INTEGRATED CERTIFICATE CUM DIPLOMA PROGRAMME (ICD)

DIPLOMA IN ELECTRICAL ENGINEERING (DEE)
&
CERTIFICATE IN ELECTRICIAN (CEN)

(Applicable only to DEE-CEN-24)

Study Scheme

DEPARTMENT OF ELECTRICAL & INSTRUMENTATION ENGINEERING

SANT LONGOWAL INSTITUTE OF ENGINEERING & TECHNOLOGY

(Deemed-to-be-University, Established by Govt. of India)

Longowal, Distt.- Sangrur, Punjab, 148106

Study Scheme of Integrated Certificate Diploma Programme

Semester-I							
S. No	Code No.	Course Title	Hours per week			Hours	Credits
			L	T	P		
1.	BSMA-101	Mathematics-I	3	1	0	4	4
2.	BSPH-103	Applied Physics-I	2	1	0	3	3
3.	BSCY-105	Applied Chemistry	2	1	0	3	3
4	HSMH-101	Communication Skills in English	2	0	0	2	2
5.	BSPH-107	Applied Physics-I Lab	0	0	2	2	1
6.	BSCY-109	Applied Chemistry Lab	0	0	2	2	1
7	HSMH-105	Communication Skills in English Lab	0	0	2	2	1
8.	ESME-101	Engineering Graphics	0	0	2	2	1
9	ESWS-103	Engineering Workshop Practice	0	0	4	4	2
10	HSSP-103	Sports and Yoga	0	0	2	2	1
		Total	9	3	14	26	**19**
11	QPEE-101	Junior Mechanic Electrical/ Electronics/ Instruments **(Module-1)**	0	0	8	8	**01**
		Grand Total	9	3	22	**34**	**20**

Semester-II							
S. No	Code No.	Course Title	Hours per week			Hours	Credits
			L	T	P		
1.	BSMA-102	Mathematics-II	3	1	0	4	4
2.	BSPH-104	Applied Physics-II	2	1	0	3	3
3	ESCS-102	Introduction to IT Systems	2	0	0	2	2
4	ESEE-104	Fundamentals of Electrical Engineering	2	0	0	2	2
5	ESEC-108	Fundamentals of Electronics Engineering	2	0	0	2	2
6	ESME-106	Engineering Mechanics	2	1	0	3	3
7	BSPH-106	Applied Physics-II Lab	0	0	2	2	1
8	ESCS-110	Introduction to IT Systems Lab	0	0	2	2	1
9	ESEE-112	Fundamentals of Electrical Engineering Lab	0	0	2	2	1
10	ESEC-114	Fundamentals of Electronics Engineering Lab	0	0	2	2	1
11	ESME-116	Engineering Mechanics Lab	0	0	2	2	1

		Total	13	3	10	26	**21**
12	QPEE-102	Junior Mechanic Electrical/ Electronics/ Instruments (**Module-2**)	0	0	8	8	**01**
13	EAA -102	Extra Academic Activities	0	0	1	1	**01 (S/US)**
		Grand Total	13	3	19	35	**23**

Summer-I

S. No	Code No.	Course Title	Hours per week			Hours	Credits
			L	T	P		
1	QPEE-103	In-house Training (4 Weeks) in Junior Mechanic Electrical/ Electronics/ Instruments (**Module-3**)	0	0	24	24	3

Semester-III

S. No	Code No.	Course Title	Hours per week			Hours	Credits
			L	T	P		
1.	PCEE-201	D.C. Machines and Transformer	3	1	0	4	4
2.	PCEE-203	Analog and Digital Electronics	3	1	0	4	4
3.	PCEE-205	Electrical Measurements	3	0	0	3	3
4.	PCEE-207	Elements of Power System	3	0	0	3	3
5.	PCEE-209	Non-Conventional Energy Sources	3	0	0	3	3
6.	PCEE-211	D.C. Machines and Transformer Lab	0	0	2	2	1
7.	PCEE-213	Electrical Measurements Lab	0	0	2	2	1
8.	PCEE-215	Analog and Digital Electronics Lab	0	0	2	2	1
9.	AUCH-201	Environmental Science	2	0	0	2	0
		Total	17	2	6	**25**	**20**
10	QPEE-201	• Electrical Repair and Maintenance Technician (Industrial and Home Appliances) **(Module-1)** OR • Solar PV Installer - Electrical **(Module-1)**	0	0	8	8	**01**
11	EAA -201	Extra Academic Activities	0	0	1	1	**01 (S/US)**
		Grand Total	17	2	15	**34**	**21**

Semester-IV							
S. No	Code No.	Course Title	Hours per week			Hours	Credits
			L	T	P		
1.	PCEE-202	A.C. Machines	3	1	0	4	4
2.	PCEE-204	Sensor and Transducer	3	1	0	4	4
3.	PCEE-206	Utilization of Electrical Energy	3	0	0	3	3
4.	PEEE-202	Professional Elective-I	3	1	0	4	4
5.	OEXX-202	Open Elective-I	3	0	0	3	3
6.	PCEE-208	Sensor and Transducer Lab	0	0	2	2	1
7.	PCEE-210	Basic Computer Programming Lab	0	0	2	2	1
8.	AUMH-202	Essence of Indian Knowledge and Tradition	2	0	0	2	0
		Total	17	3	4	24	**20**
9	QPEE-202	• Electrical Repair and Maintenance Technician (Industrial and Home Appliances) **(Module-2)** OR • Solar PV Installer - Electrical **(Module-2)**	0	0	8	8	**01**
10	EAA-202	Extra Academic Activities	0	0	1	1	**01 (S/US)**
		Grand Total	17	3	13	**33**	**21**

Summer-II							
S. No	Code No.	Course Title	Hours per week			Hours	Credits
			L	T	P		
1	TPED-202	Summer Internship–II with On Job Training (4-6weeks) relevant to QP	0	0	24	24	**03**

Semester-V							
S. No	Code No.	Course Title	Hours per week			Hours	Credits
			L	T	P		
1.	HSMH-301	Entrepreneurship and Start-ups	3	1	0	4	4
2.	PCEE-301	Microprocessors	3	0	0	3	3
3.	PCEE-303	Electrical Engineering Materials	3	0	0	3	3
4.	PEEE-301	Professional Elective-II	3	1	0	4	4

5.	OEXX-301	Open Elective-II	3	0	0	3	3
6.	PCEE-305	Microprocessor Lab	0	0	2	2	1
7	PREE-301	Minor Project	0	0	4	4	2
		Total	15	2	6	23	**20**
8	QPEE-301	• Foreman Electrical Works (Construction) **(Module-1)** OR • Electrical Design Developer **(Module-1)**	0	0	8	8	**01**
		Grand Total	15	2	14	**31**	**21**

Semester-VI

S. No	Code No.	Course Title	Hours per week			Hours	Credits
			L	T	P		
1.	AUMH-302	Indian Constitution	2	0	0	2	0
2.	PCEE-302	Switchgear and Protection	3	0	0	3	3
3.	PEEE-302	Professional Elective-III	3	1	0	4	4
4.	PEEE-304	Professional Elective-IV	3	1	0	4	4
5.	OEXX-302	Open Elective-III	3	0	0	3	3
6.	PCEE-304	Switchgear and Protection Lab	0	0	2	2	1
7.	PREE-302	Major Project	0	0	8	8	4
8.	SEEE-302	Seminar	1	0	0	1	1
		Total	15	2	10	27	**20**
9	QPEE-302	• Foreman Electrical Works (Construction) **(Module-1)** OR • Electrical Design Developer **(Module-1)**	0	0	8	8	**01**
		Grand Total	15	2	18	**35**	**21**

Course Code	Definitions
L	Lecture
T	Tutorial
P	Practical
HS	Humanities &Social Sciences Courses
BS	Basic Science Courses
ES	Engineering Science Courses
PC	Program Core Courses
PE	Program Elective Courses
OE	Open Elective Courses
AU	Audit Courses
SI	Summer Internship
PR	Project
SE	Seminar

XX	EE (Electrical engineering)
	IE (Instrumentation Engineering)
	EC (Electronics & Communication Engineering)
	CS (Computer Science & Engineering)
	CH (Chemical Engineering)
	ME (Mechanical Engineering)
	FT (Food Technology)
	PH (Physics)
	CY (Chemistry)
	MA (Mathematics)
	MH (Management & Humanities)
	SP (Sports)

PCXX- YZZ
Y-stands for year code 1, 2 or 3
ZZ- odd for odd semester subject e.g. 101, 103, 201, 305 etc.
ZZ-Even for even semester subject e.g. 102, 112, 202, 306 etc

Course Title: **Fundamentals of Electrical Engineering**
Course Code: **ESEE-104**

L	T	P	Credits	Weekly Load
2	0	0	2	2

Course Outcomes:

After successful completion of course, the students should be able to
CO1: Apply the knowledge of Electrical Engineering principles to solve D.C and A. C. circuits.
CO2: Formulate and analyse electrical circuits.
CO3: Understand basic principles of electromagnetism to implement in electrical machines and transformers.
CO4: Identify and select various electrical machines according to the applications.
CO5: Apply the ethical principles for troubleshooting and installation of safety devices as per norms ofengineering practice.

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):									
COs	Programme Outcomes (POs)								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
CO1	3	-	-	-	2	-	-	2	-
CO2	-	3	3	-	-	-	3	-	-
CO3	1	-	-	3	3	2	1	3	3
CO4	3	2	-	2	-	2	2	-	3
CO5	-	-	2	2	-	3	-	2	2

Theory:

Unit	Main Topics	Course Outlines	Hour(s)
Unit - 1	**Basic Concepts**	Electric Charge, Current and Electromotive force, Potential and Potential Difference; conductor, semiconductor insulator and dielectric; Electrical Power and Energy; Ohm's Law, Resistance, and color coding; Capacitance and Inductance, their ratings; Effects of Temperature on Resistance, Series and Parallel Connection of Resistances and capacitances, Kirchoff's Laws and their applications	06
	AC Fundamentals	Concept of Alternating Voltage and Alternating Current (AC), Difference between AC and Direct Current (DC), Various Terms Related with AC Waves; Root Mean Square (RMS) and Average Values, Concept of Phase and Phase Difference, Single Phase and	04

		Three Phase Supply; three phase Star-Delta connections, Inter-Relation between phase voltage/current and line voltage/current; Alternating Voltage applied to Pure Resistance, Pure Inductance, Pure Capacitance and their combinations, Concept of Power and Power Factor in AC Circuit.	
	Measuring Instruments	Principle and Construction of Instruments used for Measuring Current, Voltage, Power and Energy, Methods and precautions in use of these and other instruments e.g. digital multimeters, oscilloscopes, signal generators etc.	03
	Electrical Safety	Electrical Shock and Precautions against it, Treatment of Electric Shock; Concept of Fuses and Their Classification, Concept of Earthing Miniature Circuit Breakers (MCBs) and their Application.	03
Unit - 2	**Electromagnetic Induction**	Concept of Magnetic Field, Magnetic Flux, Reluctance, Magneto Motive Force (MMF), Permeability; Self and Mutual Induction, Basic Electromagnetic laws, Effects on a Conductor Moving in A Magnetic Field, various losses in magnetic circuits;	08
	Electrical Machines and Transformers	Elementary concepts of an electrical machine, Construction and Working of a Transformer, DC generator, DC Motor, their characteristics and applications.	08
		Total hours	32

Recommended Books-

1. D P Kothari and I J Nagrath, *Basic Electrical Engineering,* TMH.
2. D P Kothari and I J Nagrath, *Electrical Machines,* TMH.
3. Edward Hugh, *Electrical Technology,* Pearson Education.
4. S K Bhattacharya, *Electrical Machines,* TMH.

