Semester III

Course Code	:	EEEPC201
Course Title	:	INTRODUCTION TO ELECTRIC GENERATION SYSTEMS
Number of Credits	:	3 (L:3,T:0,P:0)
Prerequisites	:	NIL
Course Category	:	PC

SPECIFICATION TABLE OF MARKS & HOURS

K=Knowledge level, **C**= Comprehension Level, **A**=Application level

Unit No.	Unit Title	Hours	K	C	A	Total Marks
1	**Thermal Power Plants: Coal, Gas/ Diesel and Nuclear-based**	10	2	5	5	12
2	**Large and Micro-Hydro Power Plants**	8	2	5	5	12
3	**Solar and Biomass based Power Plants**	10	3	5	4	12
4	**Wind Power Plants**	7	2	5	5	10
5	**Economics of Power Generation and Interconnected Power System**	10	4	5	5	14
	Total	**45**				**60**

COURSE OBJECTIVES:

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

- Maintaintheefficientoperationofvariouselectricpowergeneratingplants.

COURSE CONTENTS:

Unit–I: Thermal Power Plants: Coal, Gas/Diesel and Nuclear-based

Layout and working of a typical thermal power plant with steam turbines and electric generators.

Properties of conventional fuels used in the energy conversion equipment used in thermal power plants: Coal, Gas/ diesel, Nuclear fuels –fusion and fission action Safe Practices and working of various thermal power plants: coal-based, gas-based, diesel-based, nuclear-based. Functionsofthefollowingtypesofthermalpowerplantsandtheirmajorauxiliaries: Coal fired boilers: fire tube and water tube. Gas/diesel based combustion engines

Types of nuclear reactors: Disposal of nuclear waste and nuclear shielding.

Unit–II: Large and Micro-Hydro Power Plants

Energy conversion process of hydro power plant

Classification of hydro power plant: High, medium and low head.

Constructionandworkingofhydroturbinesusedindifferenttypesofhydropower plant:

a. High head–Pelton turbine
b. Medium head–Francis turbine
c. Low head–Kaplan turbine.

Safe Practices for hydro power plants.

Different types of micro-hydro turbines for different heads: Pelton, Francis and Kaplan turbines Locations of these different types of large and micro-hydro power plants in Nagaland. Potential locations of micro-hydro power plants in Nagaland.

Unit–III: Solar and Biomass based Power Plants

Solar Map of India: Global solar power radiation.

Solar Power Technology

a. Concentrated Solar Power(CSP) plants, construction and working of: Power Tower, Parabolic Trough, Parabolic Dish, Fresnel Reflectors
b. Solar Photo voltaic (PV) power plant: layout, construction, working.
Biomass-based Power Plants

- Layout of a Bio-chemical based (e.g. biogas) power plant:
- Layout of a Thermo-chemical based (e.g. Municipal waste) power plant
- Layout of an Agro-chemical based (e.g. bio-diesel) power plant

Features of the solid, liquid and gas bio masses as fuel for bio mass power plant

Unit–IV: Wind Power Plants

Wind Map of India**:** Wind power density in watts per square meter

Layout of Horizontal axis large wind power plant:

Geared wind power plant. Direct-drive wind power plant.

Salient Features of electric generators used in large wind power plants: Constant Speed Electric Generators: Squirrel Cage Induction Generators (SCIG), Wound Rotor Induction Generator (WRIG)

Variable Speed Electric Generators: Doubly-fed induction generator (DFIG), wound rotor synchronous generator (WRSG), permanent magnet synchronous generator (PMSG)

Unit– V: Economics of Power Generation and Interconnected Power System

Related terms: connected load, firm power, cold reserve, hot reserve, spinning reserve. Base load and peak load plants; Load curve, load duration curve, integrated duration curve

Cost of generation: Average demand, maximum demand, demand factor, plant capacity factor, plant use factor, diversity factor, load factor and plant load factor. Choice of size and number of generator units, combined operation of power station. Causes and Impact and reasons of Grid system fault: State grid, national grid, brown out and black out; sample blackouts at national and international level

REFERENCES:

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COURSE OUTCOMES:

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

a) Maintain the optimised working of the thermal power plant.

b) Maintain the optimised working of large and micro hydro power plants.

c) Maintain the optimized working of solar and biomass-based power plants.

d) Maintain the optimized working of wind power plants.

e) Select the adequate mix of power generation based one noncooperation.

Course Code	:	EEEPC203
Course Title	:	INTRODUCTION TO ELECTRIC GENERATION SYSTEMS LABORATORY
Number of Credits	:	1 (L:0,T:0,P:2)
Prerequisites	:	NIL
Course Category	:	PC

COURSE OBJECTIVES:

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

- Maintaintheefficientoperationofvariouselectricpowergeneratingplants.

PRACTICALS:

1. Identify the routine maintenance parts of the coal fired thermal power plant after watching A video programme
2. Identify the routine maintenance parts of the gas fired thermal power plant after watching a video programme
3. Assemble and dismantle a small diesel generator power plant.
4. Identify the routine maintenance parts of the nuclear fired thermal power plant after watching a video programme.
5. Identify the routine maintenance parts of the large hydropower plant after watching a video programme
6. Identify the routine maintenance parts of the micro hydro power plant after watching a video programme.
7. Assemble a microhy dropower plant and then dismantle it.
8. Assemble the parabolic trough or parabolic dish Concentrated Solar Power (CSP) plant.
9. Dismantle the parabolic trough or parabolic dish CSP plant.
10. Assemble the solar PV plant to produce electric power and then dismantle it.
11. Assemble a small biogas plant to generate electric power
12. Dismantle the biogas plant.
13. Identify the routine maintenance parts of the large wind power plant after watching a video programme.
14. Assemble a horizontal axis small wind turbine to produce electric power
15. Dismantle a horizontal axis small wind turbine.
16. Assemble a vertical axis small wind turbine to produce electric power and then dismantle it.
17. Identify the routine maintenance parts of the horizontal axis small wind turbine after watching a video programme.
18. Identify the routine maintenance parts of the vertical axis small wind turbine after watching a video programme.

COURSE OUCTOMES:

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

a) Maintain the optimized working of the thermal power plant.
b) Maintain the optimised working of large and micro hydro power plants.
c) Maintain the optimised working of solar and biomass-based power plants.
d) Maintain the optimized working of wind power plants.
e) Select the adequate mix of power generation based on economic operation.

Course Code	:	EEEPC205
Course Title	:	ELECTRIC CIRCUITS
Number of Credits	:	3 (L:2, T:1, P:0)
Prerequisites (Course code)	:	NIL
Course Category	:	PC

SPECIFICATION TABLE OF MARKS & HOURS

K=Knowledge Level, **C**=Comprehension Level, **A**=Application Level

Unit No.	Unit Title	Hours	Marks			
			K	C	A	Total Marks
I	**Single Phase A.C Series Circuits**	8	4	4	2	10
II	**Single Phase A.C Parallel Circuits**	9	3	5	4	12
III	**Three Phase Circuits**	9	2	4	4	10
IV	**Networks Reduction and Principles of Circuit Analysis**	9	2	4	8	14
V	**Network Theorems**	10	2	4	8	14
	Total	**45**				**60**

COURSE OBJECTIVES:

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

- Maintain electrical systems applying AC and DC circuit fundamentals.

COURSE CONTENTS:

Unit – I: Single Phase A.C Series Circuits

Generation of alternating voltage, Phasor representation of sinusoidal quantities R, L, C circuit elements its voltage and current response ,R-L, R-C, R-L-C combination of A.C series circuit, impedance, reactance, impedance triangle, Power factor, active power, reactive power, apparent power, power triangle and vector diagram Resonance, Bandwidth, Quality factor and voltage magnification in series R-L, R-C, R-L-C circuit

Unit – II: **Single Phase A.C Parallel Circuits**

R-L, R-C and R-L-C parallel combination of A.C. circuits. Impedance, reactance, phasor diagram, Impedance triangle R-L, R-C, R-L-C parallel A.C. circuit's power factor, active power, apparent power, reactive power, Power triangle Resonance in parallel R-L, R-C, R-L-C circuit, Bandwidth, Quality factor and voltage magnification

Unit– III: Three Phase Circuits

Phasor and complex representation of three phase supply, Phase sequence and polarity, Types of three-phase connections, Phase and line quantities in three phase star and Delta system, Balanced and unbalanced load, neutral shift in unbalanced load Three phase power, active, reactive and apparent power in star and delta system.

Unit– IV: Network Reduction and Principles of Circuit Analysis

Source transformation Star/delta and delta/star transformation, Mesh Analysis, Node Analysis

Unit– V: Network Theorems

Super position theorem, Thevenin's theorem. Norton's theorem Maximum power transfer theorem Reciprocity theorem Duality in electric circuits

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COURSE OUTCOMES:

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

a) Trouble shoot problems related to single phase A.C series circuits.
b) Trouble shoot problems related to single phase A.C parallel circuits.
c) Troubleshoot problems related to three phase circuits.
d) Use principles of circuit a lysis to troubleshoot electric circuits.
e) Apply network theorems to troubleshoot electric circuits.

