.1 Find the transformation ratio of single phase transformer.	17	* Transformation ratio of single phase transformer.	2	CO3
LLO 18.1 Test the performance of single phase transformer.	18	*Direct load test of single phase transformer.	2	CO3
LLO 19.1 Test the performance of single phase transformer.	19	*Open circuit and short circuit test on single phase transformer to determine equivalent circuit parameters.	2	CO3
LLO 20.1 Test the performance of single phase transformer.	20	*Open circuit and short circuit test on single phase transformer to determine voltage regulation and efficiency.	2	CO3
LLO 21.1 Perform parallel operation of two single phase transformers.	21	*Perform parallel operation of two single phase transformers to determine the load current sharing.	2	CO3
LLO 22.1 Perform parallel operation of two single phase transformers.	22	*Perform parallel operation of two single phase transformers to determine the apparent and real power load sharing.	2	CO3
LLO 23.1 Perform polarity test on a single phase transformer.	23	*Perform polarity test on a single phase transformer whose polarity markings are masked.	2	CO3
LLO 24.1 Convert three phase to two phase conversion by Scott-Connection.	24	Scott-Connection of three phase transformer.	2	CO4
LLO 25.1 Perform Back to Back test on single phase transformer.	25	*Back to Back test on single phase transformer.	2	CO4
LLO 26.1 Connect the auto-transformer in step-up and step-down modes, measure input and output voltage.	26	*Connection of the auto-transformer.	2	CO5
LLO 27.1 Verify the Current transformer (CT) ratio.	27	Functioning of the Current transformer (CT).	2	CO5
LLO 28.1 Verify the Potential Transformer (PT) ratio.	28	Functioning of the Potential Transformer (PT).	2	CO5
LLO 29.1 Verify turns ratio of the isolation transformer.	29	*Functioning of the isolation transformer.	2	CO5

Note : Out of above suggestive LLOs -

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

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

NO SLA

- Not applicable for this course

D.C. MACHINES AND TRANSFORMERS **Course Code : 314322**

Note :

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

VIII. LABORATORY EQUIPMENT / INSTRUMENTS / TOOLS / SOFTWARE REQUIRED

Sr.No	Equipment Name with Broad Specifications	Relevant LLO Number
1	DC series and shunt machines (up to 230 V, 4 kW).	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15
2	Three point starter.	13
3	Four point starter.	14
4	Two point starter.	15
5	Single phase transformer of suitable size (500 VA to 1 kVA).	16,17,18,19,20,21,22,23
6	Three phase transformer of suitable size (1 kVA to 3 kVA).	16,24,25
7	AC Ammeter range (0-2.5-5-10A). Portable analog MI type as per relevant BIS standard.	17,18,19,20,21,22,23,24,25,26,27,28,29
8	AC Voltmeter Range (0-75/150/300V), Portable analog MI type as per relevant BIS standard.	17,18,19,20,21,22,23,24,25,26,27,28,29
9	Wattmeter 0-300/600 V, 5/10 A, for use in A.C. circuits.	18,19,20,22
10	L.P.F. Wattmeter, 0-300/600 V, 1A to 2A, for use in A.C. circuits.	19,20
11	Lamp load of 10-20 A.	2,3,4,5,13,14,15,17,18,21,22,29
12	DC Supply, 230 V, 25 A.	2,3,4,5,6,7,8,9,10,11,12,13,14,15,23
13	Rheostat (0-500 Ohm. 1.2A), Nichrome wire wound rheostat on epoxy resin or class F insulating tube with two fixed and one sliding contact.	2,3,4,5,7,8,10,11
14	Tachometer(0-10,000 RPM).	2,3,4,5,7,8,10,11
15	DC Ammeter range (0-5-10A), Portable analog PMMC type as per relevant BIS standard.	2,3,4,5,7,8,10,11,12
16	DC Voltmeter Range (0-150/300V), Portable analog PMMC type as per relevant BIS standard.	2,3,4,5,7,8,10,11,12
17	Rheostat (0-400 Ohm, 1.5A). Nichrome wire wound rheostat on epoxy resin or class F insulating tube with two fixed and one sliding contact.	2,5,7,8,10,11
18	Single phase auto transformer 0-270 V, 15 A.	26
19	CT of suitable ratio.	27
20	PT of suitable ratio.	28
21	Isolation transformer of suitable ratio.	29
22	Rheostat (0-100 Ohm, 5A), Nichrome wire wound rheostat on epoxy resin or class F insulating tube with two fixed and one sliding contact.	7,8,10
23	Rheostat (0-50 Ohm, 10A), Nichrome wire wound rheostat on epoxy resin or class F insulating tube with two fixed and one sliding contact.	7,8,10,11

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

D.C. MACHINES AND TRANSFORMERS **Course Code : 314322**

Sr.No	Unit	Unit Title	Aligned COs	Learning Hours	R-Level	U-Level	A-Level	Total Marks
1	I	D.C. Generator	CO1	8	2	0	6	8
2	II	D.C. Motor	CO2	16	6	4	10	20
3	III	Single Phase Transformer	CO3	17	2	8	10	20
4	IV	Three Phase Transformer	CO4	13	2	8	6	16
5	V	Special Purpose Transformer	CO5	6	2	0	4	6
Grand Total				**60**	**14**	**20**	**36**	**70**

X. ASSESSMENT METHODOLOGIES/TOOLS

Formative assessment (Assessment for 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 appropriate % weightage to process and product and other instructions of assessment.

Summative Assessment (Assessment of Learning)

- End semester summative assessment of 25 marks for laboratory learning.
- End semester assessment of 70 marks through offline mode of examination.

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

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

XII. SUGGESTED LEARNING MATERIALS / BOOKS

Sr.No	Author	Title	Publisher with ISBN Number
1	Mittle, V.N. and Mittle, Arvind	Basic Electrical Engineering	McGraw Hill Education, New Delhi ISBN-13: 978-0070593572
2	Kothari, D. P. and Nagrath, I. J.	Electrical Machines	McGraw Hill Education, New Delhi ISBN-13:978-9352606405
3	Bhattacharya,S. K	Electrical Machines	McGraw Hill Education, New Delhi ISBN-13:978-0070669215
4	Mehta, V. K. and Mehta, Rohit	Principles of Electrical Machines	S.Chand and Co.Ltd., New Delhi ISBN-13: 978-8121921916

D.C. MACHINES AND TRANSFORMERS **Course Code : 314322**

Sr.No	Author	Title	Publisher with ISBN Number
5	Theraja B. L.	Electrical Technology Vol-II (AC and DC machines)	S.Chand and Co.Ltd., New Delhi ISBN-13: 978-8121924375
6	Bandyopadhyay M. N.	Electrical Machines Theory and Practice	PHI Learning Pvt. Ltd., New Delhi ISBN-13:978-8120329973
7	Murugesh Kumar K.	DC Machines and Transformers	S. Chand, ISBN-13: 978-8125916055
8	J. B. Gupta	Theory & Performance of Electrical Machine	S-K-Kataria, ISBN-13: 978-9350142776

XIII . LEARNING WEBSITES & PORTALS

Sr.No	Link / Portal	Description
1	https://youtu.be/D4RFFnzRdkk?si=d5iNRWSZbl01NvT3	Construction & Working Principle of a D.C. Machine.
2	https://youtu.be/1OfLgpFq6Rc?si=bwN9d7ESlV2Utzb6	D.C. Motors.
3	https://youtu.be/6dF3LDzb-tE?si=OYZMdgs2I5d7bqAa	D.C. Generator.
4	https://youtu.be/qmcriUdYBW0?si=ea5Sa1G9R9m7aRTm	Transformer.
5	www.nptel.ac.in	About construction, working principle and operation of D.C. Machine, single phase transformer, three phase transformer and special purpose transformer.
6	www.electricaltechnology.org	About construction, working principle and operation of D.C. Machine, single phase transformer, three phase transformer and special purpose transformer.
7	www.electrical4u.com	About construction, working principle and operation of D.C. Machine, single phase transformer, three phase transformer and special purpose transformer.