Course Title: **Fundamentals of Electrical Engineering Lab**
Course Code: **ESEE-112**

L	T	P	Credits	Weekly Load
0	0	2	1	2

Course Outcomes:

After successful completion of course, the students should be able to

CO1: Demonstrate the ability to analyze and construct basic electrical circuits using Ohm's and Kirchhoff's Laws.

CO2: Demonstrate the ability to select and implement appropriate protection devices to ensure electrical safety and circuit protection.

CO3: Analyze the circuit diagrams and engineering drawings of electrical, electronic, and instrumentation systems.

CO4: Ability to connect and operate various types of motors and their starters.

CO5: Develop troubleshooting skills for identifying and correcting issues in electrical circuits and systems.

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):									
COs	Programme Outcomes (POs)								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
CO1	3	-	-	-	2	-	-	2	-
CO2	-	1	3	-	-	-	3	-	-
CO3	1	-	-	3	3	2	1	1	3
CO4		2	3	1	-	2	1	-	-
CO5	3	1	2	2	-	3	-	2	2

List of Practical's:

1. Study of various passive components and measuring instruments and their connections in electrical circuits
2. Verification of Ohm's Law.
3. Verification of Kirchoff's laws (KCL and KVL).
4. Verification of equivalent resistances in series and parallel connections.
5. Measurement of various characteristic values of a Sinusoidal waveform with the help of Cathode Ray Oscilloscope (CRO)
6. Measurement of voltage, current and power in Resistance-Inductance (RL) and Resistance Inductance Capacitance (RLC) circuits and Verification of phase angle and power factor concept.
7. Study of various types of earthing.
8. Study of various types of protection devices e.g. fuses, MCBs and ELCBs
9. Verification of Faraday's laws and Lenz's law.
10. Study of various types of DC motors and their starters.
11. Study of various types of AC motors and their starters.
12. Study of various types of transformers and Verification of turns ratio.
13. Starting and reversing various AC and DC motors.
14. Fault diagnosis and removal in general electrical connection/apparatus.

Course Title: **D.C. Machines and Transformer**
Course Code: **PCEE-201**

L	T	P	Credits	Weekly Load
3	1	0	4	4

Course Outcomes:

After successful completion of course, the students should be able to
CO1: Understand the construction and working principle of single and two winding transformers.
CO2: Operate the single-phase transformers in parallel.
CO3: Acquire the knowledge to design and operate DC machine.
CO4: Learn and perform various tests of DC machines.
CO5: Understanding of various losses and efficiency of DC Machine.

CO/PO Mapping : (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):									
COs	Programme Outcomes (POs)								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
CO1	3	-	-	-	-	-	-	-	3
CO2	-	1	-	1	2	3	1	3	2
CO3	3	-	3	-	-	-	-	2	3
CO4	2	2	-	1	-	3	-	2	3
CO5	-	-	3	2	-	1	-	1	-

Theory:

Unit	Main Topics	Course Outlines	Hour(s)
Unit-1	**Transformers**	Working principle, construction of single-phase transformer, Electro Motive Force (EMF) equation, phasor diagrams on no-load and on loaded conditions, open circuit and short circuit tests, equivalent circuit parameters estimation, voltage regulation and efficiency, back-to-back test. Effect of saturation on exciting current and in-rush current phenomenon. Parallel operation of single-phase transformers.	14
	Auto Transformers	Principle of operation, equivalent circuit and phasor diagrams, comparison with two winding transformers.	10

Unit - 2	**D.C. Generator**	Working principle, construction of Direct Current (DC) Machines, Armature windings, single- and double-layer winding diagrams, E.M.F. and torque equations, armature reaction, effect of brush shift, compensating winding, commutation, causes of bad commutation, methods of improving commutation, methods of excitation of D.C. generators and their characteristics.	12
	D.C. Motor	Working principle characteristics, starting of shunt and series motor, starters, speed control methods: field and armature control. Braking: plugging, dynamic and regenerative braking, Testing: Swinburn's test, Hopkinson test, Field test. Estimation of losses and efficiency	12
		Total hours	48

Recommended Books-

1. Edward Hughes, *Electrical Engineering*, Tata McGraw Hill
2. I. J. Nagrath and D.P. Kothari , *Electrical Machines*, Tata McGraw Hill
3. J. B. Gupta, *Electrical Engineering*, S. K. Kataria
4. S. K Sahdev, *Electrical Machines*, Unique publisher
5. S. K. Bhattacharya, *Electrical Machines*, Tata McGraw Hill

Course Title: **Analog and Digital Electronics**
Course Code: **PCEE-203**

L	T	P	Credits	Weekly Load
3	1	0	4	4

Course Outcomes:

After successful completion of course, the students should be able to
CO1: Understand the basics of number system and various logic family circuits.
CO2: Acquire knowledge of various logic gates and flip flops.
CO3: Learn the concept of Registers and counters.
CO4: Be conversant with arithmetic logic circuits, A/D and D/A converters.
CO5: Learn the operation of decoders, display devices and related circuits.

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):									
Cos	Programme Outcomes (POs)								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
CO1	3	-	2	-	3	3	-	-	3
CO2	3	2	-	3	-	2	2	1	-
CO3	-	2	3	-	2	2	1	3	3
CO4	1	2	-	3	-	2	1	1	3
CO5	-	2	3	2	-	-	-	3	-

Theory:

Unit	Main Topics	Course Outlines	Hour (s)
Unit-1	**Number system and Logic gates**	Decimal, Binary, Octal, and hexadecimal number system and their inter-conversions. Definitions, symbols and truth table of NOT, OR, AND, NAND, NOR, XOR, XNOR gates; realization of basic gates using universal gates	06
	Boolean algebra and introduction to Logic families	De-Morgan's theorems, Boolean algebra, sum of product(SOP) ,product of sum(POS) form, introduction to Karnaugh map (k-map) (2 variable ,3 variables),Simplification of Boolean function using k-map; realization ofsimple Boolean equations using universal gates, introduction to Integrated Circuits (IC) logic families, tri-state logic, Transistor-transistor-logic (TTL) logic family.	06

	Flip flops	Logic diagram, truth table; timing diagram and operation of following latches and flip flops; NOR latch, NAND latch, Set-Rest (SR), Toggle (T), Delay (D), JK flip flops.	06
	Combinational circuits	Half adder and full adder circuit, design and implementation, Half and full subtractor circuit, design and implementation, Multiplexers (MUXs) and De- multiplexers (DEMUXs); basic functions and block diagram of MUX and DEMUX.	06
Unit - 2	**Registers**	Shift registers, Serial in serial out, Serial in Parallel out, Parallel in Parallel out Parallel in Serial out, ht shift register, universal shift register	06
	Counters	Synchronous and Asynchronous counters, Modulus counters, decade counter and its application, Ring counter and its application.	06
	A/D and D/A Converters	Resistor divider Digital to Analog (D/A) converter, Analog to digital (A/D) conversion, Dual slope integrator A/D converter, Flash type A/D converter, Successive Approximation type A/D converter	08
	Decoders, display devices and associated circuits	Light Emitting Diode (LED), Liquid Crystal Display (LCD), seven segment display	04
		Total hours	48

Recommended Books-

1. A. Anand Kumar, *Fundamentals of Digital Electronics,* PHI
2. Herbert Raub and Donals Sachilling, *Digital Integrated Electronics*, Prentice Hall of India, NewDelhi.
3. Malvino Leach, *Digital Electronics and Applicatio*ns, McGraw Hill, New Delhi
4. Maini, Anil K. *Digital electronics: principles, devices and applications*. John Wiley & Sons, 2007.

Course Title: **Electrical Measurements**
Course Code: **PCEE-205**

L	T	P	Credits	Weekly Load
3	0	0	3	3

Course Outcomes:

After successful completion of course, the students should be able to

CO1: Acquire knowledge of the characteristics of measuring instruments and their classification.

CO2: Be conversant in construction, working of measuring instruments and their proficient use.

CO3: Acquire knowledge of various methods of electrical parameters measurement.

CO4: Be competent to handle various instruments for the measurement of electrical quantities.

CO5: Understanding of various bridges.