Course Code	:	EEEPC207
Course Title	:	ELECTRIC CIRCUITS LABORATORY
Number of Credits	:	1 (L:0,T:0,P:2)
Prerequisites	:	NIL
Course Category	:	PC

COURSE OBJECTIVES:

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

- Maintain electrical systems applying AC and DC circuit fundamentals.

PRACTICALS:

1. Use dual trace oscilloscope to determine A.C voltage and current response in given R, L, Ccircuit.
2. Use voltmeter, ammeter, wattmeter to determine active, reactive and apparent power consumed in given R-L series circuit. Draw phasor diagram.
3. Use voltmeter, ammeter to determine active, reactive and apparent power consumed in given R-C series circuit. Draw phasor diagram.
4. Use voltmeter, ammeter, wattmeter to determine active, reactive and apparent power consumed in given R-L-C series circuit. Draw phasor diagram.
5. Use variable frequency supply to create resonance in given series R-L-C circuit or by using variable inductor or variable capacitor.
6. Use voltmeter, ammeter, watt meter to determine current, p.f., active, reactive and apparent power in R-C parallel A.C. circuit.
7. Use volt meter, ammeter, wattmeter, p.f meter to determine current, p.f., active, reactive and apparentpowerforgivenR-L-Cparallelcircuitwithseriesconnectionofresistorandinductor in parallel with capacitor.
8. Use variable frequency supply create resonance in given parallel R-L-C circuit or by using variable inductor or capacitor.
9. Use voltmeter, ammeter, watt meter, p.f meter to determine line and phase quantities of volt- age and current for balanced three phase star and delta connected load and calculate active, reactive, and apparent power. Draw phasor diagram.
10. Use volt meter, ammeter, wattmeter, p.f meter to determine line and phase quantities ofvolt- age and current for unbalanced three phase star and delta connected load and calculate ac- tive, reactive, and apparent power. Draw phasor diagram.
11. Use volt meter, ammeter to determine current through the given branch of a electric network by applying mesh analysis.
12. Use volt meter, ammeter to determine current through the given branch of a electric network by applying node analysis.
13. Use voltmeter, ammeter to determine current through the given branch and voltage across the given element of circuit by applying superposition theorem.
14. Use volt meter, ammeter to determine equivalent circuit parameter in a given circuit by applying Thevenin's theorem
15. Use voltmeter, ammeter to determine equivalent circuit parameter in a given circuit by applying Norton's theorem

16. Use volt meter, ammeter to determine load resistance for maximum power transfer for a given circuit by applying maximum power transfer theorem.

COURSE OUTCOMES:

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

a) Trouble shoot problems related to single phase A. C series circuits.

b) Trouble shoot problems related to single phase A.C parallel circuits.

c) Trouble shoot problems related to three phase circuits.

d) Use principles of circuit analysis to trouble shoot electric circuits.

e) Apply network theorems to trouble shoot electric circuits.

Course Code	:	EEEPC209
Course Title	:	ELECTRICAL AND ELECTRONIC MEASUREMENTS
Number of Credits	:	3 (L:2, T:1, P:0)
Prerequisites	:	NIL
Course Category	:	PC

SPECIFICATION TABLE OF MARKS & HOURS

K=Knowledge Level, **C**=Comprehension Level, **A**=Application Level

Unit No.	Unit Title	Hours	Marks			
			K	C	A	Total Marks
I	**Fundamental of Measurements**	7	4	5	2	12
II	**Measurement of Voltage and Current.**	8	2	8	3	13
III	**Measurement of Electric Power**	9	2	7	2	11
IV	**Measurement of Electric Energy**	8	3	5	2	10
V	**Circuit Parameter Measurement, CRO and Other Meters**	13	2	8	4	14
	Total	**45**				**60**

COURSE OBJECTIVES:

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

- Use relevant measuring instrument in different electrical applications.

COURSE CONTENTS:

Unit–I: Fundamentals of Measurements

Measurement: Significance, units, fundamental quantities and standards Classification of Instrument Systems:

Null and deflection type instruments Absolute and secondary instruments Analog and digital instruments

Static and dynamic characteristics, types of errors Calibration: need and procedure

Classification of measuring instruments: indicating, recording and integrating instruments.

Essential requirements of an indicating instruments

Unit–II: Measurement of voltage and current

DC Ammeter: Basic, Multirange, Universal shunt,

DC Voltmeter: Basic, Multi-range, concept of loading effect and sensitivity

AC voltmeter: Rectifier type (halfwave and full wave)

CT and PT: construction, working and applications. Clamp-on meter.

Unit–III: Measurement of Electric Power

Analog meters: Permanent magnet moving coil (PMMC) and Permanent magnet moving iron (PMMI) meter, their construction, working, salient features, merits and demerits

Dynamometer type wattmeter: Construction and working Range: Multiplying factor and extension of range using CT and PT Errors and compensations.

Active and re active power measurement: One, two and three wattmeter method.

Effect of Power factor on watt meter reading in two watt meter method

Maximum Demand indicator

Unit–IV: Measurement of Electric Energy

Single and three phase electronic energy meter: Constructional features and working principle. Errors and their compensations

Calibration of single phase electronic energy meter using direct loading.

Unit–V: Circuit Parameter Measurement, CRO and Other Meters

Measurement of resistance:

Low resistance: Kelvin's double bridge,

Medium Resistance: Voltmeter and ammeter method

High resistance: Megger and Ohm meter: Series and shunt

Measurement of inductance using Anderson bridge (no derivation and phasor diagram) Measurement of capacitance using Schering bridge (no derivation and phasor diagram) Single beam/single trace CRO, Digital storage Oscilloscope: Basic block diagram, working,

Cathode ray tube, electrostatic deflection, vertical amplifier, time base generator, horizontal amplifier, measurement of voltage/ amplitude/ time period/ frequency/ phase angle delay line, specifications.

Other meters: Earth tester, Digital Multimeter; L-C-Rmeter, Frequency meter (ferromagnet- ic and Weston type), Phase sequence indicator, power factor meter (single phase and three phase dynamometer type), Synchro scope, Tri-vector meter

Signal generator: need, working and basic block diagram.

Function generator: need, working and basic block diagram, function of symmetry.

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COURSE OUT COMES:

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

a) Check the working of thee lectrical measuring instrument.

b) Use different types of measuring instruments for measuring voltage and current.

c) Use different types of measuring instruments for measuring electric power

d) Use different types of measuring instruments for measuring electric energy.

e) Use different types of electrical instruments for measuring various ranges of electrical pa- rameters.

Course Code	:	EEEPC211
Course Title	:	ELECTRICAL AND ELECTRONIC MEASUREMENTS LABORATORY
Number of Credits	:	1 (L:0, T:0, P:2)
Prerequisites	:	NIL
Course Category	:	PC

COURSE OBJECTIVES:

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

- Userelevantmeasuringinstrumentindifferentelectricalapplications.

PRACTICALS:

1. Identify measuring instruments on the basis of symbols on dial, type, accuracy, class position and scale.
2. Identify the components of PMMC and MI instruments.
3. Troubleshoot PMMC and MI instruments.
4. Measure AC and DC quantities in a working circuit.
5. Extend range of ammeter and voltmeter by using (i) shunt and multiplier (ii) CT and PT.
6. Use Clamp-on meter for measurement of AC/DC current, AC/DC voltage.
7. Use electro-dynamic watt-meter for measurement of power in a single-phase circuit
8. Troubleshoot electro dynamic watt-meter for measurement of power in a single-phase circuit
9. Use single watt meter for measurement of active and reactive power of three phase balanced load.
10. Use two watt-meters for measuring active power of three-phase balanced load.
11. Calibrate single phase electronic energy meter by direct loading.
12. Troubleshoot single phase electronic energy meter.
13. Use digital multi-meter for measurement of AC/DC current, AC/DC voltage.
14. Use Kelvin's double bridge for measurement of low resistance.
15. Use volt meter and ammeter method for measurement of medium resistance.
16. Use Megger for insulation resistance measurements.
17. Use earth tester for measurement of earth resistance.
18. Use CRO for the Measurement of supply frequency in single-phase circuit.
19. Use Tri-vector meter for measuring kW, kVAr and kVA of a power line.

COURSE OUT COMES:

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

a) Check the working of the electrical measuring instrument.
b) Use different types of measuring instruments for measuring voltage and current.
c) Use different types of measuring instruments for measuring electric power

a. Use different types of measuring instruments for measuring electric energy.
b. Use different types of electrical instruments for measuring electrical parameters of various ranges.

Course Code	:	EEEPC213
Course Title	:	ELECTRIC MOTORS AND TRANSFORMERS
Number of Credits	:	3 (L:2, T:1, P:0)
Prerequisites	:	NIL
Course Category	:	PC

SPECIFICATION TABLE OF MARKS & HOURS

K = Knowledge Level, **C** = Comprehension Level, **A** = Application Level

Unit No.	Unit Title	Hours	Marks			
			K	C	A	Total Marks
I	**DC Generators**	8	3	4	4	11
II	**DC motors**	9	3	5	4	12
III	**Single phase Transformers**	9	3	5	4	12
IV	**Three Phase Transformers**	10	3	5	5	13
V	**Special purpose Transformers**	9	3	4	5	12
	Total	**45**				**60**

COURSE OBJECTIVES:

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

- Maintain electric motors and transformers.