Note :

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

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DIGITAL ELECTRONICS AND MICROCONTROLLER APPLICATIONS **Course Code : 314324**

Programme Name/s : **Electrical Engineering/ Electrical Power System**
Programme Code : **EE/ EP**
Semester : **Fourth**
Course Title : **DIGITAL ELECTRONICS AND MICROCONTROLLER APPLICATIONS**
Course Code : **314324**

I. RATIONALE

In the era of digitization, all the equipment like computers, mobiles, music systems, ATM, automation and control circuits and systems are built on digital circuits. Diploma Electrical pass out plays a key role in control panel operations based on microcontroller systems. This course emphasizes on knowledge of digital electronics required to use microcontroller-based systems.

II. INDUSTRY / EMPLOYER EXPECTED OUTCOME

• Use microcontroller based systems for various industrial applications.

III. COURSE LEVEL LEARNING OUTCOMES (COS)

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

- CO1 - Apply knowledge of number system and logic circuits in working of digital system.
- CO2 - Build simple combinational and sequential circuits.
- CO3 - Access various registers in 8051 microcontroller.
- CO4 - Develop and execute programs in assembly language for microcontroller.
- CO5 - Use microcontroller in various applications.

IV. TEACHING-LEARNING & ASSESSMENT SCHEME

Course Code	Course Title	Abbr	Course Category/s	Learning Scheme					Credits	Assessment Scheme											
				Actual Contact Hrs./Week			SLH	NLH		Paper Duration	Theory				Based on LL & TL				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	
314324	DIGITAL ELECTRONICS AND MICROCONTROLLER APPLICATIONS	DEM	SEC	3	-	4	1	8	4	3	30	70	100	40	25	10	25@	10	25	10	175

Total IKS Hrs for Sem. : 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, *# On Line Examination , @$ Internal Online Examination
Note :

1. FA-TH represents average of two class tests of 30 marks each conducted during the semester.
2. If candidate is not securing minimum passing marks in FA-PR of any course then the candidate shall be declared as "Detained" in that semester.
3. If candidate is not securing minimum passing marks in 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.* 15 Weeks
5. 1 credit 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.

V. THEORY LEARNING OUTCOMES AND ALIGNED COURSE CONTENT

DIGITAL ELECTRONICS AND MICROCONTROLLER APPLICATIONS **Course Code : 314324**

Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
1	TLO 1.1 Recognize and convert the given number into the specified number system. TLO 1.2 Perform the binary and BCD arithmetic operation on the given numbers. TLO 1.3 Develop the basic gates using the given NAND/NOR gate as universal gate. TLO 1.4 Construct adder and subtractor circuit using logic gates.	**Unit - I Number System and Logic Gates** 1.1 Number System : Decimal, Binary, octal, hexadecimal, BCD. Conversion of one system into other. 1.2 Binary Arithmetic: - Addition, Subtraction (1's and 2's complement) Multiplication, Division. BCD addition. 1.3 Logic Gates: Symbol, switch circuit, logical expression, truth table of basic logic gates (AND, OR, NOT), Universal gates (NAND and NOR) and Special purpose gates (EX-OR, EX-NOR). 1.4 Arithmetic Circuits: Half and full Adder, Half and full subtractor with its truth table, boolean expression and circuits using logic gates.	Chalk-Board Presentations Demonstration Flipped Classroom
2	TLO 2.1 Draw MUX/DEMUX tree for the given number of input and output lines. TLO 2.2 Describe the building process of the specified type of flip-flop. TLO 2.3 Use excitation table of the given flip-flop to design asynchronous counter.	**Unit - II Digital Logic Circuits** 2.1 Multiplexer and Demultiplexer: working , truth table and applications of Multiplexers and Demultiplexers. 2.2 SR Flip Flops: SR-flip flop, clocked SR flip flop with preset and clear, drawbacks of SR flip flop. JK Flip Flops: Clocked JK Flip flop with preset and clear, D and T type flip flop, Excitation table of flip flops. 2.3 Counters: Types (Asynchronous, Synchronous) and their applications.,4 bit asynchronous counter – Circuit diagram and truth table.	Chalk-Board Presentations Video Demonstrations Flipped Classroom
3	TLO 3.1 Compare the salient features of microcontroller and microcomputer for the given parameters. TLO 3.2 Compare the given types of architecture on the given parameters. TLO 3.3 Describe the given types of registers of 8051. TLO 3.4 Justify the use of the given type of memory in 8051.	**Unit - III 8051 Microcontroller Architecture** 3.1 Microcomputers and microcontrollers (basic introduction and comparison). 3.2 Types of buses, address bus, data bus and control bus. Harvard and Von-Neumann architecture. 3.3 8051 Microcontroller Architecture: - Pin configuration, Register banks, bit and byte addressable area, Registers: PC, DPTR, A&B, PSW and other Special function registers(SFR), I/O ports, Timers (pins and associated SFRs). 3.4 Stack and stack pointer , memory organization (RAM , ROM).	Chalk-Board Presentations Video Demonstrations Flipped Classroom
4	TLO 4.1 Identify addressing mode of the given instruction with examples. TLO 4.2 Describe function of the given instruction with suitable examples. TLO 4.3 Justify the use of the given assembler directives with examples.	**Unit - IV 8051 Instruction Set and Programming** 4.1 Addressing Modes: Immediate, register, direct, indirect, indexed, relative, absolute, bit inherent, bit direct. 4.2 Instruction Set (with appropriate example) : Data transfer, Logical, Arithmetic, Branching, Machine control, Stack operation, Boolean. 4.3 Assembler Directives: ORG, DB, EQU, END, CODE, DATA .	Chalk-Board Presentations Video Demonstrations Flipped Classroom Hands-on
5	TLO 5.1 Describe with sketches the procedure to interface the given external memory. TLO 5.2 Describe with sketch the interfacing of the given external I/O devices.	**Unit - V 8051 Interfacing and Application** 5.1 Memory interfacing - Program and Data memory 5.2 I/O Interfacing (Diagram and Flowchart) for following applications - LED, Relays, Switch, LCD, Stepper motor.	Lecture Using Chalk-Board Presentations Demonstration Flipped Classroom Hands-on