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):									
COs	Programme Outcomes (POs)								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
CO1	3	1	-	-	-	2	-	3	1
CO2	3	-	3	2	-	2	2	1	1
CO3	2	-	-	-	2	2	-	2	-
CO4	2	-	-	-	2	2	2	-	2
CO5	3	-	-	1	1	-	3	2	2

Theory:

Unit	Main Topics	Course Outlines	Hour(s)
Unit-1	**Analog instruments**	Analog instruments, classification of analog instruments, Principles of operations, operating forces, constructional details, control systems, damping systems, Symbols used for analog instruments.	08
	Analog Voltmeter, Ammeter and Ohmmeter	Types of instruments, Permanent Magnet Moving Coil (PMMC) instruments, shunts and multipliers, ohmmeters-series and shunt type, torque equation moving iron instruments, torque equations, Advantages, disadvantages and their comparison.	08
	Measurement of power and energy	Electrodynamometer type of instruments, Power in Alternating current (AC) and Direct Current (DC) circuits, single phase wattmeter, measurement of power in single and three phase circuits. Energy meter for ac circuits, single phase induction type watt hour meter.	08
Unit - 2	**Measurement of phase and frequency**	Single phase electrodynamometer and moving iron power factor meters, Frequency meters and their types, phase sequence indicators.	08

	Measurement of resistance	Classification of resistances, measurement of medium resistance with voltmeter-ammeter method,Wheatstone bridge and substitution method, measurement of low resistance with the Kelvin double bridge, Potentiometer method, Measurement of high resistance with the direct deflection method, Loss of chargemethod and megger.	08
	AC Bridges	General form of AC bridge, Measurement of inductance, capacitance and frequency, Maxwell bridge, Hay bridge, De Sauty bridge, Schering bridge etc., sources of error and their minimization	08
		Total hours	48

Recommended Books-

1. A. K. Sawhney and Puneet Sawhney,*A Course on Electrical and Electronic Measurements andInstrumentation*, Dhanpat Rai and co..
2. David A Bell, *Electronic Instrumentation and Measurement*, Prentice Hall of India
3. Bakshi UA, Bakshi LA. *Electrical measurements and instrumentation. Technical Publications*; 2020 Nov 1.
4. Reissland MU. *Electrical measurements: fundamentals, concepts, applications.* bohem press; 1989.

Course Title: **Elements of Power System**
Course Code: **PCEE-207**

L	T	P	Credits	Weekly Load
3	0	0	3	3

Course Outcomes:
After successful completion of course, the students should be able to
CO1: Acquire knowledge of basic transmission system.
CO2: Line parameter calculations.
CO3: Gain the knowledge of mechanical components of line
CO4: Performance and losses awareness.
CO5: Acquire the knowledge of cable materials.

CO/PO Mapping: (Strong (3) / Medium(2) / Weak(1) indicates strength of correlation):

COs	Program Outcomes (POs)/Program Special Outcome (PSO's)								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
CO1	3	2	1	1	-	3	-	1	1
CO2	3	2	2	-	1	3	-	2	2
CO3	3	2	2	1	2	2	-	3	2
CO4	3	2	2	-	2	3	1	3	1
CO5	3	3	3	1	2	2	1	3	1

Theory:

Unit	Main Topics and Course Outlines	Hour(s)
Unit-1	**Supply System:** Introduction to transmission and distribution systems, comparison between DC and AC systems for transmission and distribution, comparison of cost of conductors, choice of working voltage for transmission & distribution, economic size of conductors- Kelvin's law, radial and mesh distribution networks, voltage regulation.	10
	Components of Line: Conductor materials; solid, stranded, ACSR, hollow and bundle conductors, different types of supporting structures for overhead lines. elementary ideas about transmission line construction and erection. stringing of conductors, spacing, sag and clearance from ground, overhead line insulators, concept of string efficiency.	8
	Transmission Line Parameters: Introduction to line parameters, resistance Inductance, concept of G.M.D., Inductance of three phase line, use of bundled conductor, transposition of power lines, capacitance of 1-phase and 3-phase lines. effect of earth on capacitance of conductors.	10
Unit – 2	**Performance of Transmission Lines:** Representation of short transmission line, medium length line (nominal T and II circuits) long length line by hyperbolic equations and equivalent T & II circuits. power flow through transmission lines, ABCD constants, voltage regulation.	10

	Underground Cables: Classification of cables based upon voltage and dielectric material, insulation resistance and capacitance of single core cable, dielectric stress, capacitance of 3 core cables, method of laying, heating effect, maximum current carrying capacity, cause of failure, comparison with overhead transmission lines. Projects related to this course should be given to students (in groups) in order to promote team work and ethical values.	10
	Total hours	48

Recommended Books:

1. J. Grainger and W. D. Stevenson, *"Power System Analysis"*, McGraw Hill Education,1994.
2. O. I. Elgerd, *"Electric Energy Systems Theory"*, McGraw Hill Education, 1995.
3. A. R. Bergen and V. Vittal, *"Power System Analysis"*, Pearson Education Inc., 1999.
4. D. P. Kothari and I. J. Nagrath, *"Modern Power System Analysis"*, McGraw Hill Edu.2003.
5. B. M. Weedy, B. J. Cory, N. Jenkins and G. Strbac, *"Electric Power Systems"*, Wiley, 2012.
6. Sadhu, Pradip Kumar, *"Elements of Power Systems"* CRC Press, 2017.

Course Title: **Non-Conventional Energy Sources**
Course Code: **PCEE-209**

L	T	P	Credits	Weekly Load
3	0	0	3	3

Course Outcomes:

After successful completion of course, the students should be able to

CO1: Understand the need of alternative energy sources

CO2: Acquire knowledge of MHD, thermoelectric generators

CO3: Learn the concept of Fuel cells and biomass energy

CO4: Be conversant with the working of solar cell and collectors and their applications.

CO5: Acquire knowledge of Wind power generators

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):									
COs	Programme Outcomes (POs)								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
CO1	3	2	-	-	-	3	3	-	2
CO2	-	-	2	1	2	-	-	2	-
CO3	-	-	2	1	2	3	3	1	2
CO4	3	-	2	-	1	-	-	2	-
CO5	3	-	-	-	-	-	2	-	2

Theory:

Unit	Main Topics	Course Outlines	Hour(s)
Unit-1	**Introduction:**	Limitation of conventional energy sources, need and growth of alternative energy source, basic scheme and application of direct energy conservation.	04
	Non conventional sources	Basic principles of Magneto Hydro Dynamic (MHD) generators, thermoelectric generators, thermionic converters, Fuel cells, biomass for electricity generation, Geothermal system, low hydro-plants, tidal energy, ocean energy.	08
	Fuel Cells	Working of ideal fuel cell, types Losses in fuel cell, , VI characteristics Power current characteristics and application	06
	Biomass	Biomass resources, energy from biomass, , conversion process, biodigesters, biogas storage,	06

Unit - 2	**Photo voltaic effectand solar energy**	Photovoltaic effect, different types of photovoltaic cells, cell fabrication, characteristics of photovoltaic cells, conversion efficiency,solar collectors, types, solar furnaces.	12
	Wind power generation	Wind surveys, basic principle of wind energy conversion, lift and drag, site selection, Parts of wind turbine, types of wind turbine, controls of wind turbine, Hybrid wind-solar system	12
		Total hours	48

Recommended Books-

1. A Chakrabarti, M. L. Soni, P. V. Gupta and U. S.Bhatnagar, *Power System Engineering*, Dhanpat Raiand Co.
2. B. R. Gupta, *Generation of Electrical Energy*, S. Chand.
3. G. D. Rai, *Nonconvential Energy Sources*, Khanna Publishers.
4. Singh, Vir. "Energy resources." In *Textbook of Environment and Ecology*, pp. 185-206. Singapore: Springer Nature Singapore, 2024.

Course Title: **D.C. Machines and Transformer Lab**
Course Code: **PCEE-211**

L	T	P	Credits	Weekly Load
0	0	2	1	2

Course Outcomes:

After successful completion of course, the students should be able to
CO1: Understand the construction and working principle of single and two winding transformers.
CO2: Operate the single-phase transformers in parallel.
CO3: Acquire the knowledge to design and operate DC machines.
CO4: Learn and perform various tests of DC machines.\
CO5: Understanding of various losses and efficiency of DC Machine.

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):									
COs	Programme Outcomes (POs)								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
CO1	3	-	-	-	-	-	-	-	3
CO2	-	1	-	1	2	3	1	3	2
CO3	3	-	3	-	-	-	-	2	3
CO4	2	2	-	1	-	3	-	2	3
CO5	-	-	3	2	-	1	-	1	-

List of Practical's:

1. Measurement of induced EMF and magnetizing current under open circuit condition in DC generators.
2. Determination of the relationship between terminal voltage and load current keeping speed constant for:
   (a) Separately excited generator keeping excitation constant.
   (b) D.C. shunt generator.
3. To measure the variation in no load speed of a separately excited D.C. motor for the variation in
   (a) Armature circuit resistance
   (b) Field circuit resistance.
4. Measurement of the speed of a D.C. series motor as a function of the load torque.
5. (a) No-load and short circuit test on a single-phase transformer.
   (b) Determination of efficiency and regulation of transformer.
6. To determine the insulation resistance of a transformer at no load and at full laod condition.

Course Title: **Electrical Measurements Lab**
Course Code: **PCEE-213**

L	T	P	Credits	Weekly Load
0	0	2	1	2

Course Outcomes:

After successful completion of course, the students should be able to

CO1: Proficiently utilize multimeter to measure voltage, current, and resistance in electrical circuits.
CO2: Skillfully connect instruments to measure supply voltage, frequency, power.
CO3: Demonstrate proficiency in measuring power and power factor of three-phase loads.
CO4: Ability to measure the earth resistance using appropriate techniques.
CO5: Understanding of various bridges.

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):									
COs	Programme Outcomes (POs)								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
CO1	3	3	-	-	-	2	3	-	2
CO2	2	-	1	1	3	1	-	2	-
CO3	-	-	2	1	2	3	1	-	3
CO4	1	1	2	-	1	1	-	2	3
CO5	3	-	-	1	1	-	3	2	2

List of Practical's:

1. Use of multimeter for measuring voltage, current and resistance.
2. To calibrate single-phase energy meter by direct loading method.
3. To measure the value of earth resistance.
4. To measure power, power factor in a single-phase circuit, using wattmeter and power factor meterand verify results with calculations.
5. Measurement of power and power factor of a three-phase balance load by two-wattmeter method.
6. Measurement of voltage, frequency of a Sinusoidal signal with Cathode Ray Oscilloscope (CRO).
7. Measurement of power in a three-phase circuit using Current Transformer (CT), PotentialTransformer (PT) and three- phase energy meter.
8. Connecting appropriate instruments at the supply of an installation to measure supply voltage,frequency, power, maximum demand, Phase sequence and energy consumed.
9. Use of LCR meter for measuring inductance, capacitance and resistance.
10. Connection of three-phase energy meter in an electrical system for Measurement of energy.
11. To determine the input impedance of a multimeter.
12. To determine the error in Measurement in voltage when a multimeter is used and then Digital Voltmeter (DVM) [Vacuum Tube voltmeter (VTVM)] is used.

Subject Code : **PCEE-215**
Title of the course: **Analog and Digital Electronics Lab**

L	T	P	Credits	Weekly Load
0	0	2	1	2

Course Outcomes:

After successful completion of course, the students should be able to

CO 1: basic knowledge about digital components.
CO 2: implement the Boolean algebra, coding-decoding, Multiplexing, de-multiplexing etc.
CO 3: acquire knowledge to rectify various digital circuits with logics.
CO 4: practical approach for designing of digital.