COURSE CONTENTS:

Unit–I: DC Generators

DC generator: construction, parts, materials and their functions.

Principle of operation of DC generator: Fleming's right hand rule, schematic diagrams, e.m.f. equation of generator, armature reaction, commutation and Applications of DC generators. Classification of measuring instruments: indicating, recording and integrating instruments.

Unit–II: D.C. Motors

DC motor: Types of DC motors. Fleming's left hand rule, Principle of operation of, Backe. m.f. and its significance, Voltage equation of DC motor.

Torque and Speed; Armature torque, Shaft torque, BHP, Brake test, losses, efficiency.

DC motor starters: Necessity, two point and three point starters.

Speed control of DC shunt and series motor: Flux and Ar mature control.

Brushless DC Motor: Construction and working.

Unit–III: Single Phase Transformers

Types of transformers: Shell type and core type; Construction: Parts and functions, materials used for different parts: CRGO, CRNGO, HRGO, amorphous cores,

Transformer: Principle of operation, EM Fequation of transformer: Derivation, Voltage trans-formation ratio, Significance of transformer ratings

Transformer No-load and on-load phasor diagram, Leakage reactance, Equivalent circuit of transformer: Equivalent resistance and reactance.

Voltage regulation and Efficiency: Direct loading, OC/SC method, Allday efficiency.

Unit–IV: Three Phase Transformers

Bank of three single phase transformers, Single unit of three phase transformer Distribution. And Power transformers.

Construction, cooling, Three phase transformers connections as per IS:2026 (part IV)-1977, Three phase to two phase conversion (Scott Connection), Selection of transformer as per IS: 10028 (Part-I)-1985, Criteria for selection of distribution transformer, and power transformer, Amorphous Core type Distribution Transformer, Specifications of three-phase distribution transformers as per IS:1180 (part I)-1989

Need of parallel operation of three phase transformer, Conditions for parallel operation.

Polarity tests on mutually inductive coils and single-phase transformers; Polarity test, Phasing out test on Three-phase transformer.

Unit–V: Special Purpose Transformers

Single phase and three phase auto transformers: Construction, working and applications.

Instrument Transformers: Construction, working and applications of Current transformer and Potential transformer.

Isolation transformer: Constructional Features and applications.

Single phase welding transformer: constructional features and applications. Pulse transformer: constructional features and applications.

'K'factor of transformers: overheating due to non-linear loads and harmonics.

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COURSE OUTCOMES:

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

a. Maintain different types of DC generators.
b. Maintain different types of DC motors.
c. Maintain single phase transformer.
d. Maintain three phase transformers.
e. Maintain different types of special purpose transformers used in different applications.

Course Code	:	EEEPC215
Course Title	:	ELECTRIC MOTORS AND TRANSFORMERS LABORATORY
Number of Credits	:	1 (L:0,T:0,P:2)
Prerequisites	:	NIL
Course Category	:	PC

COURSE OBJECTIVES:

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

- Use electric motors and transformers.

PRACTICALS:

1. Dismantle a DC machine.
2. Reverse the direction of rotation of the DC shunt motor.
3. Perform brake test on DC shunt motor.
4. Control the speed of DC shunt motor by different methods.
5. Control the speed of DC series motor by different methods.
6. Perform the brake test on DC series motor.
7. Check the functioning of single phase transformer.
8. Determine regulation and efficiency of single phase transformer by direct loading.
9. Perform open circuit and short circuit test on single phase transformer to determine equiva-Lent circuit constants, voltage regulation and efficiency.
10. Perform parallel operation of two single phase transformers to determine the load Current sharing.
11. Perform parallel operation of two single phase transformers and determine the apparent and real power load sharing.
12. Perform polarity test on a single phase transformer whose polarity markings are masked.
13. Perform phasing out test on a three phase transformer whose phase markings are masked.
14. Connect the auto-transformer in step-up and step-down modes noting the input/output read- ings.
15. Check the functioning of the CT, PT and isolation transformer.
16. Test the pulse transformer.

COURSE OUT COMES:

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

a) Maintain different types of DC generators.
b) Maintain different types of DC motors.
c) Maintain single phase trans former.
d) Maintain three phase transformers.
e) Maintain different types of special purpose transformers used in different applications.

Course Code	:	EEEPC 217
Course Title	:	Electronics Devices and Circuits
Number of Credits	:	3 (L:3, T:0, P:0)
Prerequisites	:	NIL
Course Category	:	PC

SPECIFICATION TABLE OF MARKS & HOURS

K = Knowledge Level, **C** = Comprehension Level, **A** = Application Level

Unit No.	Unit Title	Hours	Marks			
			K	C	A	Total Marks
I	**Semiconductor and Diodes**	8	3	4	4	11
II	**Bipolar Junction Transistor (BJT)**	9	3	4	5	12
III	**Field Effect Transistors**	9	3	4	5	12
IV	**SCR DIAC & TRIAC**	10	3	4	6	13
V	**Amplifiers and Oscillators**	9	3	4	5	12
	Total	**45**				**60**

COURSE OBJECTIVES:

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

- Maintain Electronics Devices and Circuits.

COURSE CONTENT:

Unit1–Semi conduct or and Diodes

Definition, Extrinsic/Intrinsic, N-type & p-type

PN Junction Diode–Forward and Reverse Bias Characteristics Zener Diode–Principle, characteristics, construction, working Diode Rectifiers – Half Wave and Full Wave

Filters–C, LC and PI Filters

Unit2–Bipolar Junction Transistor (BJT)

NPN and PNP Transistor – Operation and characteristics Common Base Configuration – characteristics and working Common Emitter Configuration–characteristics and working Common Base Configuration – characteristics and working High frequency model of BJT

Classification of amplifiers, negative feed back

Unit3–Field Effect Transistors

FET–Working Principle, Classification

MOSFET Small Signal model

N-Channel/ P-Channel MOSFETs – characteristics, enhancement and depletion mode, MOS- FET as a Switch Common Source Amplifiers

Uni-Junction Transistor–equivalent circuit and operation

Unit4–SCRDIAC&TRIAC

SCR – Construction, operation, working, characteristics DIAC - Construction, operation, working, characteristics TRIAC - Construction, operation, working, characteristics SCR and MOSFET as a Switch, DIAC as bidirectional switch Comparison of SCR, DIAC, TRIAC, MOSFET

Unit5–Amplifiers and Oscillators

Feedback Amplifiers – Properties of negative Feedback, impact of feedback on different pa- rameters
Basic Feed back Amplifier Topologies: Voltage Series, Voltage Shunt Current Series, Current Shunt
Oscillator–Basic Principles, Crystal Oscillator, Non-linear/Pulse Oscillator

1 SUGGESTED LEARNING RESOURCES:

S. No.	Title of Book	Author	Publication
1.	Analog Circuits	A.K. Maini	Khanna Publishing House Ed.2018(ISBN:978-93-86173-584)
2.	Electronic Devices and Circuits	S. Salivahanan and N. SureshKumar	Mc Graw Hill Education; Fourth edition (1July 2017) ISBN: 978-9339219505
3.	Electronics Devices and circuit theory	Boyestad & Nash-elsky	Pearson Education India; 11 edition (2015) ISBN: 978-9332542600
4.	Electronic Principles	Albert Malvino & David Bates	Tata Mc Graw Hill Publication 2010 ISBN: 978-0070634244
5.	Electronics Devices & Circuits	Jacob Millman	Mc Graw Hill Education; 4 edition (2015) ISBN: 978-9339219543

SUGGESTED SOFTWARE / LEARNING WEBSITES:

a. https://www.electronics-tutorials.ws/
b. https://www.youtube.com/watch?v=Rx43l-QpeWQ
c. https://electronicsforu.com/resources/electronic-devices-and-circuit-theory

COURSE OUTCOMES:

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

a) Maintain Semi-conductor and Diodes.
b) Maintain Field Effect Transistors
c) Maintain Bipolar Junction Transistor (BJT)
d) Maintain Amplifiers and Oscillators.
e) Maintain SCR, DIAC & TRIAC.

Course Code	:	EEEPC219
Course Title	:	Electronic Devices and Circuits Lab
Number of Credits	:	1 (L:0,T:0,P:2)
Prerequisites	:	NIL
Course Category	:	PC

COURSE OBJECTIVES:

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

- Maintain Electronics Devices and Circuits.