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

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs

DIGITAL ELECTRONICS AND MICROCONTROLLER APPLICATIONS **Course Code : 314324**

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 1.1 Build AND, OR, NOT gates to verify its truth table.	1	* Verification of truth table of AND, OR, NOT gates using ICs .	2	CO1
LLO 2.1 Build AND, OR, NOT gates using NAND gate and verify its truth table of NAND gate as universal gate	2	Building of AND, OR, NOT gates using NAND gate.	2	CO1
LLO 3.1 Build AND, OR, NOT gates using NOR gate and verify NOR gate as universal gate.	3	* Building of AND, OR, NOT gates using NOR gate.	2	CO1
LLO 4.1 Build Half adder and Half subtractor.	4	* Building of Half adder and Half subtractor using Boolean expressions.	2	CO1
LLO 5.1 Build Full adder and full subtractor.	5	* Building of Full adder and full subtractor using Boolean expressions.	2	CO1
LLO 6.1 Build a Multiplexer using IC.	6	* Verification of operation of Multiplexer IC 74151	2	CO2
LLO 7.1 Build a Demultiplexer using IC.	7	Verification of operation of Demultiplexer IC 74155	2	CO2
LLO 8.1 Test the function of RS flip flop.	8	Testing the function of RS flip flop using NAND Gate.	2	CO2
LLO 9.1 Test the function of JK flip flop.	9	Testing the function of JK flip flop using 7476.	2	CO2
LLO 10.1 Construct and test the functionality of D flip flop.	10	* Construction and testing the functionality of D flip flop using IC 7476.	2	CO2
LLO 11.1 Construct and test the functionality of T flip flop.	11	* Construction and testing the functionality of T flip flop using IC 7476.	2	CO2
LLO 12.1 Implement 4 bit ripple counter using 7476.	12	Implementation of 4 bit ripple counter using 7476.	2	CO2
LLO 13.1 Develop and execute an assembly language program (ALP) to perform addition of 8-bit data .	13	* Assembly language program (ALP) to perform addition of 8-bit data using various addressing modes.	2	CO3 CO4
LLO 14.1 Develop and execute an assembly language program (ALP) to perform subtraction of 8-bit data.	14	* Assembly language program (ALP) to perform subtraction of 8-bit data using addressing modes.	2	CO3 CO4
LLO 15.1 Develop and execute an assembly language program (ALP) to perform multiplication of 8-bit data.	15	*Assembly language program (ALP) to perform multiplication of 8-bit data , take the input data from port1 and display the output data on port 2	2	CO3 CO4
LLO 16.1 Develop and execute an assembly language program (ALP) to perform division of 8-bit data	16	* Assembly language program (ALP) to perform division of 8-bit data , take the input data from port 2 & display the output data on port 0	2	CO3 CO4
LLO 17.1 Develop and execute an assembly language program to transfer data using internal data memory.	17	* Assembly language program to transfer data from source to destination location of internal data memory.	2	CO3 CO4
LLO 18.1 Develop and execute an assembly language program to transfer data using external data memory.	18	Assembly language program to transfer data from source to destination location of external data memory.	2	CO3 CO4
LLO 19.1 Develop and execute an assembly language program to exchange data of memory locations.	19	* Assembly language program to exchange data from source to destination memory location.	2	CO3 CO4
LLO 20.1 Develop and execute an assembly language programto find smallest number from the given data.	20	Assembly language program to find smallest number from the given data bytes stored in internal / external data memory locations.	2	CO3 CO4
LLO 21.1 Develop and execute an assembly language program to find largest number from the given data.	21	* Assembly language program to find largest number from the given data bytes stored in internal / external data memory locations.	2	CO3 CO4

DIGITAL ELECTRONICS AND MICROCONTROLLER APPLICATIONS **Course Code : 314324**

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 22.1 Develop and execute an assembly language program for arranging numbers in ascending order.	22	* Assembly language program for arranging numbers in ascending order stored in external memory locations.	2	CO3 CO4
LLO 23.1 Develop and execute an assembly language program for arranging numbers in descending order.	23	Assembly language program for arranging numbers in descending order stored in external memory locations.	2	CO3 CO4
LLO 24.1 Develop and execute an assembly language program for masking particular bit of given register. LLO 24.2 Develop and execute an assembly language program to SET particular bit of given register.	24	* Assembly language program MASK and SET particular bit of given register using 1) bit addressable instructions 2) Logical instructions.	2	CO3 CO4
LLO 25.1 Develop and execute an assembly language program to get a rolling display on given I/O port.	25	* Assembly language program to get a rolling display on port 2.	2	CO3 CO4
LLO 26.1 Interface LED with 8051. LLO 26.2 Interface SWITCH with 8051.	26	* Interfacing of LED and switch with 8051 to turn ON / OFF the LED.	4	CO5
LLO 27.1 Interface RELAY with 8051.	27	* Interfacing of RELAY with 8051 to turn ON / OFF the LED.	2	CO5
LLO 28.1 Interface 7-segment display with 8051.	28	Interfacing of 7-segment display with 8051 to give output as decimal number from 0 to 9.	2	CO5
LLO 29.1 Interface 7-segment display with 8051.	29	Interfacing of LCD with 8051 microcontroller to display the alphabets and decimal numbers.	2	CO5
LLO 30.1 Interface 7-segment display with 8051.	30	Interfacing of stepper motor with 8051 microcontroller and write ALP to rotate stepper motor in clockwise and anti-clockwise direction at given angles.	2	CO5

Note : Out of above suggestive LLOs -

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

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

Following are the suggested student-related co-curricular activities

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

Micro project

- Build a circuit of ALU using IC 74181.
- Build a circuit for decade counter using IC 7490.
- Build a water level controller to indicate overflow & under level of water in a tank.
- Build a dc motor speed controller using 8051.
- Prepare a chart of various features using data sheets of 8051 microcontroller and its derivatives.
- Build a circuit to turn the buzzer ON after 10 seconds.

DIGITAL ELECTRONICS AND MICROCONTROLLER APPLICATIONS **Course Code : 314324**

Note :

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

VIII. LABORATORY EQUIPMENT / INSTRUMENTS / TOOLS / SOFTWARE REQUIRED

Sr.No	Equipment Name with Broad Specifications	Relevant LLO Number
1	Digital Multimeter: 3 and ½ digit with R, V, I measurements, diode and BJT testing.	1,2,3,4,5,6,7,8,9,10,11,12
2	DIGITAL IC tester: Provision for testing a wide range of Digital IC's such as 74 Series, 40/45 Series of CMOS IC's.	1,2,3,4,5,6,7,8,9,10,11,12
3	Bread Board Development System: Bread Board system with DC power output 5V, +/-12V and 0-5V variable , digital voltmeter , ammeter, LED indicators 8 no, logic input switches 8 no, 7 segment display 2 no, clock generator, Manual pulser, Breadboard with about 1,600 points, Potentiometer, relay etc	1,2,3,4,5,6,7,8,9,10,11,12
4	Trainer kits for digital ICs: Trainer kit shall consists of digital ICs for logic gates, flop-flop, shift registers, counter along with toggle switches for inputs and bi-colour LED at outputs, built in power supply.	1,2,3,4,5,6,7,8,9,10,11,12
5	Regulated power supply: Floating DC Supply Voltages Dual DC : 2 x 0 -30V; 0-2 A Automatic Overload (Current Protection) Constant Voltage and Constant Current Operation Digital Display for Voltage and Current Adjustable Current Limiter Excellent Line and Load Regulation	1,2,3,4,5,6,7,8,9,10,11,12
6	Latest Desktop PC compatible with microcontroller IDE simulation software	13,14,15,16,16,17,18,19,20,21,22,23,24,25,26,27,28,29,3
7	Microcontroller kit :-single board systems with 8K RAM,ROM memory with battery back up,16X4,16 X2, LCD display, PC keyboard interfacing facility, Hex keypad facility, single user cross c-compiler,RS-232,USB, interfacing facility with built in power supply.	26,27,28,29,30
8	Relay with driver ,5V	27
9	LCD trainer board	29
10	Stepper Motor, 50/100 RPM with driver circuitry	30

IX. SUGGESTED 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	Number System and Logic Gates	CO1	8	6	6	4	16
2	II	Digital Logic Circuits	CO2	12	2	4	8	14

DIGITAL ELECTRONICS AND MICROCONTROLLER APPLICATIONS **Course Code : 314324**

Sr.No	Unit	Unit Title	Aligned COs	Learning Hours	R-Level	U-Level	A-Level	Total Marks
3	III	8051 Microcontroller Architecture	CO3	12	6	6	4	16
4	IV	8051 Instruction Set and Programming	CO4	8	2	6	4	12
5	V	8051 Interfacing and Application	CO5	5	2	2	8	12
Grand Total				**45**	**18**	**24**	**28**	**70**

X. ASSESSMENT METHODOLOGIES/TOOLS

Formative assessment (Assessment for Learning)

- Each practical will be assessed considering : 60 % weightage to process. 40 % weightage to product
- Average of Two unit tests of 30 marks each will be considered.
- Laboratory learning will be of 25 marks.