Mapping COs/Bloom's Taxonomy Level (BLs)				
Cos	CO1	CO2	CO3	CO4
BLs	BL1	BL3	BL2	BL6

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):									
COs	Program Outcomes (POs)/Program Special Outcome (PSO's)								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO 1	PSO 2
CO1	3	1	-	-	2	2	-	3	2
CO2	3	3	3	2	3	-	-	2	1
CO3	3	2	2	-	3	3	-	2	1
CO4	3	2	2	2	2	3	1	3	3

To understand the practicability of **Digital Electronics**, the list of experiments is given below to be performed (at least 10) in the laboratory.

1. Verification of the truth tables of TTL gates.
2. Verify the NAND and NOR gates as universal logic gates.
3. Design and verification of the truth tables of Half and Full adder circuits.
4. Design and verification of the truth tables of Half and Full subtractor circuits.
5. Verification of the truth table of the Multiplexer 74150.
6. Verification of the truth table of the De-Multiplexer 74154.
7. Design and test of an S-R flip-flop using NOR/NAND gates.
8. Verify the truth table of a J-K flip-flop (7476)
9. Verify the truth table of a D flip-flop (7474)
10. Operate the counters 7490, 7493.
11. Design of 4-bit shift register (shift right).

Course Title: **A.C. Machines**
Course Code: **PCEE-202**

L	T	P	Credits	Weekly Load
3	1	0	4	4

Course Outcomes:

After successful completion of course, the students should be able to

CO1: Understand the construction, working principle and starting method of three phase induction motor.

CO2: Learn the working principle, construction, open circuit characteristics and short circuitcharacteristics of alternator.

CO3: Know about operating characteristics, V-curve and inverted-V curve of synchronous motor.

CO4: Understand parallel operation of alternators, concept of hunting and damper winding.

CO5: Learn working principle of Single-Phase Induction Motors, Universal Motors, Reluctance and Hysteresis motors.

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):									
COs	Programme Outcomes (POs)								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
CO1	3	-	3	-	1	2	-	3	1
CO2	2	2	-	3	-	3	3	-	1
CO3	1	2	2	-	2	3	3	3	-
CO4	2	-	1	3	-	1	2	-	-
CO5	3	-	-	-	3	1	-	3	2

Theory:

Unit	Main Topics	Course Outlines	Hours
Unit - 1	**Alternating Current (AC) Machines**	Brief introduction about three phase induction motors, its principle of operation, Types of induction motors and constructional feature of squirrel cage and slip ring motors, Starting of three phase induction motors: star Delta and DOL (direct-on-line), starters, Reversal of direction of rotation of three motors. Application of induction motors.	12
	Alternators	Construction, Phasor diagram of cylindrical rotor alternator, ratings, nature of armature reaction, determination of synchronous reactance; open circuit characteristics, short circuit characteristics, short circuit ratio, short circuit loss. Effect of variation of power factor on voltage. Determination of voltage regulation: Electro Motive Force (EMF) method, Magneto Motive Force (M.M.F.) method. Zero Power Factor (Z.P.F.) method.	12

		Alternator on infinite bus bar, operating characteristics, operation at constant load and variable excitation, power flow through inductive impedance.	
Unit - 2	**Synchronous motors**	Operating characteristics, power-angle characteristics, conditions for maximum power developed. V-curves and inverted V-curves, methods of starting, synchronous motors applications, synchronous condensers.	8
	Parallel operation of alternators	Conditions for proper synchronizing for single phase and three phase alternators, conditions for parallel operation, synchronizing power, current and torque, effect of increasing excitation of one of the alternators, effect of change of speed of one of the alternators, effect of unequal voltages, load sharing. Hunting and damper windings.	8
	Single phase motors	Single Phase Induction Motors, Universal Motors, Reluctance and Hysteresis motors.	8
		Total hours	48

Recommended Books-

1. A. E Fitzgerald, C. Kingsley and S. D. Umans, *Electric Machinery*, McGraw Hill
2. E. H. Langsdorff, *Principles of D.C. machines*, McGraw Hill
3. I. J. Nagrath and D. P. Kothari, *Electrical Machines*, Tata McGraw Hill
4. M. G. Say, *Alternating Current Machines*, Sir Isaac Pitman and Sons Ltd
5. P. S. Bimbhra, *Electrical Machinery*, Khanna Publishers

Course Title: **Sensor and Transducer**
Course Code: **PCEE-204**

L	T	P	Credits	Weekly Load
3	1	0	4	4

Course Outcomes:

After successful completion of course, the students should be able to
CO1: Introduce different type of transducers.
CO2: Learn the construction and working principle of Resistive transducer, Inductive transducer,Piezoelectric transducer, Capacitance Transducer
CO3: Study classification and construction of different digital encoding transducers.
CO4: Know different type of photo emissive, photovoltaic and photoconductive cells.
CO5: Describe the load cell, strain gauge and inductive torque meter.

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):									
Cos	Programme Outcomes (POs)								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
CO1	3	-	2	-	-	3	-	-	3
CO2	3	2	-	3	-	2	2	1	-
CO3	-	2	3	-	2	2	1	3	3
CO4	-	2	-	3	-	2	1	1	3
CO5	-	2	3	2	-	-	-	3	-

Theory:

Unit	Main Topics	Course Outlines	Hours
Unit - 1	**Introductions**	Definitions and types of transducers, Characteristics and choice of Transducers, Factors Influencing the choice of Transducers	06
	Resistive Transducers	Construction, working principles, types, applications, advantages and disadvantages of potentiometers and strain gauge, Resistance temperature Detector (RTD), Thermocouples and Thermistors	06
	Inductive Transducers	Basic principles of Variable Inductance Transducers, Electromagnetic pick up, Induction potentiometer, Linear variable differential transformer (LVDT), Variable reluctance transducers.	06
	Piezoelectric Transducers	Basic principle and uses of piezoelectric transducers, Piezoelectric crystals and their properties, General forms of piezoelectric transducers.	06

Unit - 2	**Capacitance Transducers**	Basic principles and types of Variable Capacitance Transducers, frequency response, advantaged disadvantages and uses of capacitive transducers Capacitance pick up, Condenser microphones, Differential capacitor pick up.	06
	Digital Encoding Transducers	Definition, classification, construction of digital encoding transducers, optical displacement transducers, shaft encoders	06
	Photo electric devices	Definitions and types photo emissive cells, Photovoltaic, photoconductive cells	06
	Other Transducers	Load cell, strain gauge and inductive torque meter magneto strictive transducers electrical tachometers (Alternating Current and Direct Current both)	06
		Total hours	48

Recommended Books-

1. A.K. Sawhney, *A Course in Electrical and Electronic Measurements and Instrumentation*, DhanpatRai
2. E.O. Doeblin, *Measurement Systems*, McGraw Hill
3. Nakra, *Instrument Measurement and Analysis*, PHI
4. Rangam, Sarma and Mani, *Instrumentation -Devices and Systems*, TMH
5. W.D. Cooper, A.D. Helfrick, *Electronic instrumentation and measurement techniques*, PHI

Course Title: **Utilization of Electrical Energy**
Course Code: **PCEE-206**

L	T	P	Credits	Weekly Load
3	0	0	3	3

Course Outcomes:

After successful completion of course, the students should be able to
CO1: Analyse the various methods of illumination and electric traction system.
CO2: Understand working and applications of lamps.
CO3: Understand the different methods of electric welding.
CO4: Learn about electric traction systems.
CO5: Know requirement and classification of Braking Systems with qualitative description.

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):									
Cos	Programme Outcomes (POs)								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
CO1	3	2	-	3	-	-	-	-	2
CO2	3	2	1	-	1	-	2	3	3
CO3	3	-	-	1	-	-	2	-	3
CO4	3	2	-	-	-	2	-	1	-
CO5	2	1	3	-	-	3	-	2	2

Theory:

Unit	Main Topics	Course outlines	Hours
Unit-1	**Illumination:**	Definitions of Terms Used in Illumination: Light, Luminous Flux, Luminous Intensity, Lumen, Candle Power, Illumination, Lux or Meter Candle, Mean Horizontal Candle Power (MHCP), Mean Spherical Candle Power (MSCP), Mean Hemi-spherical Candl Power (MHSCP), Reduction Factor, Lamp Efficiency, Specific Consumption, Glare, Space-Height Ratio, Utilization Factor, Maintenance Factor, Depreciation Factor, Waste Light Factor, Absorption Factor, Reflection Factor, Solid Angle. Laws of Illumination: Law of Inverse Squares (Lambert's Cosine Law. (No Numerical) Sources of Light: Construction, Working and Applications of Following Lamps (Incandescent Lamps, Halogen Lamps, Low Pressure Mercury Vapour Lamps (Fluorescent Tube), High Pressure Mercury Vapour Lamps, Sodium Vapour Lamps, Compact Fluorescent Lamps (C.F.L.), Metal Halide Lamps, Light emitting diode(LED) Lamps	12

	Electric Heating	Advantages of Electric Heating. Modes of Transfer of Heat: Conduction, Convection and Radiation. Classification of Electric Heating Methods and their applications: Resistance Heating Construction and Operation), Direct Resistance Heating: Salt Bath Furnace, Indirect Resistance Heating: Resistance Ovens, Basic concept of various Industrial furnaces.	12
Unit – 2	**Electric Welding**	Methods of Electric Welding: Electric Arc Welding, Resistance Welding. Principle of Resistance Welding, Advantages of Resistance Welding, Types of Resistance Welding – (Only List), Basic concept of various welding machines.	12
	Electric Traction	Requirements of an Ideal Traction System. Traction Systems: Non electric Traction Systems, Electric Traction Systems: Straight Electric Traction, Its advantages and Disadvantages. Diesel Electric Traction, Its advantages and Disadvantages. Systems of Track Electrification: Direct Current (DC) System, Composite System – Single Phase to Three Phase System and Single-Phase Alternating Current (AC) to DC System (Kando System). Advantages and Disadvantages of Single Phase 25 KV AC System Over DC System. **Electric Braking**: Requirement, Classification of Braking Systems withqualitative description.	12
		Total hours	48

Recommended Books-

1. G. C. Garg, *Utilisation of Electric Power and Electric Traction*, Khanna Publishers
2. H. Partab, *Art and Science of Utilisation of Electrical Energy*, Dhanpat Rai and Sons
3. J. B. Gupta, *Utilisation of Electric Power and Electric Traction*, S. K. Kataria and Sons
4. J. Upadhyay, S. N. Mahendra, *Electric Traction*, Allied Publisher Ltd.