PRACTICALS

S. No.	Practical Outcomes (PrOs)	Unit No.
1.	Construct the circuit and plot the VI characteristics of the PN Junction Diode, Find the cut in voltage	1
2.	Construct the circuit and plot the characteristics of a Zener Diode. Find the Breakdown voltage	1
3.	Construct a Half Wave Rectifier and obtain regulation characteristics – Without Filters and with Filters Compare the results	1
4.	Construct a Full Wave Rectifier and obtain regulation characteristics – Without Filters and with Filters Compare the results	1
5.	Construct a Bridge Rectifier and obtain regulation characteristics–Without Fil- ters and with Filters	1
6.	Obtain the characteristics of DIAC and TRIAC	3
7.	Simulate half wave, full wave and bridge rectifier using simulation tool like PSpice/Orcad/Multisim.	3
8.	Develop a simulation model for Voltage Series and Voltage Shunt Feedback Am-plifiers	5
9.	Develop circuits for Voltage Series and Voltage Shunt Feedback Amplifiers and obtainoutputplots.Compareth eresultswiththesimulationmodel.	5
10.	Develop a simulation model for Current Series and Current Shunt Feedback Amplifiers	5
11.	Develop circuits for Current Series and Current Shunt Feedback Amplifiers and Obtain output plots. Compare there sults with the simulation model.	5

Reference Books:

S. No.	Title of Book	Author	Publication
1.	Analog Circuits	A.K. Maini	Khanna Publishing House Ed.2018(ISBN:978-93-86173-584)

2.	Electronic Devices and Cir- cuits	S. Salivahanan and N. Suresh Kumar	McGraw Hill Education; Fourth edition (1 July 2017) ISBN: 978-9339219505
3.	Electronics Devices and circuit theory	Boyestad & Nashelsky	Pearson Education India; 11 edition (2015) ISBN: 978-9332542600
4.	Electronic Principles	Albert Malvino & Da- vid Bates	Tata Mc Graw Hill Publication 2010 ISBN: 978-0070634244
5.	Electronics Devices & Cir- cuits	Jacob Millman	McGraw Hill Education; 4 edition (2015) ISBN: 978-9339219543

COURSE OUTCOMES:

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

a) Maintain Semiconductor and Diodes.
b) Maintain Field Effect Transistors
c) Maintain Bipolar Junction Transistor (BJT)
d) Maintain Amplifiers and Oscillators.
e) Maintain SCR, DIAC & TRIAC.

Semester– IV

Course Code	:	EEEPC202
Course Title	:	Fundamentals of Power Electronics
Number of Credits	:	3 (L:3, T:0, P:0)
Prerequisites	:	NIL
Course Category	:	PC

SPECIFICATION TABLE OF MARKS & HOURS

K = Knowledge Level, **C** = Comprehension Level, **A** = Application Level

Unit. No.	Unit Title	Hours	K	C	A	Total Marks
1	**Power Electronic Devices**	10	2	6	3	11
2	**Thyristor Family Devices**	9	4	8	2	14
3	**Turn-on and Turn-off Methods of Thyristors**	10	5	8	3	16
4	**Phase Controlled Rectifiers**	8	2	4	4	10
5	**Industrial Control Circuits**	8	2	3	4	9
	Total	**45**				**60**

COURSE OBJECTIVES:

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

- Maintain the proper functioning of power electronic devices.

COURSE CONTENTS:

Unit–I: Power Electronic Devices

Power electronic devices

Power transistor: construction, working principle, V-I characteristics and uses. IGBT: Construction, working principle, V-I characteristics and uses.

Concept of single electron transistor (SET)-aspects of Nano-technology.

Unit–II: Thyristor Family Devices

SCR: construction, two transistor analogy, types, working and characteristics.

SCR mounting and cooling.

Types of Thyristors: SCR, LASCR, SCS, GTO, UJT, PUT, DIAC and TRIAC

Thyristor family devices: symbol, construction, operating principle and V-I characteristics.

Protection circuits: over-voltage, over-current, Snubber, Crowbar.

Unit–III: Turn-on and Turn-off Methods of Thyristors

SCR Turn-On methods: High Voltage thermal triggering, Illumination triggering, dv/dt triggering, Gate triggering.

Gatetrigger circuits–Resistance and Resistance-Capacitance circuits.
SCR triggering using UJT, PUT: Relaxation Oscillator and Synchronized UJT circuit.
Pulse transformer and opto-coupler based triggering.

SCR Turn-Off methods: Class A- Series resonant commutation circuit, Class B-Shunt Resonant commutation circuit, Class C-Complimentary Symmetry commutation circuit, Class
D–Auxiliary commutation, Class E-External pulse commutation, Class F-Line or natural commutation.

Unit–IV: Phase Controlled Rectifiers

Phase control: firing angle, conduction angle.
Single phase half controlled, full controlled and mid-point controlled rectifier with R, RL load: Circuit diagram, working, input-output wave forms, equations for DC out put and effect of freewheeling diode.

Different configurations of bridge-controlled rectifiers: Full bridge, half bridge with common anode, common cathode, SCR sin one arm and diodes in another arm.

Unit–V: Industrial Control Circuits

Applications: Burglar's alarm system, Battery charger using SCR, Emergency light system, Temperature controller using SCR and; Illumination control / fan speed control TRIAC.

SMPS.
UPS: Offline and Online
SCR based AC and DC circuit breakers.

REFERENCES:

1. Ramamoorty M., An Introduction to Thyristors and their applications, East- West Press Pvt. Ltd., New Delhi, ISBN: 8185336679.
2. Sugandhi, Rajendra Kumarand Sugandhi, Krishna Kumar, Thyristors: Theory and Applications, New Age International (P) ltd. Publishers, New Delhi, ISBN: 978-0-85226-852-0.
3. Bhattacharya, S.K., Fundamentals of Power Electronics, Vikas Publishing House Pvt. Ltd. Noida. ISBN: 978-8125918530.
4. Jain & Alok, Power Electronics and its Applications, Penram International Publishing (India) Pvt. Ltd, Mumbai, ISBN: 978-8187972228.
5. Rashid, Muhammad, Power Electronics Circuits Devices and Applications, Pearson Education India, Noida, ISBN: 978-0133125900.
6. Singh, M. D. and Khanchandani, K.B., Power Electronics, Tata McGraw Hill Publishing Co. Ltd, New Delhi, 2008 ISBN: 9780070583894.
7. Zbar,PaulB., Industrial Electronics: A Text–Lab Manual, Mc Graw Hill Publishing Co. Ltd., New Delhi, ISBN:978-0070728226.
8. Grafham D.R., SCR Manual, General Electric Co., ISBN:978-0137967711.

COURSE OUT COMES:

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

a) Select power electronic devices for specific applications.

b) Maintain the performance of Thyristors.

c) Troubleshoot turn-on and turn-off circuits of Thyristors.

d) Maintain phase controlled rectifiers.

e) Maintain industrial control circuits.

Course Code	:	EEEPC204
Course Title	:	FUNDAMENTALS OF POWER ELECTRONICS LABORATORY
Number of Credits	:	1 (L:0,T:0,P:2)
Prerequisites	:	NIL
Course Category	:	PC

COURSE OBJECTIVES:

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

- Maintain the proper functioning of power electronic devices.

PRACTICALS:

1. Test the proper functioning of power transistor.
2. Test the proper functioning of IGBT.
3. Test the proper functioning of DIAC to determine the break over voltage.
4. Determine the latching current and holding current using V-I characteristics of SCR.
5. Test the variation of R, C in R and RC triggering circuits on firing angle of SCR.
6. Test the effect of variation of R, C in UJT triggering technique.
7. Perform the operation of Class–A,B,C, turn off circuits.
8. Perform the operation of Class–D,E,F turn off circuits.
9. Use CRO to observe the output wave form of half wave controlled rectifier with resistive load And determine the load voltage.
10. Draw the output wave form of Full wave controlled rectifier with R load, RL load, free wheeling Diode and determine the load voltage.
11. Determine the firing angle using DIAC and TRIAC phase-controlled circuit on output power Under different loads such as lamp, motor or heater
12. Simulate above firing angle control on SCILAB software
13. Test the performance of given SMPS, UPS.
14. Troubleshoot the Burglar's alarm, Emergency light system, Speed control system, Temperature control system.

COURSE OUTCOMES:

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

a) Select power electronic devices for specific applications.
b) Maintain the performance of Thyristors.
c) Troubleshoot turn-on and turn-off circuits of Thyristors.
d) Maintain phase controlled rectifiers.
e) Maintain industrial control circuits.

Course Code	:	EEEPC206
Course Title	:	Digital Electronics
Number of Credits	:	3 (L:2, T:1, P:0)
Prerequisites	:	NIL
Course Category	:	PC

SPECIFICATION TABLE OF MARKS & HOURS

K=Knowledge level, **C**= Comprehension Level, **A**=Application level

Unit No.	Unit Title	Hours	K	C	A	Total Marks
1	**Number Systems & Boolean Algebra**	10	2	5	8	15
2	**Logic Gates**	7	2	2	4	8
3	**Combinational Logic Circuits**	10	4	5	5	14
4	**Sequential Logic Circuits**	10	2	6	5	13
5	**Memory Devices**	8	3	6	1	10
	Total	45				60

COURSE OBJECTIVES:

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

- Maintain Digital Electronics number system, various gates, memory devices and its applications.