Summative Assessment (Assessment of Learning)

- End of Term Examination (Lab. performance), Viva-voce

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

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

XII. SUGGESTED LEARNING MATERIALS / BOOKS

Sr.No	Author	Title	Publisher with ISBN Number
1	R.P. Jain	Modern Digital Electronics	McGraw-Hill Publishing, New Delhi, 2009; ISBN: 9780070669116
2	V.K.Puri	Digital Electronics	McGraw Hill Education (1 July 2017); ISBN-13 : 978-0074633175
3	Salivahanan S.; Arivazhagan S.	Digital Circuits and Design	Oxford University Press India; 5th edition ; ISBN13- 978-0199488681
4	Malvino, A.P.; Leach, D.P.; Saha G.	Digital Principles and Applications	McGraw Hill Education, New Delhi, 2014, ISBN : 9789339203405
5	V. Udayashankara M. S. Mallikarjuna Swamy	8051 Microcontroller: Hardware, Software and application.	McGraw Hill Education; 1st edition; ISBN-13 : 978-0070086814
6	Kenneth Ayala	8051 Microcontroller Architecture Programming and Application	Cengage Learning India; 3rd edition ; ISBN-13 : 978-8131502006

DIGITAL ELECTRONICS AND MICROCONTROLLER APPLICATIONS **Course Code : 314324**

Sr.No	Author	Title	Publisher with ISBN Number
7	Mazidi, Mohmad Ali; Mazidi, Janice Gelispe; Mckinlay Roline D.	The 8051 Microcontroller and Embedded system	Pearson Education India; 2nd edition; ISBN-13 : 978-0199681273
8	Ajay Deshmukh	Microcontroller Theory and Application	Mc Graw Hill., New Delhi,2011, ISBN- 9780070585959

XIII . LEARNING WEBSITES & PORTALS

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

Note :

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

Programme Name/s	**: Architecture Assistantship/ Architecture and Interior Design/ Automobile Engineering./ Artificial Intelligence/ Agricultural Engineering/ Artificial Intelligence and Machine Learning/ Automation and Robotics/ Architecture/ Cloud Computing and Big Data/ Civil Engineering/ Chemical Engineering/ Computer Technology/ Computer Engineering/ Civil & Rural Engineering/ Construction Technology/ Computer Software Technology/ Computer Science & Engineering/ Fashion & Clothing Technology/ Dress Designing & Garment Manufacturing/ Digital Electronics/ Data Sciences/ Electrical Engineering/ Electronics & Tele-communication Engg./ Electrical and Electronics Engineering/ Electrical Power System/ Electronics & Communication Engg./ Electronics Engineering/ Food Technology/ Computer Hardware & Maintenance/ Hotel Management & Catering Technology/ Instrumentation & Control/ Industrial Electronics/ Information Technology/ Computer Science & Information Technology/ Instrumentation/ Interior Design & Decoration/ Interior Design/ Civil & Environmental Engineering/ Mechanical Engineering/ Mechatronics/ Medical Laboratory Technology/ Manufacturing Technology/ Medical Electronics/ Metallurgical Engineering/ Production Engineering/ Printing Technology/ Polymer Technology/ Surface Coating Technology/ Computer Science/ Textile Technology/ Electronics & Computer Engg./ Travel and Tourism/ Textile Manufactures**
Programme Code	**: AA/ AD/ AE/ AI/ AL/ AN/ AO/ AT/ BD/ CE/ CH/ CM/ CO/ CR/ CS/ CST/ CW/ DC/ DD/ DE/ DS/ EE/ EJ/ EK/ EP/ ET/ EX/ FC/ HA/ HM/ IC/ IE/ IF/ IH/ IS/ IX/ IZ/ LE/ ME/ MK/ ML/ MRT/ MU/ MY/ PG/ PN/ PO/ SC/ SE/ TC/ TE/ TR/ TX**
Semester	**: Fourth / Sixth**
Course Title	**: ENVIRONMENTAL EDUCATION AND SUSTAINABILITY**
Course Code	**: 314301**

I. RATIONALE

The survival of human beings is solely depending upon the nature. Thus, threats to the environment directly impact on existence and health of humans as well as other species. Depletion of natural resources and degradation of ecosystems is accelerated due to the growth in industrial development, population growth, and overall growth in production demand. To address these environmental issues, awareness and participation of individuals as well as society is necessary. Environmental education and sustainability provide an integrated, and interdisciplinary approach to study the environmental systems and sustainability approach to the diploma engineers.

II. INDUSTRY / EMPLOYER EXPECTED OUTCOME

Resolve the relevant environmental issue through sustainable solutions

III. COURSE LEVEL LEARNING OUTCOMES (COS)

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

- CO1 - Identify the relevant Environmental issues in specified locality.
- CO2 - Provide the green solution to the relevant environmental problems.
- CO3 - Conduct SWOT analysis of biodiversity hotspot
- CO4 - Apply the relevant measures to mitigate the environmental pollution.
- CO5 - Implement the environmental policies under the relevant legal framework.

IV. TEACHING-LEARNING & ASSESSMENT SCHEME

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ENVIRONMENTAL EDUCATION AND SUSTAINABILITY **Course Code : 314301**

Course Code	Course Title	Abbr	Course Category/s	Learning Scheme					Credits	Assessment Scheme											
				Actual Contact Hrs./Week			SLH	NLH		Paper Duration	Theory				Based on LL & TL				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	
314301	ENVIRONMENTAL EDUCATION AND SUSTAINABILITY	EES	VEC	3	-	-	1	4	2	1.5	30	70*#	100	40	-	-	-	-	25	10	125

Total IKS Hrs for Sem. : 2 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, *# On Line Examination , @$ Internal Online Examination

Note :

1. FA-TH represents average of two class tests of 30 marks each conducted during the semester.
2. If candidate is not securing minimum passing marks in FA-PR of any course then the candidate shall be declared as "Detained" in that semester.
3. If candidate is not securing minimum passing marks in 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.* 15 Weeks
5. 1 credit 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.