Course Title: **Sensor and Transducer Lab**
Course Code: **PCEE-208**

L	T	P	Credits	Weekly Load
0	0	2	1	2

Course Outcomes:
After successful completion of course, the students should be able to
CO1: Recall the working principle of transducers for the measurement of parameters like displacement, temperature etc.
CO2: Calculate the static and dynamic characteristics for different sensors applications.
CO3: Measure the effects of loading on the transducers.
CO4: Differentiate between ideal and real characteristics of transducers.
CO5: Design of circuits for integrating transducers in different applications for measuring and conditioning signals.

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):									
Cos	Programme Outcomes (POs)								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
CO1	3	-	2	-	-	3	-	-	3
CO2	3	2	-	3	-	2	2	1	-
CO3	-	2	3	-	2	2	1	3	3
CO4	-	2	-	3	-	2	1	1	3
CO5	-	2	3	2	-	-	-	3	-

List of Practicals:

1. To study the characteristics of LVDT.
2. To study the characteristics of Variable Capacitor.
3. To study the characteristics of Light Dependent Resistor (LDR).
4. To study the characteristics of Strain Gauge.
5. To study the characteristics of Crompton Potentiometer.
6. To study the characteristics of Resistance Temperature Detector (RTD).
7. To study the characteristics of Thermistor.
8. To study the characteristics of a Thermocouple.
9. To study the characteristics of Piezoelectric transducer.
10. To study the characteristics of Load ell.

Course Title: **Basic Computer Programming Lab**
Course Code: **PCEE-210**

L	T	P	Credits	Weekly Load
0	0	2	1	2

Course Outcomes:

CO1: Understand fundamental programming concepts.
CO2: Apply problem-solving techniques using programming.
CO3: Design algorithms and write efficient code.
CO4: Utilize standard libraries and debugging tools.
CO5: Develop basic programs for real-world applications

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):									
Cos	Programme Outcomes (POs)								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
CO1	3	2	-	3	-	-	-	-	2
CO2	3	2	1	-	1	-	2	3	3
CO3	3	-	-	1	-	-	2	-	3
CO4	3	2	-	-	-	2	-	1	-
CO5	2	1	3	-	-	3	-	2	2

List of Practicals:

1. WAP that accepts the marks of 5 subjects and finds the sum and percentage marks obtained by thestudent.
2. WAP that calculates the Simple Interest and Compound Interest. The Principal, Amount, Rate ofInterest and Time are entered through the keyboard.
3. WAP to calculate the area and circumference of a circle.
4. WAP that accepts the temperature in Centigrade and converts into Fahrenheit using the formulaC/5= (F-32)/9.
5. WAP that swaps values of two variables using a third variable.
6. WAP that checks whether the two numbers entered by the user are equal or not.
7. WAP to find the greatest of three numbers.
8. WAP that finds whether a given number is even or odd.
9. WAP that tells whether a given year is a leap year or not.
10. WAP that accepts marks of five subjects and finds percentage and prints grades according to thefollowing criteria:
    Between 90-100% -------- Print ‘A’
    80-90% ..... Print ‘B’
    60-80% ---------- Print ‘C’ Below 60% Print ‘D’
11. WAP that takes two operands and one operator from the user and perform the operation and printsthe result by using Switch statement.
12. WAP to print the sum of all numbers upto a given number.

13. WAP to find the factorial of a given number.
14. WAP to print sum of even and odd numbers from 1 to N numbers.
15. WAP to print the Fibonacci series.
16. WAP to check whether the entered number is prime or not.
17. WAP to find the sum of digits of the enterednumber.
18. WAP to find the reverse of a number.
19. WAP to print Armstrong numbers from 1 to 100.
20. WAP to convert binary number into decimal number and vice versa.
21. WAP that simply takes elements of the array from the user and finds the sum of these elements.
22. WAP that inputs two arrays and saves sum of corresponding elements of these arrays in a thirdarray and prints them.
23. WAP to find the minimum and maximum element of the array.
24. WAP to search an element in a array using Linear Search.
25. WAP to sort the elements of the array in ascending order using Bubble Sort technique.
26. WAP to add and multiply two matrices of order n x n.
27. WAP that finds the sum of diagonal elements of amxn matrix.
28. WAP to implement strlen (), strcat (), strcpy () using the concept of Functions.

Course Title: **Microprocessors**
Course Code: **PCEE-301**

L	T	P	Credits	Weekly Load
3	0	0	3	3

Course Outcomes:

After successful completion of course, the students should be able to
CO1: Understand basics of microprocessor, its block diagram and history.
CO2: Acquire knowledge of 8085 microprocessor, its architecture and functioning.
CO3: Learn the instruction cycle and timing diagram of microprocessor.
CO4: Understand and create programs for 8085 microprocessors.
CO5: Develop the knowledge of interrupts and data transfer techniques.

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):									
COs	Programme Outcomes (POs)								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
CO1	3	-	-	-	2	-	2	-	2
CO2	-	-	3	2	-	1	3	3	-
CO3	3	-	-	3	3	-	-	3	-
CO4	3	2	3	-	-	1	-	-	2
CO5	3	2	-	-	3	-	-	2	2

Theory:

Unit	Main Topics	Course Outlines	Hour(s)
Unit-1	**Introduction**	Typical organization of microcomputer system its Functions with block diagram, microprocessor evolution on modern society. Architecture**,** Concept of Bus, Bus organization of 8085, functional block diagram of 8085 and function of each block, internal operation of 8085 timing diagram, memory read/write and Input / Output (I/O) read/write addressing modes, flags in 8085.	12
	Instruction Cycle and Timing Diagram	Instruction cycle, machine cycle T-State, fetch and execute cycle (with diagram), Memory Organization**,** Memory mapping, decoding memory interfacing (Random Access Memory (RAM)/Read Only Memory (ROM)), concept of I/O mapped and memory mapped I/O.	12
Unit-2	**Programming 8085 Microprocessor**	Brief idea of assembly language and machine language, memory codes, instruction format, instruction set of 8085, data transfer group, arithmetic group, logic group, STACK Branch operation and machine control group, programming exercise in assembly	12

		language.	
	Interrupts	Concept of interrupts, maskable and non-maskable interrupts, software interrupts, various hardware interrupts of 8085, Masking of interrupts. Brief introduction to Data Transfer Techniques.	12
		Total hours	48

Recommended Books-

1. B. Ram, *Microprocessor and 8085 and Hardware*, Dhanpat Rai.
2. M. Rafiquzzuman, *Microprocessors Theory and applications*, PHI.
3. Ramesh S. Gaonker, *Microprocessor Architecture Programming and Applications with the 8085*, NewAge.
4. Money, Steve A. *Microprocessor data book*. Academic Press, 2014.

Course Title: **Electrical Engineering Materials**
Course Code: **PCEE-303**

L	T	P	Credits	Weekly Load
3	0	0	3	3

Course Outcomes:

After successful completion of course, the students should be able to
CO1: Develop understanding of classification of materials according to their atomic structure.
CO2: Learn features of conducting materials along with important terminologies.
CO3: Understand insulating materials and their properties.
CO4: Identify magnetic materials and categorize them.
CO5: Be conversant in semiconductor materials and special purpose materials.

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):									
Cos	Programme Outcomes (POs)								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
CO1	3	-	2	-	-	1	3	3	2
CO2	2	1	-	3	3	-	3	-	3
CO3	-	-	2	-	2	1	2	3	-
CO4	-	1	-	3	-	-	-	-	-
CO5	1	-	3	-	1	3	1	2	2

Theory:

Unit	Main Topics	Course Outlines	Hour (s)
Unit-1	**Classification**	Classification of materials into conducting, semiconducting and insulating materials with reference to their atomic structure and energy bands.	6
	Conducting materials:	Conducting Materials: Resistivity and factors affecting resistivity, such as temperature, alloying. Super conductivity and super conducting material. Low resistivity materials e.g. copper, aluminum and steel, their general properties as conductor e.g. resistivity, temperature co-efficient, mechanical properties, corrosion, solar ability, contact resistance and practical application. High resistivity materials: manganin, carbon, tungsten, their practical applications.	9

	Insulating Materials	Properties of insulating material: - Electrical properties, Mechanical properties, Physical properties, Thermal properties, Chemical properties, insulating materials and their application-Definition and classification of Thermo setting materials e.g. Phenol Formaldehyde, Resins (i.e. Bakelite), Thermo Plastic materials e.g. Polyvinyl Chloride (P.V.C.), Natural Insulating Materials- Mica and Asbestos, Gaseous Materials e.g. Air, Hydrogen and SF6.	9
Unit - 2	**Magnetic Materials:**	B-H curve of magnetic materials, Classification of magnetic materials into soft and hard magnetic materials. Soft magnetic materials - high silicon alloy steel for transformers and low silicon alloy steel, for electric rotating machine cold rolled grain oriented and non-oriented steel, Nickel iron alloy, soft ferrites, their properties and uses. Hard magnetic materials - tungsten steel, chrome steel, cobalt steel, hard ferrites, their properties and applications.	8
	Semiconductor Materials	Introduction, semiconductor and their applications, Different semiconductor materials used in manufacturing various semiconductors (Si and Ge), Material used for electronic components like resister, capacitor, diode, transistors and inductors.	8
	Special Purpose Materials:	Thermocouple, bimetals, lead soldering and fuses material, mention their applications, Introduction of various engineering materials necessary for fabrication of electrical machines such as motors, generators, transformers etc.	8
		Total hours	48

Recommended Books-

1. A. J. Dekker, *Electrical Engineering materials*
2. G. P. Chhalotra, *Electrical Engineering Materials*
3. S. P. Seth and P.V. Gupta., *Electrical Engineering materials*
4. Martinez-Vega, Juan, ed. *Dielectric materials for electrical engineering.* John Wiley & Sons, 2013.

Course Title: **Microprocessor Lab**
Course Code: **PCEE-305**

L	T	P	Credits	Weekly Load
0	0	2	1	2

Course Outcomes (COs):
After successful completion of the course, the students should be able to
CO1: Develop a program for addition, subtraction of numbers in decimal, hexadecimal and BCD system.
CO2: Write a program to perform multiplication, division of 8-bit numbers, obtain largest, smallest number from an array and arrange data in ascending, descending order.
CO3: Write a program to convert hexadecimal number into ASCII number and vice versa.
CO4: Connect 8251 with 8085 for serially communication and interfacing of 8253 timer to verify its operation in six different modes.
CO5: Design a circuit to interface the DAC with 8085 for generation of square, saw tooth and triangular waves, and implement a serial communication through RS-232 C port.