COURSE CONTENT:

Unit1–Number Systems & Boolean Algebra

Introduction to different number systems–Binary, Octal, Decimal, Hexadecimal
Conversion from one number system to another. Boolean variables–Rules and laws of Boolean Algebra De-Morgan's Theorem
Karnaugh Maps and their use for simplification of Boolean expressions

Unit2–Logic Gates

Logic Gates–AND, OR, NOT, NAND, NOR, XOR, XNOR: Symbolic representation and truth table Implementation of Boolean expressions and Logic Functions using gates Simplification of expressions

Unit3–Combinational Logic Circuits

Arithmetic Circuits–Addition, Subtraction, 1's2's Complement, Half Adder, Full Adder, Half Subtractor, Full Subtractor, Parallel and Series Adders Encoder, Decoder
Multiplexer–2 to 1 MUX, 4 to 1 MUX, 8 to 1 MUX. Applications
Demultiplexer– 1 to 2 DEMUX, 1-4 DEMUX, 1-8 DEMUX

Unit4–Sequential Logic Circuits

Flip Flops–SR, JK, T, D, FF, JK-MS, Triggering

Counters–4 bit Up–Down Counters, Asynchronous/Ripple Counter, Decade Counter-Mod 3, Mod 7 Counter, Johnson Counter, Ring Counter

Registers–4 bit Shift Register: Serial In Serial Out, Serial in Parallel Out, Parallel In Serial Out, Parallel In Parallel Out

Unit5–Memory Devices

Classification of Memories–RAM Organization, Address Lines and Memory Sixe,

Static RAM, Bipolar RAM, cell Dynamic RAM, DRAM, DDRRAM

Read Only memory–ROM organization, Expanding memory, PROM, EPROM, EEPROM, Flash
memory

Data Converters–Digital to Analog converters, Analog to Digital Converters

SUGGESTED LEARNING RESOURCES:

S. No.	Title of Book	Author	Publication
1.	Digital principles & Applications	Albert Paul Malvino & Donald P. Leach	McGraw Hill Education; Eighth edition ISBN: 978-9339203405
2.	Digital Electronics	Roger L. Tokheim Macmillian	McGraw-Hill Education (ISE Editions); International 2 Revised ed edition ISBN: 978-0071167963
3.	Digital Electronics – an introduction to theory and practice	William H. Gothmann	Prentice Hall India Learning Private Limited; 2 edition ISBN: 978-8120303485
4.	Fundamentals of Logic Design	Charles H. Roth Jr.	Jaico Publishing House; First edition ISBN: 978-8172247744
5.	Digital Electronics	R. Anand	Khanna Publications, New Delhi (Edition2018)ISBN:978-93-82609445

COURSE OUTCOMES:

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

a) Use number systems and Boolean algebra with applications.

b) Understand Logic gates.

c) Maintain combinational logic circuits.

d) Maintains equential logic gates.

e) Maintain and use various memory devices.

Course Code	:	EEEPC208
Course Title	:	Digital Electronics Lab
Number of Credits	:	1 (L:0, T:0, P:2)
Prerequisites	:	NIL
Course Category	:	PC

COURSE OBJECTIVES:

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

- Maintain Digital Electronics number system, various gates, memory devices and its applications.

SUGGESTEDPRACTICALS/EXERCISES

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

S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. Required
1.	To verify the truth tables for all logic fates–NOT ORANDNAND NOR XORXNOR using CMOS Logic gates and TTL Logic Gates	1	02
2.	Implement and realize Boolean Expressions with Logic Gates	2	02
3.	Implement Half Adder, Full Adder, Half Subtractor, Full subtractor us- ing ICs	3	02
4.	Implement parallel and serial full-adder using ICs	3	02
5.	Design and development of Multiplexer and De-multiplexer using mul- tiplexer ICs	3	02
6.	Verification of the function of SR, D, JK and TF lip Flops	4	02
7.	Design controlled shift registers	4	02
8.	Construct a Single digit Decade Counter (0-9) with 7 segment display	4	03
9.	To design a programmable Up-Down Counter with a 7 segment display.	4	03
10.	Study of different memory ICs	5	02
11.	Study Digital-to–Analog and Analog to Digital Converters	5	02
12.	Simulate in Software (such as P Spice) an Analog to Digital Converter	5	03
13.	Simulate in Software (such as P Spice) an Analog to Digital Converter	5	03
	Total		**30**

REFERENCEBOOKS:

S. No.	Title of Book	Author	Publication
1.	Digital principles & Applications	Albert Paul Malvino & Donald P. Leach	McGraw Hill Education; Eighth edition ISBN: 978-9339203405
2.	Digital Electronics	Roger L.Tokheim Macmillian	McGraw-Hill Education(ISE Editions); International 2 Revised ed edition ISBN: 978-0071167963
3.	Digital Electronics – an introduction to theory and practice	William H. Goth-mann	Prentice Hall India Learning Private Limited; 2 edition ISBN: 978-8120303485
4.	Fundamentals of Logic Design	Charles H. Roth Jr.	Jaico Publishing House; First edition ISBN: 978-8172247744
5.	Digital Electronics	R. Anand	Khanna Publications, New Delhi (Edition2018)ISBN:978-93-82609445

COURSE OUT COMES:

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

a) Use number systems and Boolean algebra with applications.

b) Understand Logic gates.

c) Maintain combinational logic circuits.

d) Maintain sequential logic gates.

e) Maintain and use various memory devices

Course Code	:	EEEPC210
Course Title	:	INDUCTION, SYNCHRONOUS AND SPECIAL ELECTRIC MACHINES
Number of Credits	:	3 (L:2, T:1, P:0)
Prerequisites	:	NIL
Course Category	:	PC

- **SPECIFICATION TABLE OF MARKS & HOURS**

K=Knowledge level, **C**= Comprehension Level, **A**=Application level

Unit No.	Unit Title	Hours	K	C	A	Total Marks
1	**Three Phase Induction Motor**	10	2	5	5	14
2	**Single phase induction motors**	10	2	5	5	10
3	**Three phase Alternators**	10	3	5	4	14
4	**Synchronous motors**	8	2	5	5	12
5	**Fractional horse power (FHP) Motors**	7	4	5	5	10
	Total	**45**				**60**

COURSE OBJECTIVES:

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

- Maintain Induction, Synchronous and FHP Machines used in different applications.

COURSE CONTENTS:

Unit–I: Three Phase Induction Motor

Working principle: production of rotating magnetic field, Synchronous speed, rotor speed and slip.

Constructional details of 3 phase induction motors: Squirrel cage induction motor and Slipring induction motor.

Rotor quantities: frequency, induced emf, power factor at starting and running condition.

Characteristics of torque versus slip (speed), Torques: starting, full load and maximum with Relations among them.

Induction motor as a generalized transformer with phasor diagram.

Four quadrant operation, Power flow diagram

Starters: need and types; stator resistance, auto transformer, star delta, rotor resistance and soft starters.

Speed control methods: stator voltage, pole changing, rotor resistance and VVVF. Motor selection for different applications as per the load torque-speed requirements. Maintenance of three phase induction motors

Unit–II: Single phase induction motors

Double field revolving theory, principle of making these motors self-start.

Construction and working: Resistance start induction run, capacitor start induction run, capacitor start capacitor run, shaded pole, repulsion type, series motor, universal motor, hysteresis motor.

Torque-speed characteristics for all of the above motors.

Motor selection for different applications as per the load torque-speed requirements. Maintenance of single phase induction motors

Unit–III: Three phase Alternators

Principle of working, moving and stationary armatures.

Constructional details: parts and their functions, rotor constructions. Windings: Single and Double layer.

E.M.F. equation of an Alternator with numerical by considering short pitch factor and distribution factor.

Alternator loading: Factors affecting the terminal voltage of alternator; Armature resistance and leakage reactance drops.

Armature reaction at various power factors and synchronous impedance. Voltage regulation: direct loading and synchronous impedance methods. Maintenance of alternators

Unit–IV: Synchronous motors

Principle of working/operation, significance of load angle.

Torques: starting torque, running torque, pull in torque, pull out torque. Synchronous motor on load with constant excitation (numerical), effect of excitation at constant load (numerical).

V-Curves and Inverted V-Curves. Hunting and Phase swinging.

Methods of Starting of Synchronous Motor.

Losses in synchronous motors and efficiency (no numerical).

Applications areas

Unit–V: Fractional horse power (FHP)Motors

Construction and working: Synchronous Reluctance Motor, Switched Reluctance Motor, BLDC, Permanent Magnet Synchronous Motors, stepper motors, AC and DC servomotors.

Torque speed characteristics of above motors. Applications of above motors.