V. THEORY LEARNING OUTCOMES AND ALIGNED COURSE CONTENT

Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
1	TLO 1.1 Explain the need of studying environment and its components. TLO 1.2 Investigate the impact of population growth and industrialization on the relevant environmental issues and suggest remedial solutions TLO 1.3 Explain the Concept of 5 R w.r.t. the given situation TLO 1.4 Elaborate the relevance of Sustainable Development Goals in managing the climate change TLO 1.5 Explain the concept of zero carbon-footprint with carbon credit	**Unit - I Environment and climate change** 1.1 Environment and its components, Types of Environments, Need of environmental studies 1.2 Environmental Issues- Climate change, Global warming, Acid rain, Ozone layer depletion, nuclear accidents. Effect of population growth and industrialization 1.3 Concept of 5R, Individuals' participation in i) 5R policy, ii) segregation of waste, and iii) creating manure from domestic waste 1.4 Impact of Climate change, Factors contributing to climate change, Concept of Sustainable development, Sustainable development Goals (SDGs), Action Plan on Climate Change in Indian perspectives 1.5 Zero Carbon footprint for sustainable development, (IKS-Enviornment conservation in vedic and pre-vedic India)	Lecture Using Chalk-Board Presentations

ENVIRONMENTAL EDUCATION AND SUSTAINABILITY **Course Code : 314301**

Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
2	TLO 2.1 Justify the importance of natural resources in sustainable development TLO 2.2 Explain the need of optimum use of natural resources to maintain the sustainability TLO 2.3 Differentiate between renewable and non-renewable sources of energy TLO 2.4 Suggest the relevant type of energy source as a green solution to environmental issues	**Unit - II Sustainability and Renewable Resources** 2.1 Natural Resources: Types, importance, Causes and effects of depletion. (Forest Resources, Water Resources, Energy Resources, Land resources, Mineral resources), (IKS- Concepts of Panchmahabhuta) 2.2 Impact of overexploitation of natural resources on the environment, optimum use of natural resources 2.3 Energy forms (Renewable and non-renewable) such as Thermal energy, nuclear energy, Solar energy, Wind energy, Geothermal energy, Biomass energy, Hydropower energy, biofuel 2.4 Green Solutions in the form of New Energy Sources such as Hydrogen energy, Ocean energy & Tidal energy	Lecture Using Chalk-Board Presentations
3	TLO 3.1 Explain the characteristics and functions of ecosystem TLO 3.2 Relate the importance of biodiversity and its loss in the environmental sustainability TLO 3.3 Describe biodiversity assessment initiatives in India TLO 3.4 Conduct the SWOT analysis of the biodiversity hot spot in India TLO 3.5 Explain the need of conservation of biodiversity in the given situation	**Unit - III Ecosystem and Biodiversity** 3.1 Ecosystem - Definition, Aspects of ecosystem, Division of ecosystem, General characteristics of ecosystem, Functions of ecosystem 3.2 Biodiversity - Definitions, Levels, Value, and loss of biodiversity 3.3 Biodiversity Assessment Initiatives in India 3.4 SWOT analysis of biodiversity hot spot in India 3.5 Conservations of biodiversity - objects, and laws for conservation of biodiversity	Lecture Using Chalk-Board Presentations Video Demonstrations
4	TLO 4.1 Classify the pollution based on the given criteria TLO 4.2 Justify the need of preserving soil as a resource along with the preservation techniques TLO 4.3 Maintain the quality of water in the given location using relevant preventive measures TLO 4.4 State the significance of controlling the air pollution to maintain its ambient quality norms TLO 4.5 Compare the noise level from different zones of city with justification TLO 4.6 Describe the roles and responsibilities of central and state pollution control board	**Unit - IV Environmental Pollution** 4.1 Definition of pollution, types- Natural & Artificial (Man- made) 4.2 Soil / Land Pollution – Need of preservation of soil resource, Causes and effects on environment and lives, preventive measures, Soil conservation 4.3 Water Pollution - sources of water pollution, effects on environment and lives, preventive measures, BIS water quality standards for domestic potable water, water conservation 4.4 Air pollution - Causes, effects, prevention, CPCB norms of ambient air quality in residential area 4.5 Noise pollution - Sources, effects, prevention, noise levels at various zones of the city 4.6 Pollution Control Boards at Central and State Government level: Norms, Roles and Responsibilities	Lecture Using Chalk-Board Presentations

ENVIRONMENTAL EDUCATION AND SUSTAINABILITY **Course Code : 314301**

Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
5	TLO 5.1 Explain Constitutional provisions related to environmental protection TLO 5.2 Explain importance of public participation (PPP) in enacting the relevant laws TLO 5.3 Use the relevant green technologies to provide sustainable solutions of an environmental problem TLO 5.4 Explain the role of information technology in environment protection	**Unit - V Enviornmental legislation and sustainable practices** 5.1 Article (48-A) and (51-A (g)) of Indian Constitution regarding environment, Environmental protection and prevention acts 5.2 Public awareness about environment. Need of public awareness and individuals' participation. Role of NGOs 5.3 Green technologies like solar desalination, green architecture, vertical farming and hydroponics, electric vehicles, plant-based packaging 5.4 Role of information technology in environment protection and human health	Lecture Using Chalk-Board Presentations Video Demonstrations

VI. LABORATORY LEARNING OUTCOME AND ALIGNED PRACTICAL / TUTORIAL EXPERIENCES : NOT APPLICABLE.

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

Assignment

•

Suggest the steps to implement (or improve the implementation) of the 5R policy in your home/institute stating your contribution
Draft an article on India's Strategies to progress across the Sustainable Development Goals
Make a chart of Renewable and non-renewable energy sources mentioning the advantages and disadvantages of each source
Conduct the SWOT analysis of biodiversity hotspot in India
Prepare a mind-mapping for the zero carbon footprint process of your field
Prepare a chart showing sources of pollution (air/water/ soil), its effect on human beings, and remedial actions
Any other assignment on relevant topic related to the course suggested by the facilitator

UNICEF Certification(s)

- Students may complete the self-paced course launched by Youth Leadership for climate Exchange under UNICEF program on portal www.mahayouthnet.in . The course encompasses five Modules in the form of Units as given below: -

Unit 1: Living with climate change
Unit 2 : Water Management and Climate Action
Unit 3: Energy Management and Climate Action
Unit 4 : Waste Management and Climate Action
Unit 5 : Bio-cultural Diversity and Climate Action
If students complete all the five Units they are not required to undertake any other assignment /Microproject/activities specified in the course. These units will suffice to their evaluations under SLA component

Micro project

•

Technical analysis of nearby commercial RO plant.
Comparative study of different filters used in Household water filtration unit
Evaluate any nearby biogas plant / vermicomposting plant or any such composting unit on the basis of sustainabilityand cost-benefit
IKS-Study and prepare a note on Vedic and Pre-Vedic techniques of environmental conversion

Visit a local polluted water source and make a report mentioning causes of pollution
Any other activity / relevant topic related to the course suggested by the facilitator

Activities

•

Prepare a report on the working and functions of the PUC Center machines and its relavance in pollution control.
Prepare and analyse a case study on any polluted city of India
Prepare a note based on the field visit to the solid waste management department of the municipal corporation / local authority
Record the biodiversity of your institute/garden in your city mentioning types of vegetation and their numbers
Visit any functional hall/cultural hall /community hall to study the disposal techniques of kitchen waste and prepare a report suggesting sustainable waste management tool
Watch a video related to air pollution in India and present the summary
Any other assignment on relevant topic related to the course suggested by the facilitator

Note :

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

VIII. LABORATORY EQUIPMENT / INSTRUMENTS / TOOLS / SOFTWARE REQUIRED

Sr.No	Equipment Name with Broad Specifications	Relevant LLO Number
1	Nil	All

IX. SUGGESTED 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	Environment and climate change	CO1	8	4	4	4	12
2	II	Sustainability and Renewable Resources	CO2	10	4	4	8	16
3	III	Ecosystem and Biodiversity	CO3	8	4	4	4	12
4	IV	Environmental Pollution	CO4	12	4	8	6	18
5	V	Enviornmental legislation and sustainable practices	CO5	7	4	4	4	12
Grand Total				**45**	**20**	**24**	**26**	**70**

X. ASSESSMENT METHODOLOGIES/TOOLS

Formative assessment (Assessment for Learning)