List of Practical's:

1. Write a program using 8085 Microprocessor for Decimal, Hexadecimal addition and subtraction of two Numbers.
2. Write a program using 8085 Microprocessor for addition and subtraction of two BCD numbers.
3. To perform multiplication and division of two 8-bit numbers using 8085.
4. To find the largest and smallest number in an array of data using 8085 instruction set.
5. To write a program to arrange an array of data in ascending and descending order.
6. To convert given Hexadecimal number into its equivalent ASCII number and vice versa using 8085instruction set.
7. To write a program to initiate 8251 and to check the transmission and reception of character.
8. To interface 8253 programmable interval timer to 8085 and verify the operation of 8253 in six different modes.
9. To interface DAC with 8085 to demonstrate the generation of square, saw tooth and triangular wave.
10. Serial communication between two 8085 through RS-232 C port.

Course Title: **Switchgear and Protection**
Course Code: **PCEE-302**

L	T	P	Credits	Weekly Load
3	0	0	3	3

Course Objectives:

After successful completion of course, the students should be able to
CO 1: Understand the principle of protective schemes and various faults in the Power System Scenario.
CO 2: Acquire the knowledge about various designs of circuit breakers on the basis of arc quenching phenomena.
CO 3: Be competent in use of static and digital relays.
CO 4: Examine the protection of feeders, alternators and other power system components with various protective relays.
CO 5: Know about various types of grounding systems and methods of protection against over voltages.

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):									
COs	Programme Outcomes (POs)								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
CO1	3	-	-	1	-	2	-	3	2
CO2	-	-	3	1	2	2	2	-	2
CO3	2	-	-	1	3	1	-	3	-
CO4	3	3	3	3	-	-	-	-	3
CO5	3	3	-	1	-	1	-	1	2

Theory:

Unit	Main Topics	Course Outlines	Hour(s)
Unit-1	**Introduction**	Classification of substations, graphical symbols of substation components, Key diagram, substation equipment and auxiliaries	6
	Conventional Relays	Introduction, classification, constructional features; and principle of operation of Electromagnetic, Induction, Thermal, Overcurrent relays, Directional relays, Distance relays, Differential, Translay relay	6
	Circuit Breakers (CBs)	Classification of circuit breakers, circuit breaker ratings, restriking voltage, current chopping, duties of switch gear, automatic switch, air circuit breaker, bulk oil CB, minimum oil CB, air blast CB, SF6 CB, vacuum and Direct Current (DC) circuit breakers	6
	Protection of Feeders	Time graded protection, Differential and Distance protection of feeders, Impedance, Reactance and Mho relays, Elementary idea about carrier current protection of lines.	6

Unit - 2	**Protection of Alternators**	Types of faults on alternator, Stator and rotor protection, Negative sequence protection, Loss of excitation and overload protection.	6
	Protection of Transformers	Types of fault on transformers, Protection schemes of transformer, percentage differential protection, Buchholz relay	6
	Protection Against Over-Voltages	Ground wires, Rod gap, Impulse gap, Valve type and Metal Oxide Arresters, Line Arrester/SurgeAbsorber. Ungrounded neutral system, Grounded neutral system and Selection of Neutral Grounding.	6
	Static Relays	Classification of static relays, amplitude and phase comparators, block-spike and block-average comparators, rectifier type relays, Introduction to digital relay: basic principles, Application of microprocessors and computers.	6
		Total hours	48

Recommended Books-

1. A. Chakrabarti, M. L. Soni, P.V. Gupta and U.S. Bhatanagar, *A Textbook on Power SystemEngineering,* Dhanpat Rai and Co.
2. Badri Ram and D.N. Vishwakarma, *Power system Protection and Switchgear,* Tata McGraw Hill.
3. B. R. Gupta, *Power System Analysis and Design,* Wheeler Publishing.
4. C. L. Wadhawa, *A Course in Electrical Pow*er, 6th Edition, New Age international Pvt. Ltd, 2010.
5. I. J. Nagrath. and D. P Kothari , *Power System Analysis,* Tata McGraw-Hill Publication.
6. J. B. Gupta , *A Course in Power System,* S. K. Kataria and Sons.
7. O. L. Elgerd., *Electrical Energy System Theory - An introduction,* Tata McGraw-Hill Publication.
8. W. D. Stevenson Jr., *Elements of Power System Analysis,* Tata McGraw-Hill Publication.

Course Title: **Switchgear and Protection Lab**
Course Code: **PCEE-304**

L	T	P	Credits	Weekly Load
0	0	2	1	2

Course Outcomes:
After successful completion of course, the students should be able to
CO 1: Assessment of the performance of transmission line
CO 2: Analyze the performance of various protective devices like relays and circuit breakers.
CO 3: Be competent in use of static and digital relays.
CO 4: Analyse the radial feeder performance.
CO 5: Learn about different types of faults on transmission line.

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):									
COs	Programme Outcomes (POs)								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
CO1	3	1	-	-	-	3	-	1	2
CO2	-	-	-	-	1	-	2	2	2
CO3	1	-	-	1	-	1	-	3	-
CO4	3	3	3	2	3	-	3	-	3
CO5	1	2	2	1	-	1	-	1	1

List of Practical's:

1. To study the performance of a transmission line. Also compute its ABCD parameters.
2. Study of Characteristics of over current and earth fault protection.
3. To study the operating characteristics of fuse. (High rupturing capacity (HRC) or open type)
4. To find the earth resistance using three spikes
5. To study over current static relay.
6. To study the different types of faults on transmission line demonstration panel/model.
7. To study the radial feeder performance when
   (a) Fed at one end.
   (b) Fed at both ends
8. To study the performance of under voltage and over voltage relay.
9. To study the characteristics of bimetal mini circuit breakers.
10. To study the characteristics of Distance Relay.
11. To find the breakdown strength of transformer oil.

Course Title: **Electrical Estimation & Costing**
Course Code: **PEEE-202A**

L	T	P	Credits	Weekly Load
3	1	0	4	4

Course Outcomes:

After successful completion of course, the students should be able to

CO1: Choose different wiring systems according to the requirement.
CO2: Install various domestic circuits and sub-circuits.
CO3: Design lighting schemes for factories, streets etc.
CO4: Acquire knowledge about various methods of earthing.
CO5: Make estimate and install power circuits for motors.

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):									
COs	Programme Outcomes (POs)								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
CO1	2	3	-	-	1	3	2	-	3
CO2	3	3	3	-	3	-	-	2	2
CO3	-	2	3	-	-	-	-	2	1
CO4	-	1	-	-	2	3	2	-	3
CO5	-	2	-	3	1	1	1	3	-

Theory:

Unit	Main Topics	Course outlines	Hour(s)
Unit - 1	**Introduction**	Estimating, Electrical schedules; Catalogues, Recording of estimates, Determination of required quantity of material, Determination of cost of material and labor, Contingencies, overhead charges, Profit, Tender form and Exercises	4
	Wiring Systems	Introduction: Systems of distribution of electrical energy, Methods of wiring, Systems of wiring, Comparison between various systems of wiring, Choice of wiring system and exercises	4
	Wiring Material and Accessories	Wire and cable: Conductor materials used in cables, Insulating material, mechanical protection, Types of cables, voltage grading of cables, General specification of cables, Main switch and distribution boards, Conduits, Conduit accessories and fittings, Lighting accessories and fitting, Fuse, Types of fuses, Important definitions, Determination of size of fuse wire, Fuse units, Earthing conductor, Energy meter and exercises.	4

	Earthing Systems	Earthing: I.S. specifications regarding earthing of electrical installation, Points to be earthed, Factors influencing the earth resistance, Methods of reducing earth resistance of system, Earth electrode and earth lead, Types of earthing, Determination of size of earth wire and earth plate for domestic and motor installation, Material required for Galvanized Iron (G.I.) pipe earthing, Specification of earth wire and earth plate,	4
	Testing of Installations	Testing of wiring installation, Inspection of internal wiring installation, Reasons for excess recording of energy of energy consumption by energy meter.	4
	Lighting Sub-Circuits	Circuits and sub-circuit, Types of lighting circuits, Various circuit diagrams: Two-way switching, bed room lighting, fluorescent lamps and accessories and exercises	4
Unit – 2	**Lighting Schemes and Calculations**	Lighting; Lighting Schemes, Electric lamps, Comparison between tungsten filament lamps and fluorescent tubes, Design of lighting schemes, Factory lighting, street lighting, Methods of lighting calculation, examples.	4
	Internal Wiring Estimation	General rules for wiring; Determination of number of points, determination of total load, Determination of number of sub-circuits, Determination of rating of main switch and distribution board, Determination of size of conductor, layout, Specimen internal wiring estimates	4
	Electrical Installation for Power Circuits	Introduction, Important points about motor installation wiring, Determination of input power, Determination of input current to the motors, Determination of rating of cables, Determination of rating of fuses, Determination of size of conduit, distribution boards, main switch and starter, Specimen estimates, Exercise and problems	4
	Overhead and Underground Transmission and Distribution	Introduction: Main components of overhead line, Line supports, Clearance of conductor from ground, spacing between conductors, Factors governing height of pole, Conductors: Determination of size of conductor for overhead line, Insulators; Cross arm, Clamps, stay wire, Lighting arrestors, Phase plate, Danger plate, Earthing of transmission line, Important specifications, Underground cables: Method of laying underground cables, cable terminal box, specimen,	4
	Service Connections	Service line: Methods of installation of service lines, Specimen estimates, Exercise and Problems	4
	Substations	Introduction: Classification, Indoor substations, outdoor substations, Advantages and disadvantages of outdoor substations, Selection and location of site, Main connection schemes. Graphical symbols for various types of apparatus and circuit elements on substation main connection diagram, Equipment for substations and switchgear installations, Substations auxiliaries supply, Specimen estimates, Exercises and Problems	4
		Total hours	48

Recommended Books-

1. J. B. Gupta, *Electrical Installation, Estimating and Costing*, S. K. Kataria
2. N. Alagappan and B. Ekambaram, *Electrical Estimating and Costing*, TMH
3. S. L. Uppal, *Estimating and Costing*, Khanna Publishers
4. S. K. Bhattacharya, *Estimating and Costing*, Tata McGraw Hill
5. Surjeet Singh, *Estimating and Costing*, Dhanpat Rai and Co.