REFERENCES:

1. P.S. Bimbhra, Electric Machines, Khanna Book Publishing Co., New Delhi (ISBN:978-93-86173- 294)
2. Mittle, V.N. and Mittle, Arvind., Basic Electrical Engineering, Mc Graw Hill Education New Delhi, ISBN :9780070593572
3. Kothari, D.P. and Nagrath, I.J., Electrical Machines, Mc Graw Hill Education. New Delhi, ISBN:9780070699670
4. Bhattacharya, S.K., Electrical Machines, Mc Graw Hill Education, New Delhi, ISBN:9789332902855
5. Theraja, B.L., Electrical Technology Vol-II (AC and DC machines), S. Chandand Co. Ltd., New Delhi, ISBN :9788121924375
6. Sen, S.K., Special Purpose Electrical Machines, Khanna Publishers, New Delhi, ISBN: 9788174091529
7. Janardanan E.G, Special Electrical Machines, Prentice Hall India, New Delhi ISBN: 9788120348806
8. Hughes E., Electrical Technology, ELBS
9. Cotton H., Electrical Technology, ELBS

COURSE OUTCOMES:

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

a) Maintain three phase induction motor used in different applications.

b) Maintain single phase induction motor used in different applications.

c) Maintain three phase alternators used in different applications.

d) Maintain synchronous motors used in different applications.

e) Maintain FHP motors used in different applications.

Course Code	:	EEEPC212
Course Title	:	INDUCTION, SYNCHRONOUS AND SPECIAL ELECTRIC MACHINES LABORATORY
Number of Credits	:	1 (L:0, T:0, P:2)
Prerequisites (Course code)	:	NIL
Course Category	:	PC

COURSE OBJECTIVES:

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

- Maintain Induction, Synchronous and FHP Machines used in different applications.

PRACTICALS:

1. Identify the different parts (along with function and materials) for the given single phase and three phase induction motor.
2. Connect and run the three phase squirrel cage induction motors (in both directions) using the DOL, star-delta, auto-transformer starters (any two)
3. Perform the direct load test on the three phase squirrel cage induction motor and plot the

i) Efficiency versus output, ii)power factor versus output, iii) power factor versus motor Current and iv) torque–slip/speed characteristics.

4. Conduct the No-load and Blocked-rotor tests on given 3-�squirrel cage induction motor and determine the equivalent circuit parameters.
5. Conduct the No-load and Blocked-rotor tests on given 3-�squirrel cage induction motor and plot the Circle diagram.
6. Control the speed of the given three phase squirrel cage/slip ring induction motor using the applicable methods: i) auto-transformer, ii) VVVF.
7. Measure the open circuit voltage ratio of the three phase slip ring induction motor.
8. Conduct the direct load test to determine the efficiency and speed regulation for different loads on the given single phase induction motor; plot the efficiency and speed regulation curves with respect to the output power.
9. Perform the direct loading test on the given three phase alternator and determine there g-Ulation and efficiency.
10. Determine the regulation and efficiency of the given three phase alternator from OC and SC

Tests (Synchronous impedance method)

11. Conduct the test on load or no load to plot the ‘V’ curves and inverted ‘V’ curves (atno-load) of 3-�synchronous motor.
12. Dismantling and reassembling of single phase motors used for ceiling fans, universal motor formixer.
13. Control the speed and reverse the direction of stepper motor
14. Control the speed and reverse the direction of the Ac servo motor
15. Control the speed and reverse the direction of the DC servo motor

COURSE OUT COMES:

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

a) Maintain three phase induction motor used in different applications.

b) Maintain single phase induction motor used in different applications.

c) Maintain three phase alternators used indifferent applications.

d) Maintain synchronous motors used in different applications.

e) Maintain FHP motors used in different applications.

PROGRAMME ELECTIVE COURSES (EEEPE2**) COURSES

Course Code	:	EEEPE202
Course Title	:	SOLAR POWER TECHNOLOGIES
Number of Credits	:	3 (L:3, T:0, P:0)
Prerequisites	:	NIL
Course Category	:	PC

SPECIFICATION TABLE OF MARKS & HOURS

K=Knowledge level, **C**= Comprehension Level, **A**=Application level

Unit No.	Unit Title	Hours	K	C	A	Total Marks
1	**Solar Energy**	9	4	4	4	12
2	**Concentrated Solar Power (CSP)**	9	4	4	4	12
3	**Solar PV Systems**	9	5	3	4	12
4	**Solar PV Electronics**	9	5	2	5	12
5	**Solar PV Off-grid and Grid Tied Systems**	9	2	5	5	12
	Total	**45**				**60**

COURSE OBJECTIVES:

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

- Maintain the efficient operation of various types of solar power technologies.

COURSE CONTENTS:

Unit–I: Solar Energy

Solar Map of India: Global solar power radiation
Different types of Solar water heaters: Construction, working, specifications and installation
Solar Heating systems
Solar drying and different types of Solar cookers Solar lighting.
Preventive maintenance of all of the above.

Unit–II: Concentrated Solar Power (CSP)

Concentrated Solar Power (CSP) plants or solar thermal electric systems
Parabolic Trough: Construction, working and Specifications Parabolic Dish: Construction, working and specifications
Power Tower, Fresnel Reflectors: Construction, working and specifications
Solar Stirling engines
Preventive maintenance of all of the above

Unit–III: Solar PV Systems

Solar PV cell: Types construction, working, Typical specifications of solar cells Solar PV working principle: Series and parallel connections of solar modules Solar Photovoltaic (PV) system: components layout and working.
Solar modules, arrays and their standard specifications
Roof top and street light solar PV systems and typical specifications
Maintenance of these systems

Unit–IV: Solar PV Electronics

Solar Charge controllers: working and specifications, switchgear and cables Batteries: Different types for solar PV systems, maintenance and specifications Solar Inverters: working and specifications
Signal conditioning systems: working and specifications
Solar Power tracking: construction, working, tilt angle, solar radiation, I-V, P-V characteristics, maximum power point tracking (MPPT)
Maintenance of these systems.

Unit–V: Solar PV Off-grid and Grid Tied Systems

Solar off grid systems: layout and specifications
Solar Grid tied (on grid) systems: Working principle of grid-tiedd c-ac inverter, grid synchro-Nization and active power export
Net metering: main features and working
Solar-wind Hybrid systems: Layout and specifications.

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2. Kothari, D.P. etaL: Renewable Energy Sources and Emerging Technologies, PHI
3. David M. Buchla, Thomas E. Kissell, Thomas L. Floyd, - Renewable Energy Systems, Pearson Education New Delhi ,ISBN: 9789332586826
4. Rachel, Sthuthi, Earnest, Joshua;-Wind Power Technologies, PHI Learning
5. O.P. Gupta, Energy Technology, Khanna Publishing House, ISBN:978-93-86173-683

COURSE OUT COMES:

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

a) Maintain the solar non-electric equipment.
b) Maintain CSP plants
c) Maintain solar PV systems.
d) Maintain solar P V electronics and MPPT systems
e) Maintain off-grid and on-grid solar power plants.

Course Code	:	EEEPE204
Course Title	:	SOLAR POWER TECHNOLOGIES LABORATORY
Number of Credits	:	1 (L:0, T:0, P:2)
Prerequisites (Course code)	:	NIL
Course Category	:	PC

COURSE OBJECTIVES:

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

- Maintaintheefficientoperationofvarioustypesofsolarpowertechnologies.

PRACTICALS:

1. Dismantle solar power heaters
2. Assemble solar power heaters
3. Assemble the parabolic dish CSP plant.
4. Dismantle the parabolic dish CSP plant.
5. Troubleshoot a CSP plant
6. Assemble the solar PV system.
7. Dismantle the solar PV system
8. Troubleshoot a solar PV system
9. Troubleshoot a solar PV panels and arrays
10. Troubleshoot solar inverters
11. Troubleshoot solar signal conditioners
12. Troubleshoot solar PVMPPT systems
13. Troubleshoot solar off-grid systems
14. Troubleshoot solar net metering systems
15. Troubleshoot solar-wind hybrid systems.

COURSE OUT COMES:

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

a) Maintain the solar non-electric equipment.
b) Maintain CSP plants
c) Maintain solar PV systems.
d) Maintain solar PV electronics and MPPT systems
e) Maintain off-grid and on-grid solar power plants.

Course Code	:	EEEPE206
Course Title	:	WIND POWER TECHNOLOGIES
Number of Credits	:	3 (L:3, T:0, P:0)
Prerequisites (Course code)	:	NIL
Course Category	:	PE

SPECIFICATION TABLE OF MARKS & HOURS

K = Knowledge Level, **C** = Comprehension Level, **A** = Application Level

Unit. No.	Unit Title	Hours	K	C	A	Total Marks
1	**Wind Energy and Wind Power Plants**	4	4	2	-	6
2	**Construction and Working of Large Wind Power Plants**	9	4	5	3	12
3	**Aerodynamic Control, Electric Generators and Grid Connection**	8	5	5	-	10
4	**Maintenance of Large Wind Power Plants**	9	5	4	3	12
5	**Construction and Working Small Wind Turbines**	9	5	7	-	12
6	**Maintenance of Small Wind Turbines**	6	4	2	2	8
	Total	**45**				**60**

COURSE OBJECTIVES:

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

- Maintain large wind power plants and small wind turbines.