- Two-unit tests (MCQs) of 30 marks will be conducted and average of two-unit tests considered. Formative assessment of self learning of 25 marks should be assessed based on self learning activity such as UNICEF Certification(s)/Microproject/assignment/activities. (60 % weightage to process and 40 % to product)

Summative Assessment (Assessment of Learning)

- Online MCQ type Exam

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

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

XII. SUGGESTED LEARNING MATERIALS / BOOKS

Sr.No	Author	Title	Publisher with ISBN Number
1	Y. K. Singh	Environmental Science	New Age International Publishers, 2006, ISBN: 81-224-2330-2
2	Erach Bharucha	Environmental Studies	University Grants Commission, New Delhi
3	Rajagopalan R.	Environmental Studies: From Crisis to Cure.	Oxford University Press, USA, ISBN: 9780199459759, 0199459754
4	Shashi Chawla	A text book of Environmental Science	Tata Mc Graw-Hill New Delhi
5	Arvind Kumar	A Text Book of Enviornmental science	APH Publishing New Delhi (ISBN 978-8176485906)

XIII . LEARNING WEBSITES & PORTALS

Sr.No	Link / Portal	Description
1	https://sdgs.un.org/goals	United Nation’s website mentioning Sustainability goals
2	http://www.greenbeltmovement.org/news-and-events/blog	Green Belt Movement Blogs on various climatic changes and other issues
3	http://www.greenbeltmovement.org/what-we-do/tree-planting-fo r-watersheds	Green Belt Movement's work on tree plantation, soil conservation and watershed management techniques
4	https://www.youtube.com/@ierekcompany/videos	International Experts For Research Enrichment and Knowledge Exchange – IEREK's platform to exchange the knowledge in fields such as architecture, urban planning, sustainability
5	www.mahayouthnet.in	UNICEF Intiative for youth leadership for climate action

ENVIRONMENTAL EDUCATION AND SUSTAINABILITY **Course Code : 314301**

Sr.No	Link / Portal	Description
6	https://eepmoefcc.nic.in/index1.aspx?lsid=297&lev=2&lid=1180&langid=1	GOI Website for public awareness on enviornmetal issues
7	https://egyankosh.ac.in/handle/123456789/61136	IGNOU's Intiative for online study material on Enviornmental studies
8	https://egyankosh.ac.in/handle/123456789/50898	IGNOU's Intiative for online study material on sustainability
9	https://sustainabledevelopment.un.org/content/documents/11803Official-List-of-Proposed-SDG-Indicators.pdf	Final list of proposed Sustainable Development Goal indicators
10	https://sustainabledevelopment.un.org/memberstates/india	India’s Strategies to progress across the SDGs.
11	https://www.un.org/en/development/desa/financial-crisis/sustainable-development.html	Challenges to Sustainable Development
12	https://nptel.ac.in/courses/109105190	NPTEL course on sustainable development
13	https://onlinecourses.swayam2.ac.in/cec19_bt03/preview	Swayam Course on Enviornmetal studies (Natural Resources, Biodiversity and other topics)
14	https://onlinecourses.nptel.ac.in/noc23_hs155/preview	NPTEL course on enviornmental studies which encomopasses SDGs, Pollution, Cliamate issues, Energy, Policies and legal framework
15	https://www.cbd.int/development/meetings/egmbped/SWOT-analysis-en.pdf	SWOT analysis of Biodiversity
16	https://www.sanskrit.nic.in/SVimarsha/V2/c17.pdf	Central sanskrkit university publication on Vedic and pre vedic enviornmetal conservation

Note :

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

MSBTE Approval Dt. 21/11/2024 **Semester - 4 / 6, K Scheme**

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UTILIZATION OF ELECTRICAL ENERGY **Course Code : 314323**

Programme Name/s : **Electrical Engineering/ Electrical Power System**
Programme Code : **EE/ EP**
Semester : **Fourth**
Course Title : **UTILIZATION OF ELECTRICAL ENERGY**
Course Code : **314323**

I. RATIONALE

Electrical energy is the most widely used form of energy by every sector. The generated power before being utilized by the consumer has to pass through various stages. One of the important aspect of electrical power system is efficient utilization of electrical energy. The electrical engineering diploma pass outs are therefore required to posses knowledge and skills of operation and use of electrical drives, electrical furnaces, and traction systems. Essential theoretical and practical knowledge will be achieved by learning this course. Contents of course are designed essentially keeping in mind the job profile of electrical engineer handling electrical utilities.

II. INDUSTRY / EMPLOYER EXPECTED OUTCOME

Operate various electrical utilities used for industrial and commercial applications.

III. COURSE LEVEL LEARNING OUTCOMES (COS)

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

- CO1 - Design simple lighting scheme..
- CO2 - Select type of electric furnaces according to applications
- CO3 - Operate the different electric welding system
- CO4 - Select suitable electric drive for a particular application
- CO5 - Maintain different electric traction system.

IV. TEACHING-LEARNING & ASSESSMENT SCHEME

Course Code	Course Title	Abbr	Course Category/s	Learning Scheme					Credits	Assessment Scheme											
				Actual Contact Hrs./Week			SLH	NLH		Paper Duration	Theory				Based on LL & TL				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	
314323	UTILIZATION OF ELECTRICAL ENERGY	UEE	DSC	4	-	2	2	8	4	3	30	70	100	40	25	10	25@	10	25	10	175

UTILIZATION OF ELECTRICAL ENERGY **Course Code : 314323**

Total IKS Hrs for Sem. : 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, *# On Line Examination , @$ Internal Online Examination
Note :

1. FA-TH represents average of two class tests of 30 marks each conducted during the semester.
2. If candidate is not securing minimum passing marks in FA-PR of any course then the candidate shall be declared as "Detained" in that semester.
3. If candidate is not securing minimum passing marks in 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.* 15 Weeks
5. 1 credit 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.

V. THEORY LEARNING OUTCOMES AND ALIGNED COURSE CONTENT

Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
1	TLO 1.1 Define the given term(s) as related to illumination. TLO 1.2 Explain the construction and working of the given type of lamp(s) and lamp fittings. TLO 1.3 State the laws of illumination TLO 1.4 Select the relevant lamp for the specified application with justification. TLO 1.5 Design simple lighting scheme for the given data. TLO 1.6 Explain factors affecting on quality of lighting system	**Unit - I ILLUMINATION** 1.1 Definitions of various illumination terminology- Luminous flux, Lumens, Candela, solid angle, luminous intensity, lux, candlepower, MHCP, MSCP, MHSCP, illumination, lamp efficacy, glare, shadow. Brightness 1.2 Various types of Lamps :Fluorescent Tube, CFL, Metal Halide and LED. 1.3 Laws of illumination: Inverse squares and Lambert's Cosine law. 1.4 Various lighting schemes: Direct, Indirect , Semidirect and Semi indirect :features and application. 1.5 Design of Lighting Scheme: Factors considered designing such as- Space height ratio, Utilization factor, depreciation factor, reflection factor, Waste light factors, coefficient of utilization (Numerical on design of indoor lighting scheme) 1.6 Domestic and industrial lamp fittings. 1.7 Factors affecting on quality of lighting system	Lecture Using Chalk-Board Presentations Video Demonstrations Flipped Classroom