Course Title: **Electrical Circuit Theory**
Course Code: **PEEE-202B**

L	T	P	Credits	Weekly Load
3	1	0	4	4

Course Outcomes:

After successful completion of course, the students should be able to
CO1: Acquire the knowledge of the basics of electrical circuits and its elements.
CO2: Apply various theorems and transformations to solve the DC networks
CO3: Analyse series and parallel circuits in AC and terms associated with it like power factor, powertriangle, resonance and quality factor.
CO4: Analyse various signals and their responses for different circuits in DC.
CO5: Understanding of transient analysis.

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):

COs	Programme Outcomes (POs)								
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PSO1**	**PSO2**
CO1	3	-	-	-	2	2	1	-	3
CO2	2	2	2	1	2	2	-	1	3
CO3	2	2	2	2	2	2	1	2	3
CO4	2	2	1	-	3	2	2	3	3
CO5	2	2	1	-	-	-	1	1	1

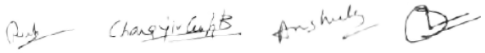
Theory:

Unit	Main Topics	Course Outlines	Hour(s)
Unit-1	**Introduction**	Voltage and current sources, relation between current, voltage, power and energy of Direct Current (DC) sources, conversion of voltage sources to current sources and vice versa; formation of branch, node and loop	12
	DC network analysis	Applications of Kirchoff 's Current Law (KCL) by using nodal current method and Kirchoff 's Voltage Law (KVL) using loop current method and branch current method for solving network problems, Star/delta and Delta/star transformations (Simple Numericals), Applications of Network theorems and transformations: Star-delta conversion, superposition theorem, Thevenin's theorem, Norton's theorem, reciprocity theorem, maximum power transfer theorem and Tellegen's theorem for the solution of networks with DC.	12

Unit - 2	**AC network analysis**	Series Alternating Current (AC) circuits Resistance –Inductance (R- L), Resistance-capacitance (R-C) and Resistance-Inductance Capacitance (R-L-C) circuits. Impedance, reactance, phasor diagram, impedance triangle, power factor, Average power, Apparent power, Reactive power, Power triangle (Numerical), Series Resonance, quality factor (Numerical), Parallel AC circuits R-L, R-C and R-L-C circuits. Admittance, Susceptance, Solution by admittance method, phasor diagram and complex Algebra method. (Numerical), Parallel resonance, quality factor, Comparison of series and Parallel circuits. Generation of three phase Electro motive force (EMF), Phase sequence, polarity marking, Types of three-phase connections, Concept of unbalanced load and balanced load, Line, phase quantities and power in three phase system with balanced star and Delta connected load and their interrelationship, Advantages of polyphase circuits over single phase circuits	12
	Transients in DC circuits	Introduction to Impulse, step, ramp and sinusoidal signals, transients introduced by these signals in RL, RC and RLC circuits	12
		Total hours	48

Recommended Books-

1. A. Chakravorty, *Circuit Theory*, Dhanpat Rai and Co.
2. Edward Hughes, *Electrical Technology*, Longman Publishers
3. G. K Mithal, *Network and Circuit Theory*, Khanna Publishers
4. J. B. Gupta, *Electrical Engineering*, S. K. Kataria and Sons
5. M. L. Soni, P.V. Gupta and U. S. Bhatnagar, *Electrical Circuit Analysis*, Dhanpat Rai and Co.
6. P. V. Gupta, P. C. Dhar, *Introduction to Networks*, Dhanpat Rai and Sons
7. Van Valkenberg, *Network and Circuit Theory*, Tata McGraw Hill



Course Title: **Electrical Safety and Applications**
Course Code: **PEEE-202C**

L	T	P	Credits	Weekly Load
3	1	0	4	4

Course Outcomes:
After successful completion of course, the students should be able to
CO1. Describe electrical hazards and protection equipments
CO2. Analyze and apply various grounding and bonding techniques.
CO3..Understand Power Safety measures
CO4. Participate in a safety team.
CO5. Carry out proper maintenance of electrical equipment by understanding various standards.

CO/PO Mapping: (Strong (3) / Medium(2) / Weak(1) indicates strength of correlation):

COs	Program Outcomes (POs)								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
CO1	3	-	2	-	3	3	-	3	3
CO2	2	3	3	3	3	3	1	-	2
CO3	3	2	3	2	3	3	-	2	3
CO4	3	-	2	-	-	2	-	2	-
CO5	3	3	3	3	3	2	-	2	3

Theory:

Unit	Main Topics and Course Outlines	Hour(s)
Unit-1	**Electrical Hazards:** Electrostatic, Electromagnetism, Energy leakage, Clearance and creepage, insulation breakdown, Current surges –	6
	Electrical causes of fire and explosion – Human resistance to electricity Primary and secondary hazards- Shocks, Flashover, arc flash, arc blast,	6
	Electrical Protection and Maintenance: safety equipment- flash and thermal protection, head and eye protection- rubber insulating equipment, hot sticks, insulated tools, barriers and signs, safety tags, locking devices- voltage measuring instruments- proximity and contact testers-safety electrical one line diagram- electrician's safety kit.	8
	Grounding and Bounding Safety Measure: General requirements for grounding and bonding, Purpose of System grounding, equipment grounding, grounding electrode system, grounding conductor	8
Unit – 2	**Power System Operation Safety Measure:** The six step safety methods- pre job briefings - hot-work decision tree-safe switching of power system- lockout tag out approach distances- the one-minute safety audit.	8

	Company Safety Structure: Electrical safety Program company safety team- safety policy Program implementation- - safety audit accident prevention- first aid- rescue techniques-accident investigation	6
	Standards and Requirements: reliability centered maintenance (RCM) - eight step maintenance Program frequency of maintenance- regulatory bodies- national electrical safety code- Indian Electricity Acts related to Electrical Safety	6
	Total hours	48

Recommended Books-

1. John Cadick, Mary Capelli-Schellpfeffer, Dennis Neitzel, Al Winfield, "*Electrical Safety Handbook*", McGraw-Hill Education, 4thEdition, 2012.
2. Maxwell Adams.J, "*Electrical Safety- a guide to the causes and prevention of electric hazards*", The Institutionof Electric Engineers, IET 1994.
3. Ray A. Jones, Jane G. Jones, "*Electrical Safety in the Workplace*", Jones & Bartlett Learning, 2000.
4. S. Rao, R. K. Jain and H. L. Saluja, "*Electrical Safety, Fire Safety Engineering and Safety Management*"Khanna Publishers,1997.
5. J. Maxwell Adams, "*Electrical Safety a guide to the causes and prevention of electrical hazards*" The Institutionof Electrical Engineers, London, U K,2004.
6. El-Sharkawi, Mohamed A, "*Electric safety: practice and standards*", CRC Press, 2014

Course Title: **Solar and Wind Energy Systems**
Course Code: **PEEE-301A**

L	T	P	Credits	Weekly Load
3	1	0	4	4

Course Outcomes:
CO1: Describe the energy scenario and the consequent growth of the power generation from renewable energysources.
CO2: Explain the basic physics of wind and solar power generation.
CO3: Apply the power electronic interfaces for wind and solar generation.
CO4: Explain the functioning of different types of lamps and fittings.
CO5: Understanding of smart grid concept.

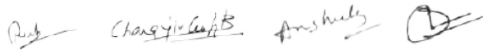
CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):

COs	Programme Outcomes (POs)								
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PSO1**	**PSO2**
CO1	3	-	-	-	2	2	1	-	3
CO2	2	2	2	1	2	2	-	1	3
CO3	2	2	2	2	2	2	1	2	3
CO4	2	2	1	-	3	2	2	3	3
CO5	-	2	1	-	-	2	2	1	1

UNIT	Course Outlines	Hours
Unit-1	Solar Resources: Introduction, solar radiation spectra, solar geometry, Earth Sun angles, observer Sun angles, solar day length, Estimation of solar energy availability.	8
	Solar Photovoltaic Generation: Technologies-Amorphous, monocrystalline, polycrystalline; V- I characteristics of a PV cell, PV module, array, power electronic converters for solar systems, maximum power point tracking (MPPT) algorithms. converter control.	8
	Network Integration Issues: overview of grid code technical requirements. fault ride-through for wind farms - real and reactive power regulation, voltage and frequency operating limits, solar PV and wind farm behavior during grid disturbances. power quality issues. power system interconnection experiences in the world. hybrid and isolated operations of solar PV and wind systems.	12
Unit-2	Physics of Wind Power: History of wind power, Indian and global statistics, wind physics, tip speed ratio, stall and pitch control, wind speed statistics-probability distributions, wind speed and power-cumulative distribution functions.	8
	Wind Generator Topologies: Review of modern wind turbine technologies fixed and variable speed wind turbines, induction generators, doubly-fed induction generators and their characteristics, permanent-magnet synchronous generators, power electronics converters. generator-converter configurations, converter control.	12
	Total hours	48

Recommended Books

1. T. Ackermann, *"Wind Power in Power Systems"*, John Wiley and Sons Ltd., 2005.
2. G. M. Masters, *"Renewable and Efficient Electric Power Systems"*, John Wiley and Sons, 2004.
3. S. P. Sukhatme, *"Solar Energy: Principles of Thermal Collection and Storage"*, McGraw Hill,1984.
4. Korsnes, Marius. *Wind and solar energy transition*. Routledge, 2019.



Course Title: **Electrical Power Generation**
Course Code: **PEEE-301B**

L	T	P	Credits	Weekly Load
3	1	0	4	4

Course Outcomes:

After successful completion of course, the students should be able to
CO1: Introduce conventional and non-conventional energy sources and their availability.
CO2: Understand power generation planning.
CO3: Learn about hydroelectric generation, thermal power generation,
CO4: Draw Layout and know Elements of gas power station, Diesel electric power generation and nuclear power generation.
CO5: Knowledge of site selection and installation of different power generating stations.