COURSE CONTENTS:

Unit–I Wind Energy and Wind Power Plants

Wind power scenario in the world and India

Characteristics of Wind Energy: Wind movement, wind profile, roughness, effects of obstacles in wind path.

Types of Wind Power Plants (WPPs): Small and large wind turbines; Horizontal and Vertical axis; Upwind and Downwind, One, Two and Three blades; constant and variable Speed; Geared, Direct-Drive and Semi-Geared (Hybrid) WPPs; WECS, WEGs, WTs, WPPs,

WPP Tower Types: Lattice; tubular: steel, concrete, hybrid, ladders, cables.

WPP substation**:** Switchgear, transformers, inside layouts of Electric electronic panels at block level.

Unit–II Construction and Working of Large Wind Power Plants.

Wind Turbine Terminologies: Cut-in, cut-out and survival wind speeds, Threshold wind speeds, rated power, nominal power, Wind Power Curve,

Major parts and Functions of WPP: Rotor blades, hub, nacelle, tower, electric sub-station, nacelle layouts of Geared, Direct-Drive and Semi-Geared WPPs, Main shaft, gearbox, electric generator, electronic control panels

Rotation principles: Drag and Lift principle, thrust and torque of wind turbine rotor.

Different types of Sensors: Anemometer, windvane, rpm sensors of main shaft and generator, temperature sensors of nacelle, gear box and generator; cable untwisting and vibration sensors. Different types of Actuators: Electric and hydraulic pitching and yawing mechanisms, cable untwisting and braking mechanisms

Unit–III Aerodynamic Control, Electric Generators and Grid Connection

Aerodynamic Control of WPPs: Stall Pitch and Active Stall. Braking mechanisms of large WPPs
Electric Generator Types: Working of Squirrel-Cage rotor Induction Generator (SCIG), Wound-Rotor Induction Generator (WRIG), Doubly-Fed Induction Generator (DFIG), wound rotor and permanent magnet synchronous generators.
Electric grid connection of WPPs: Local Impacts and system wide impact

Unit–IV Maintenance of Large Wind Power Plants

General maintenance of WPPs: preventive maintenance schedule of actuators such as yaw control, pitch control, braking mechanisms and sensors; oiling and greasing; electric and electronic equipment related; tower related; minor repairs, some tips,

Scheduled Maintenance: of Stall and Pitch and Active Pitch controlled WPPs
Unscheduled maintenance: operational factors, design faults, wear and tear of components, spurious trip, Major repairs.

Software related, warranty and insurance related issues

Unit–V Construction and Working Small Wind Turbines

Types and working of different type of small wind turbines (SWT): Classification: Horizontal and Vertical axis, Up wind and Downwind, One, Two and Three blades; Constant and Variable Speed; Direct-Drive and Geared; braking of SWTs
Parts of SWTs: Rotor, generator, gearbox, tower, electric control panel, tale vane, anemometer, Wind vane, temperature and rpm sensors. Working SWTs: Direct-drive and Geared.
Electrical generators in SWTs: permanent magnet synchronous generators, induction generators
SWT towers: Lattice tubular type, hydraulic towers, ladders, cables,

Unit–VI Maintenance of Small Wind Turbines

Small wind turbine assembly.
Installation of different types of small wind turbines (SWT): tubular and lattice types.
SWT Routine maintenance: Tips; Preventive maintenance schedule of: braking mechanisms, sensors; oiling and greasing related; electric and electronic equipment related; tower related; software related, minor repairs
Power electronic devices and converters in different types of SWTs: thyristors, power transistors
Common electrical and mechanical faults in SWTs

REFERENCES:

1. Hau, Erich: Wind Turbines Springer-Verlag, Berlin Heidel berg, Germany, ISBN: 978-3-642- 27150-2
2. Rachel, Sthuthi, Earnest, Joshua;-Wind Power Technologies, PHI Learning, New Delhi, ISBN: 978-93-88028-49- 3; E-book 978-93-88028-50-9
3. Gipe, Paul: Wind Energy Basics, Chelsea Green Publishing Co; ISBN: 978-1603580304
4. Wizelius, Tore, Earnest, Joshua-Wind Power Plants and Project Development, PHI Learning, New Delhi, ISBN:978-8120351660
5. Bhadra, S.N., Kastha, D., Banerjee, S, Wind Electrical Systems installation; Oxford University

Press, New Delhi, ISBN:9780195670936

6. O.P. Gupta, Energy Technology, Khanna Publishing House, New Delhi (ISBN:978-93-86173- 683)

COURSE OUTCOMES:

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

a) Identify the various types of wind power plants and their auxiliaries.

b) Maintain the normal working of large wind turbines.

c) Optimize the aero dynamic and electric control of large wind power plants.

d) Troubleshoot the common faults of large wind power plants.

e) Maintain the normal working of small wind turbines.

f) Troubleshoot small wind turbines.

Course Code	:	EEEPE208
Course Title	:	WIND POWER TECHNOLOGIES LABORATORY
Number of Credits	:	1 (L:0, T:0, P:2)
Prerequisites (Course code)	:	NIL
Course Category	:	PE

COURSE OBJECTIVES:

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

- Maintain large wind power plants and small wind turbines.

PRACTICALS:

1. Identify the specified items of a wind farm after watching the video clip.
2. Identify the specified parts inside the nacelle of a large wind power plant after watching the video clips.
3. Check the performance of the temperature and vibration sensor use din 125/150k WWPPs.
4. Check the performance of the SCIG
5. Check the performance of the PMSG
6. Check the performance of the hydraulic and electric pitch actuator and yaw actuator use din 125/150 kW WPPs.
7. Check the performance of the contactless RPM sensors used in WPPs
8. Troubleshoot the anemometer and windvane
9. Check the generator performance of SWTs.
10. Identify the parts of a direct-drive SWT
11. Identify the parts of a geared SWT
12. Assemble/Dismantle a direct-drive SWT
13. Assemble/Dismantle a geared SWT
14. Check the performance of direct-drive SWT
15. Check the performance of geared SWT
16. Simulate faults in the small wind turbine trainer
17. Troubleshoot direct-drive SWT
18. Troubleshoot geared SWT
19. Interpret the wiring of a SWT electric-electronic control panel

COURSE OUTCOMES:

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

a) Identify the various types of wind power plants and their auxiliaries.

b) Maintain the normal working of large wind turbines.

c) Optimize the aero dynamic and electric control of large wind power plants.

d) Troubleshoot the common faults of large wind power plants.

e) Maintain the normal working of small wind turbines.

f) Troubleshoot small wind turbines.

Course Code	:	EEEPE210
Course Title	:	BIO MASS AND MICRO-HYDRO POWER PLANTS
Number of Credits	:	3 (L:3, T:0, P:0)
Prerequisites	:	NIL
Course Category	:	PE

SPECIFICATION TABLE OF MARKS & HOURS

K = Knowledge Level, **C** = Comprehension Level, **A** = Application Level

Sl. No.	Chapter Title	Hours	K	C	A	Total Marks
1	**Basics of Biomass-based Power Plants**	9	3	6	2	11
2	**Biomass Gasification Power Plants**	10	4	8	-	12
3	**Different Types of Gasifiers**	10	4	7	2	13
4	**Micro-hydro Power Plants**	8	4	8	-	12
5	**Different types of Micro hydro power plants**	8	2	5	5	12
	Total	**45**				**60**

COURSE OBJECTIVES:

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

- Maintaintheefficientoperationofvarioustypesof BiomassandMicrohydropowerplants.

COURSE CONTENTS:

Unit–I Basics of Biomass-based Power Plants

Properties of solid fuel for biomass power plants: bagasse, wood chips, rice husk, municipal waste Properties of liquid and gaseous fuel for biomass power plants: Jatropha, bio-diesel go bar gas Layout of a Bio-chemical based (e.g. biogas) power plant:
Layout of a Thermo-chemical based (e.g. Municipa lwaste) powerplant Layout of a Agro-chemical based (e.g. bio-diesel) power plant Selection of biomass power plants.

Unit–II Biomass Gasification Power Plants

The basic principle to convert Agriculture and forestry products and wood processing re- mains (including rick husks, wood powder, branches, offcuts, corn straws, rice straws, wheat straws, cotton straws, fruit shells, coconut shells, palm shells, bagasse, corncobs) into com- bustible gas General Construction and working of a typical gasifier Power generating in gas engine: Strengths and limitations of Agriculture and forestry products gasifier Preventive maintenance steps different types of biomass gasifiers.

Unit–III Different Types of Gasifiers

Construction and working of the following types of gasifiers: Rice Husk Gasification Power Plant and their specifications Straw Gasification Power Plant and their specifications
Bamboo Waste, Bamboo Chips Gasification Power Plant and their specifications
Coconut shell, coconut peat, coconut husk, Gasification Power Plant and their specifications Bagasse/Sugar Cane Trash Gasification Power Plant and their specifications
Go bar gas plant and its specifications
Break down maintenance of biomass power plant at the module level.