UTILIZATION OF ELECTRICAL ENERGY **Course Code : 314323**

Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
2	TLO 2.1 Explain construction, working principle and classification of the specified electrical heating system. TLO 2.2 Recommend the relevant heating system for the given application with proper justification. TLO 2.3 Design the heating element of the given type of furnace from the specified data. TLO 2.4 Solve simple numerical on estimation of size of induction furnace TLO 2.5 Estimate voltage and power requirement in dielectric heating	**Unit - II ELECTRIC HEATING** 2.1 Concept of electrical heating, Advantages and classification of electric heating, modes of heat transfer. 2.2 Resistance Heating: Construction and Operation of Direct Resistance Heating - Salt Bath Furnace, Indirect Resistance Heating: Resistance Ovens, Requirements of Heating Element Material, Causes Heating Elements, Methods of Temperature Control, Applications of Resistance Heating, Design of Heating Element. (Simple Numerical problems on heating elements)of Failure of 2.3 Arc Heating - Construction and Operation of Direct Arc Furnace, Indirect Arc Furnace. Applications of Arc Heating. 2.4 Induction Heating - Construction and Operation of Core Type Induction Furnaces: Ajax Wyatt Furnace, Coreless Induction Furnace, Applications of Induction Heating, High frequency eddy current heating. Radiant and infrared heating, Estimation of Heat data (Simple Numerical to estimate rating of furnace). 2.5 Dielectric Heating: Principle of Dielectric Heating, Advantages of Dielectric Heating 2.6 Limitations of Dielectric Heating, Applications of Dielectric Heating (Simple Numericals)	Lecture Using Chalk-Board Video Demonstrations Site/Industry Visit Case Study
3	TLO 3.1 Select the relevant welding system for the specified application with justification. TLO 3.2 Describe the working principle and construction of special type of transformer used in welding. TLO 3.3 Describe the working principle of Electric Welding and its types TLO 3.4 State the applications of modern welding techniques	**Unit - III ELECTRIC WELDING** 3.1 Electric Welding: Principles of electric resistance welding. 3.2 Methods of Electric Welding – Electric arc welding, resistance welding. 3.3 Resistance Welding – Principles, Advantages, types of resistance welding. 3.4 Electric Arc Welding- Formation and Characteristics of electric arc, effects of arc length. 3.5 Principle of electric arc welding: Types, advantages, disadvantages and applications of all types. 3.6 Comparison with resistance welding and Electric Arc Welding 3.7 2.7 Modern welding techniques like Ultrasonic, Laser, under water welding, IGBT controlled welding.	Lecture Using Chalk-Board Video Demonstrations Presentations Site/Industry Visit

UTILIZATION OF ELECTRICAL ENERGY **Course Code : 314323**

Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
4	TLO 4.1 Differentiate the salient features between the given types of electric drives. TLO 4.2 Recommend the relevant motor for the given application with justification. TLO 4.3 Select the relevant enclosure for the given atmospheric condition with justification. TLO 4.4 Select the power transmission drive of the electric motor for the given application with justification. TLO 4.5 Estimate the relevant size and rating of electric motor for the specified load cycles. TLO 4.6 Select relevant elevator machine and electric motor for the specified application with justification. TLO 4.7 Describe the procedure to maintain the given electric drive and elevator.	**Unit - IV ELECTRIC DRIVES AND ELEVATORS** 4.1 Electric drives : Concept, factors governing selection of electric drives(motor). 4.2 Types of electrical drives : Individual and Group drive, Applications. 4.3 Mechanical features of drives: Types and applications various types of enclosures. 4.4 Transmission of Mechanical Power: Direct and Indirect drive (Belt, Rope, Chain, Gear), Vertical drives and its applications. 4.5 Bearing: Types and applications. 4.6 Size and Rating of motor : (Simple numerical on this topic) 4.7 Load Cycles : Concept with graphical representation. 4.8 Load Equalization : Concept , and methods and condition of load equalization. 4.9 Elevators: Function, Application, types, safety and precautions, case study of latest Elevator. 4.10 Factors on which shape and size of car depends.	Lecture Using Chalk-Board Video Demonstrations Site/Industry Visit Case Study

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Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
5	TLO 5.1 Recommend relevant traction system for the given application with justification. TLO 5.2 Select the relevant track electrification system for the specified traction services with justification. TLO 5.3 Differentiate the salient features between the given types of track electrification system. TLO 5.4 Draw the speed -time curve for the specified electric traction application. TLO 5.5 Differentiate between the given types of traction services based on the given criteria . TLO 5.6 Determine average and schedule speed for the given traction service.	**Unit - V ELECTRIC TRACTION** 5.1 Introduction of electric traction system, Requirements of ideal traction system 5.2 System of Track Electrification: DC; Single phase 25kV AC, Composite system. 5.3 Traction Mechanics : Block diagram of AC electric locomotive and function of each part, Nomenclature of Locomotivesiv 5.4 Crest, Average and Schedule Speed; definition and factors affecting them. 5.5 Traction services : Urban, suburban, main line service (Main features and comparison between the three of them),Speed Time curve, Concept and applications of Trapezoidal and quadrilateral speed time curve(simple numerical based on Trapezoidal speed time curve) 5.6 Concept and function of Catenary wire ,Contact wire and Dropper, Material used for them, Simple Catenary construction, Definition and Need of Neutral Section, Current Collecting system: Diamond type pantograph and Faiveley type pantograph(Construction and Working) 5.7 Introduction of Metro and Mono Rail (main features between the two of them).	Lecture Using Chalk-Board Video Demonstrations Site/Industry Visit Presentations

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

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 1.1 Identify the different lighting accessories required for various types of lamps.	1	*Identification of different lighting accessories required for various types of lamps.	2	CO1
LLO 2.1 To compare the Lumen output of various lamps.	2	*Comparision of Lumen output of Fluorescent tube , Metal Halide, CFL and LED.	2	CO1
LLO 3.1 To measure illumination at different locations in college using luxmeter and compare with standard illumination level as per SP 72 : 2023 (National lighting code)	3	*Measurement of illumination at different locations in college using luxmeter and compare with standard illuminationlevel as per SP 72: 2023.(National Lighting code).	2	CO1
LLO 4.1 Design a heating element as per the given parameters.	4	*Design a heating element as per the given parameters .	2	CO2
LLO 5.1 Identify the different electrical and safety equipment used for Arc welding	5	*Demonstation of different electrical and safety equipments used for arc welding.	2	CO2
LLO 6.1 Identify the different components required for various heating furnaces .	6	*Identification of different components required for various heating furnaces.	2	CO2
LLO 7.1 Write specification of Welding generator set and welding transformer.	7	*Selection of suitable current range of Welding generator set and Welding transformer for various thickness of metal job.	2	CO3

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Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 8.1 Identify the different defects in arc welding job.	8	*Identification of different defects in arc welding job.	2	CO3
LLO 9.1 Identify the different electrodes in arc welding.	9	*Identification of different electrodes used in arc welding.	2	CO3
LLO 10.1 To estimate the size of motor as per the specified load cycle.	10	*Estimatiom of size of motor as per the specified load cycle.	2	CO4
LLO 11.1 To identify the different components of elevator.	11	Identification of the different components of an Elevator.	2	CO4
LLO 12.1 To identify the different components of Escalator.	12	Identification of different components of Escalator.	2	CO4
LLO 13.1 To observe the different types of signals used in traction system. LLO 13.2 To observe the raising and lowering of Faiveley type pantograph. LLO 13.3 To observe the different parts of E.M.U	13	Visit to a traction loco shed and observe various types of system used in traction.	6	CO5
LLO 14.1 Write the specification of oven. LLO 14.2 Measure elimination of moisture from substance.	14	*Demonstrate indirect resistance Oven used in Laboratory.	2	CO2

Note : Out of above suggestive LLOs -

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

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

Assignment

- Prepare power point presentation related to heating furnaces.
- Prepare power point presentation related to welding equipment and accessories.
- Prepare power point presentation on Mono and Metro rail systems in India.
- Collect Bombay Lift Act and understand rules to inspect electrical components.
- Select any one electric drive. Explain its suitability for any one industrial application through power point presentation.(Electrical and Mechanical Characteristics)

Micro project

- Prepare report on market survey of various types of lamps(specification, manufacturer, application and cost) and do the comparative analysis.
- Prepare a market survey of various drives(specification, manufacturer, application and cost).
- Design suitable lighting scheme for a laboratory or class room.
- Prepare market survey on Lift and Escalator (specification, manufacturer, application and cost)

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Note :

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

VIII. LABORATORY EQUIPMENT / INSTRUMENTS / TOOLS / SOFTWARE REQUIRED

Sr.No	Equipment Name with Broad Specifications	Relevant LLO Number
1	Fluroscent Tube light, CFL and LED (Bulb and Tube Light) of different suitable ratings	1,2
2	Suitable data to be given to calculate the size of motor for specified load cycle.	10
3	Visit to a Elevator company/You Tube videos/Concerned learning software and Website	11
4	Visit to a Escalator company/ YouTube videos/ concerned learning website or related software.	12
5	Loco shed/ Track Electrification system visit for observing components /equipment related to traction .	13
6	Digital Lux Meter (Upto LUX-100K)	3
7	Heating furnace/Oven of suitable ratings	4,6
8	Electrical welding machine of suitable rating	5,7
9	Welding workshop of Institute / Any small scale industry (Welding) visit to observe the various defects in arc welding and the different electrodes used for arc welding.	8,9

IX. SUGGESTED 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	ILLUMINATION	CO1	12	4	4	6	14
2	II	ELECTRIC HEATING	CO2	14	4	6	6	16
3	III	ELECTRIC WELDING	CO3	8	2	4	4	10
4	IV	ELECTRIC DRIVES AND ELEVATORS	CO4	14	4	6	6	16
5	V	ELECTRIC TRACTION	CO5	12	2	6	6	14
Grand Total				**60**	**16**	**26**	**28**	**70**

X. ASSESSMENT METHODOLOGIES/TOOLS

Formative assessment (Assessment for Learning)

- Two unit tests of 30 marks will be conducted and average of two unit tests are conducted. For formative assessment of Laboratory learning 25 marks. Each practicle will be assessed considering appropriate % weightage to process and product and other instructions of assessment.

Summative Assessment (Assessment of Learning)

- End semester summative assessment of 25 marks for laboratory learning. End semester assessment of 70 marks through offline mode of examination.

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

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

XII. SUGGESTED LEARNING MATERIALS / BOOKS

Sr.No	Author	Title	Publisher with ISBN Number
1	H.Pratab	Art and Science of Utilization of Electrical Energy	Dhanpat Rai & Sons,New Delhi, ISBN: 9788177001440
2	J.B. Gupta	Utilization of Electric Power and Electric Traction.	S.K. Kataria & Sons, New Delhi, ISBN: 978- 9350142585
3	G. C. Garg	Utilization of Electric Power and Electric Traction.	Khanna Publishers, New Delhi, ISBN: 8174091645
4	J. Upadhaya and S.N. Mahendra	Electric Traction	Allied Publisher Ltd., New Delhi, ISBN: 8177640054
5	G.K. Dubey	Fundamentals of Electric Drive	Narosa Publishing House, New Delhi, ISBN: 8173190410 , 9788173190414
6	V. K. Mehta	Principles of Power System	S. Chand, New Delhi, ISBN: 9788121924962
7	H.Pratab	Modern Electric Traction	Dhanpat Rai & Sons,New Delhi, ISBN: 1234567147206
8	S. Sivanagaraju & M. Balasubba Reddy & B. Srilatha	Generation and Utilization of Electrical Energy	Personal Education, New Delhi, ISBN: 9789332515673

XIII . LEARNING WEBSITES & PORTALS

Sr.No	Link / Portal	Description
1	https://www.youtube.com/watch?v=CoHVA7nr82A	Complete description of Arc Welding
2	https://www.youtube.com/watch?v=7GLiBwgVBLQ	Videos on Electric Traction
3	https://www.youtube.com/watch?v=fakGLu03jYg	Videos on Electric Traction
4	https://www.youtube.com/watch?v=BDMFsYnTdVI	Videos on Electric Locomotive with full description
5	https://www.youtube.com/watch?v=49rH3buD0bc	Video showing the working of Diesel Locomotive
6	https://www.youtube.com/watch?v=82EFMvYcbN4	Videos on Electric Multiple Unit
7	https://www.youtube.com/watch?v=AAyLKnz4UJY	Videos to describe Electric Heating system

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Sr.No	Link / Portal	Description

Note :

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

MSBTE Approval Dt. 21/11/2024 **Semester - 4, K Scheme**

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Maharashtra State Board Of Technical Education, Mumbai

Learning and Assessment Scheme for Post S.S.C Diploma Courses

Programme Name	**: Diploma In Electrical Engineering / Electrical Power System**		
Programme Code	**: EE / EP**	**With Effect From Academic Year**	**: 2023-24**
Duration Of Programme	**: 6 Semester**	**Duration**	**: 16 WEEKS**
Semester	**: Fourth** **NCrF Entry Level : 3.5**	**Scheme**	**: K**

Sr No	Course Title	Abbrevation	Course Type	Course Code	Total IKS Hrs for Sem.	Learning Scheme					Credits	Assessment Scheme												
						Actual Contact Hrs./Week			Self Learning (Activity/ Assignment /Micro Project)	Notional Learning Hrs /Week		Paper Duration (hrs.)	Theory				Based on LL & TL Practical				Based on Self Learning		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	
(All Compulsory)																								
1	ENVIRONMENTAL EDUCATION AND SUSTAINABILITY	EES	VEC	314301	2	3	-	-	1	4	2	1.5	30	70*#	100	40	-	-	-	-	25	10	125
2	D.C. MACHINES AND TRANSFORMERS	DMT	DSC	314322	-	4	-	4	-	8	4	3	30	70	100	40	25	10	25#	10	-	-	150
3	UTILIZATION OF ELECTRICAL ENERGY	UEE	DSC	314323	-	4	-	2	2	8	4	3	30	70	100	40	25	10	25@	10	25	10	175
4	DIGITAL ELECTRONICS AND MICROCONTROLLER APPLICATIONS	DEM	SEC	314324	-	3	-	4	1	8	4	3	30	70	100	40	25	10	25@	10	25	10	175
5	ELECTRICAL ESTIMATING AND CONTRACTING	EEC	DSC	314325	-	3	-	4	1	8	4	3	30	70	100	40	25	10	25#	10	25	10	175
6	COMPUTER AIDED DRAWING AND SIMULATION	CDS	SEC	314008	-	-	-	4	-	4	2	-	-	-	-	-	25	10	25@	10	-	-	50
Total					**2**	**17**		**18**	**5**		**20**		**150**	**350**	**500**		**125**		**125**		**100**		**850**

Abbreviations : CL- Classroom Learning , TL- Tutorial Learning, LL-Laboratory Learning, 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 semester.
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 marks in 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.* 15 Weeks
5. 1 credit 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.

Course Category : Discipline Specific Course Core (DSC) , Discipline Specific Elective (DSE) , Value Education Course (VEC) , Intern./Apprenti./Project./Community (INP) , AbilityEnhancement Course (AEC) , Skill Enhancement Course (SEC) , GenericElective (GE)