Unit–IV Micro-hydro Power Plants

Locations of micro hydro power plant
Energy conversion process of hydro power plant.
Classification of hydropower plant: High, medium and low head.
General Layouts of typical micro-hydro power plant. Strengths and limitations of micro hydro power plants

Unit–V Different types of Micro hydro power plants

Construction and working of High head – Pelton turbine and their specifications
ConstructionandworkingofMediumhead–Francisturbineandtheirspecifications Construction and working of Low head – Kaplan turbine and their specifications Preventive and breakdown maintenance of micro hydro power plants
Safe Practices for micro hydro power plants.

REFERENCES:

1. Khoiyang bam, R S Navindu; Gupta and Sushil Kumar; Biogas Technology : Towards Sustain- able Development; TERI, New Delhi; ISBN: 9788179934043
2. David M. Buchla; Thomas E. Kissell; Thomas L. Floyd -Renewable Energy Systems, Pearson Education New Delhi , ISBN: 9789332586826,
3. Kothari,D.P.etaL:RenewableEnergySourcesandEmergingTechnologies,PHI
4. Rachel, Sthuthi, Earnest, Joshua;-Wind Power Technologies, PHI Learning
5. O.P. Gupta, Energy Technology, Khanna Publishing House, ISBN:978-93-86173-683

COURSE OUTCOMES:

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

a) Select the relevant biomass power plant
b) Undertake the preventive maintenance of different types of biomass gasifiers
c) Undertake the breakdown maintenance of different types of biomass gasifiers
d) Maintain the optimized working of large wind power plants
e) Maintain the optimized working of small wind turbines.
f) Maintain the optimised working of micro hydro power plants.

Course Code	:	EEEPE214
Course Title	:	BIOMASS AND MICRO-HYDRO POWER PLANTS LABORATORY
Number of Credits	:	1 (L:0,T:0,P:2)
Prerequisites (Course code)	:	NIL
Course Category	:	PE

COURSE OBJECTIVES:

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

- Maintain the efficient operation of various types of Biomass and Micro hydropower plants.

PRACTICALS:

1. Identify different components of a typical Biomass power plant.
2. Identify different biomass resources and evaluate their energy potential.
3. Determine the carbon content of solid biomass.
4. Assemble the Biogas power plant.
5. Dismantle the Biogas power plant
6. Identify the components of the high head micro hydropower plant
7. Identify the components of the medium head micro hydropower plant
8. Identify the components of the low head micro hydropower plant
9. Assemble a high head micro hydropower plant
10. Assemble a medium head micro hydropower plant
11. Assemble a low head micro hydropower plant
12. Undertake preventive maintenance of the high head micro hydropower plant
13. Undertake preventive maintenance of the medium head micro hydropower plant
14. Undertake preventive maintenance of the low head micro hydropower plant
15. Check the performance of Pelton wheel micro hydropower plant

COURSE OUTCOMES:

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

a) Select the relevant biomass power plant
b) Undertake the preventive maintenance of different types of biomass gasifiers
c) Undertake the break down maintenance of different types of biomass gasifiers
d) Maintain the optimized working of large wind power plants
e) Maintain the optimized working of small wind turbines.
f) Maintain the optimized working of micro hydropower plants.

Course Code	:	EEEPE214
Course Title	:	SWITCH GEAR AND PROTECTION
Number of Credits	:	3 (L:3, T:0, P:0)
Prerequisites	:	NIL
Course Category	:	PE

SPECIFICATION TABLE OF MARKS & HOURS

K = Knowledge Level, **C** = Comprehension Level, **A** = Application Level

Unit. No.	Unit Title	Hours	K	C	A	Total Marks
1	**Basics of Protection**	8	2	6	3	11
2	**Circuit Interruption Devices**	14	5	10	3	18
3	**Protective Relays**	7	4	5	2	11
4	**Protection of Alternator and Transformer Alternator Protection**	8	5	5	-	10
5	**Protection of Motors, Bus-bar and Transmission Line Motor**	8	5	5	-	10
	Total	**45**				**60**

COURSE OBJECTIVES:

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

- Maintainswitchgearandprotectionschemesusedinelectricalpowersystems.

COURSE CONTENTS:

Unit–I Basics of Protection

Necessity, functions of protective system. Normal and abnormal conditions.
Types of faults and their causes. Protection zones and back up protection
Short circuit fault calculations in lines fed by generators through transformers Need of current limiting reactors and their arrangements.

Unit–II Circuit Interruption Devices

Isolators- Vertical break, Horizontal break and Pantograph type. HRC fuses–Construction, working, characteristics and applications.
Arc formation process, methods of arc extinction (High resistance and Low resistance),Arc voltage, Recovery voltage, Re-striking voltage, RRRV.
HT circuit breakers (Sulphur-hexa Fluoride (SF6), Vacuum circuit breaker) - Working, con-struction, specifications and applications.
L.T. circuit breaker (Air circuit breakers (ACB), Miniature circuit breakers (MCB), Moulded case circuit breakers (MCCB) and Earth leakage circuit breaker (ELCB))-Working and appli- cations.
Selection of LT and HT circuit breakers (ratings), Selection of MCCB for motors. Gas insulated switchgear.

Unit–III Protective Relays

Fundamental quality requirements: Selectivity, Speed, Sensitivity, Reliability, Simplicity, Economy.
Basic relay terminology-Protective relay, Relay time, Pick up, Reset current, current setting, Plug setting multiplier, Time setting multiplier.
Protective relays: Classification, principle of working, construction and operation of – Electromagnetic (Attracted armature type, Solenoid type, Watt-hour meter type) relay, Thermal relay. Block diagram and working of Static relay.
Overcurrent relay-Time current characteristics.
Microprocessor based over current relays: Block diagram, working. Distance relaying- Principle, operation of Definite distance relays. Directional relay: Need and operation.
Operation of current and voltage differential relay.

Unit–IV Protection of Alternator and Transformer

Alternator Protection
Faults, Differential protection Over current, earth fault, over heating and field failure, protec- tion.
Reverse power protection.
Transformer Protection
Faults, Differential, overcurrent, earth fault, overheating protection, Limitations of differential protection.
Buchholz relay: Construction, operation, merits and demerits.

Unit–V Protection of Motors, Bus-bar and Transmission Line Motor

Faults. Short circuit protection, Overload protection, Single phase preventer.
Busbar and Transmission line
Faults on Busbar and Transmission Lines.
Bus bar protection: Differential and Fault bus protection. Transmission line: Overcurrent, Distance and Pilot wire protection.

REFERENCES:

1. Mehta V.K ;Rohit Mehta, Principles of Power System, S. Chandand Co.,New Delhi., ISBN: 978-81-2192-496-2.
2. Rao. Sunil S., Switchgear and Protection, Khanna Publishers, New Delhi, ISBN: 978-81-7409- 232-3.
3. Singh, R.P., Switch gear and Power System Protection, PHI Learning, New Delhi, ISBN: 978-81-203-3660-5.
4. Gupta. J.B.. Switch gear and Protection, S.K. Katariaand Sons, New Delhi, ISBN:978-93-5014- 372-8.
5. Veerapan, N., Krishnamurty, S. R., Switchgear and Protection, S .Chand and Co., New Delhi. ISBN: 978-81-2193-212-7.
6. Ram, Badri; Vishwakarma D.N., Power System Protection and Switch gear, McGraw-Hill, New Delhi.ISBN:978-07-107774-X

COURSE OUTCOMES:

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

a) Identify various types of faults in power system.
b) Select suitable switch gears for different applications.
c) Test the performance of different protective relays.
d) Maintain protection systems of alternators and transformers.
e) Maintain protection schemes for motors and transmission lines.
f) Maintain protection schemes for power system against over voltages.

Course Code	:	EEEPE216
Course Title	:	SWITCH GEAR AND PROTECTION LABORATORY
Number of Credits	:	1 (L:0, T:0, P:2)
Prerequisites	:	NIL
Course Category	:	PE

COURSE OBJECTIVES:

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

- Maintainswitchgearandprotectionschemesusedinelectricalpowersystems.

COURSE CONTENTS:

1. Identify various switch gears in the laboratory and write their specifications.
2. Test HRC fuse by per forming the load test.
3. Test MCB by per forming the load test
4. Dismantle MCCB/ELCB and identify various parts.
5. Dismantle ACB/VCB and identify different parts.
6. Set the plug and time (with PSM, TSM) of induction type electromagnetic relay.
7. Test electromagnetic over-current relay by per forming load test.
8. Simulate differential protection scheme for transformer with power system simulation kit.
9. Test the working of the single phasing preventer using a three phase induction motor.
10. Simulate transmission line protection by using the impedance relay/over current relay for var- ious faults. (On transmission line protection simulation Kit).
11. Dismantle Thyrite type arrester and identify different parts.
12. Perform neutral earthing at different substations/locations.

COURSE OUTCOMES:

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

a) Identify various types of faults in power system.
b) Select suitable switch gears for different applications.
c) Test the performance of different protective relays.
d) Maintain protection systems of alternators and transformers.
e) Maintain protection schemes for motors and transmission lines.
f) Maintain protection schemes for power system against over voltages.