CO/PO Mapping : (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):									
Cos	Programme Outcomes (POs)								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
CO1	3	-	-	3	-	3	-	2	-
CO2	-	3	3	2	2	-	2	3	2
CO3	2	2	1	-	-	1	-	-	2
CO4	2	3	-	1	1	-	3	2	-
CO5	-	-	3	2	3	2	-	-	2

Theory:

Unit	Main Topics	Course Outlines	Hours
Unit-1	**Introduction**	Energy sources conventional and non- conventional, their availability, demand of electricity, major electrical equipments in power stations different types of generating plants and comparison	8
	Power Generation Planning	Load forecasting, load curves, load duration curve, Base load and Peak load Power Plants, connected Load, maximum demand, demand factor, Group diversity factor, load factor, significance of load factor, plant factor, capacity factor, selection of unit size, No. of Units, reserves, cost of power generation, Depreciation,tariff.	8
	Hydro Electric Generation	Selection of site, basic definitions, classification, elements of hydroelectric plant and operation of hydro- electric plant, hydro-electric generator	8
Unit-2	**Thermal Power Generation**	Introduction, selection of site, basic parts and general layout of steam power plant and working, efficiency, fuels, fuel handling, combustion, ash handling and dust collection, draught systems, turbo alternators merits and demerits of	8

		steam power plants,	
	Diesel Electric Power Generation	selection of site for diesel plant, plant layout, performance and thermal efficiency of diesel plant merits and demerits of plant	6
	Nuclear Power Generation	Feasibility of nuclear power station, nuclear fuels, constituents and layout of nuclear power plant,	4
	Gas Power Stations	Layout and Elements of gas power station, basic principle and operation, fuels, thermal efficiency, closed cycle gas turbine plants	6
		Total hours	48

Recommended Books-

1. A. Chakrabarti, Bhatnagar, M. L. Soni, and P. V. Gupta U. S., *Power System Engineering,* Dhanpat Rai and Co
2. A. Christopher, Simon *Alternate Source of Energy*, Rowman and Little Field Publishers Inc..
3. B. R. Gupta, *Generation of Electrical Energy,* S. Chand
4. C. L. Wadhwa, *Generation, Distribution and Utilization of Electric Energy*, New Age International
   (P) Limited, Publishers
5. G. D. Rai, *Non Conventional Energy Sources*, Khanna Publishers
6. S. Rao and Parulekar, B. B., *Energy Technology: Non Conventional, Renewable and Conventional*,Khanna Publishers
7. Venikov, V.A. and Putyain, E.V., *Introduction to Energy Technology*, Mir Publishers

Course Title: **Special Purpose Electrical Machines**
Course Code: **PEEE-301C**

L	T	P	Credits	Weekly Load
3	1	0	4	4

Course Outcomes:

After successful completion of course, the students should be able to

CO1: To acquire the knowledge of DC Permanent magnet machines.
CO2: Learn about the concepts of BLDC motors.
CO3: Explain the construction and working of permanent magnet AC machines.
CO4: To acquire knowledge about Axial flux motors.
CO5: Learning about the Stepping and hybrid stepping motors.

CO/PO Mapping: (Strong(1) / Medium(2) / Weak(3) indicates strength of correlation):									
COs	Programme Outcomes (POs)								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
CO1	1	1	1	1	1	-	-	-	1
CO2	1	1	1	-	1	1	-	1	1
CO3	1	2	1	2	1	2	2	2	2
CO4	1	2	2	2	-	2	-	2	2
CO5	1	2	2	2	1	2	2	2	2

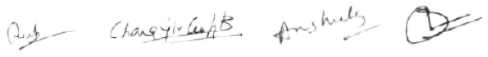
Theory:

Unit	Main Topics and Course Outlines	Hour(s)
Unit-1	**Permanent Magnet d.c. Commutator Motors.** Permanent magnet versus electromagnetic excitation, Construction: Slotted-rotor PM d.c. motors, Slotless-rotor PM motors Fundamental equations: Terminal voltage, Armature winding EMF, Electromagnetic torque, Electromagnetic power, Input and output power, Losses , Pole pitch, Air gap magnetic flux density, Armature winding resistance, Armature winding inductance; Sizing procedure, Armature reaction, Commutation, Starting, Speed control, Servo motors, Applications.	12
	D.C. Brushless Motors Fundamental equations: Terminal voltage, Instantaneous current, EMF, Electromagnetic torque of a PM brushless d.c. motor; Concentrated-coil armature winding , Commutation of PM brushless motors, Toque-speed characteristics, Winding losses, Torque ripple: Sources, minimization of torque ripple, Universal brushless motor electromechanical drives, Smart Motors, Applications	12

Unit-2	**Permanent Magnet Radial Flux Synchronous Motors** Construction, Fundamental relationships: Speed, Air gap magnetic flux density, Voltage induced (FMF), Electromagnetic power, Synchronous reactance, Sub transient synchronous reactance, Transient synchronous reactance, Electromagnetic torque, Equivalent field MMF, Armature reaction reactance; Phasor diagram, Characteristics, Starting methods, Rotor configurations comparison between synchronous and induction motors, Applications	12
	Axial Flux Motors Force and torque, Performance, Double-sided motor with internal PM disk motor, Stator core Main dimensions, Double-sided motor with one stator, Single-sided motors, Ironless double-sided motors, Multidisc motors. Applications **Stepping Motors** Features of stepping motors**,** Fundamental equations**:** Step**,** Steady-state torque**,** Maximum synchronizing torque**,** Frequency of the rotor oscillations; PM stepping motors**,** Reluctance stepping motors**,** Hybrid stepping motors: Full stepping, Half stepping**,** Voltage equations and electromagnetic torque Characteristics: Torque-angle characteristics**,** Torque-current characteristics, Torque frequency characteristics; Applications.	12
	Total hours =	48

Recommended Books:

1. E. G. Janardhanan, '*Special Electrical Machines*' PHI Learning Private Limited
2. Irving L. Kosow.*'Electrical Machinery and Transformers*', Oxford Science Publications.
3. Veinott & Martin,*'Fractional & Subfractional hp Electric Motors*'.McGraw Hill International Ed.
4. *Handbook of Electric Motors*. United Kingdom, CRC Press, 2018.



Course Title: **Power Electronics**
Course Code: **PEEE-302A**

L	T	P	Credits	Weekly Load
3	1	0	4	4

Course Outcomes:

After successful completion of course, the students should be able to

CO1: Observe the characteristics and operation of the various semiconductor devices.
CO2: Focus on different power electronic converters.
CO3: Classify resonant converters and their control techniques.
CO4: Describe the practical application of the different type of converters.
CO5: Explain the operation and control of multilevel inverters.

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):									
COs	Programme Outcomes (POs)								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
CO1	1	2	2	2	-	1	-	3	-
CO2	1	-	-	1	1	1	1	-	2
CO3	1	2	2	3	1	1	1	-	-
CO4	1	1	1	1	-	1	-	-	2
CO5	1	1	-	1	1	1	1	1	1

Unit	Main Topics and Course Outlines	Hour(s)
Unit-1	**Power Semiconductor Devices:** power diodes, power transistors, SCRs, TRIAC, GTO, power MOSFETs, IGBTs-Principles of operation, characteristics, ratings, protection and gate drive circuits, dv/dt and di/dt protection, Series and parallel operation of Thyristors.	12
	DC-DC Converters: Buck, Boost, Buck-Boost converters with circuit configuration and analysis, Introduction to Zero Voltage Switching and Zero Current Switching.	8
Unit-2	**DC-AC Converters:** Single phase and Three phase Voltage Source (VSI) and Current Source Inverter (CSI), frequency and voltage control Pulse Width Modulation Techniques (PWM).	12
	AC-AC Converter: Single and Three phase controllers, phase control, PWM AC voltage controller, Principle of ON-OFF control and Cyclo-converters.	8
	Drives: Vector and direct torque control of AC drives.	8
	Total hours	48

Recommended Books: -

1. M. H. Rashid, *Power Electronics - Circuits, Devices and Applications*, Prentice Hall Publications, 3rd Edition, 2003.
2. Ned Mohan, Tore M. Undeland, William P. Robbins, *Power Electronics*, John Wiley & Sons Publications, 3rd edition, 2006.
3. V. R. Moorthi, *Power Electronics- Devices, Circuits and Industrial Applications*, Oxford University Press, 1st Edition, 2005.
4. Philip T. Krein, *Elements of Power Electronics*, Oxford University Press, 1st Edition, 2012.
5. *Industrial Applications of Power Electronics*. Switzerland, MDPI AG, 2020.
6. Maksimović, Dragan, Erickson, Robert W. *Fundamentals of Power Electronics*. Germany, Springer International Publishing, 2020.

Subject Code : **PEEE-302B**
Title of the course: **Energy Auditing and Management**

L	T	P	Credits	Weekly Load
3	1	0	4	4

Course Outcomes:

After successful completion of course, the students should be able to
CO1: Acquire an in depth knowledge about the energy management and auditing
CO2: Recognize how energy can be conserved and managed in industries.
CO3: Acquire a comprehensive idea on tariffs in Transmission & Distribution systems.
CO4: Be competent to handle the Energy auditing procedure.
CO5: Be competent to handle the Energy Management project.

Mapping COs/Bloom's Taxonomy Level (BLs)					
CO's	CO1	CO2	CO3	CO4	CO5
BL	BL1,BL2	BL3	BL4	BL6	BL5,BL6

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):									
COs	Program Outcomes (POs)/Program Special Outcome (PSO's)								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO 1	PSO 2
CO1	3	-	1	1	-	2	-	2	1
CO2	3	2	2	-	3	3	1	3	2
CO3	2	-	2	-	2	3	2	3	3
CO4	3	2	2	2	2	3	-	3	2
CO5	3	3	3	-	3	3	-	2	3

Unit	Main Topics and Course Outlines	Hour(s)
Unit-1	**Energy Audit Methodology and Instruments:** General philosophy, need of energy audit, economics of implementation of energy optimization projects, it's constraints, barriers and limitations, report-writing, preparations and presentations of energy audit reports, post monitoring of energy conservation projects, MIS, case-studies / report studies of energy audits. guidelines for writing energy audit report, data presentation in report, findings recommendations, impact of renewable energy on energy audit	12
	Energy Conservation in Electrical Installation system: Technical losses, caused and measure to reduce by controlling I^2 R losses, optimizing	12

	phase currents. Significance of Power Factor in energy conservation. Energy conservation equipment's: Maximum Demand controller, KVAR Controller, Automatic Power Factor controller (APFC)), automatic star delta convertor. Energy Conservation in Lighting System: Replacing Lamp Sources, using energy efficient luminaries, using light controlled gears, installation of separate servo stabilizer for lighting, periodic survey an adequate maintenance programs. Energy conservation techniques in fans, Electronic	
Unit-2	**Energy Management:** Need of energy management. definition and objective of energy management, general principles of energy management, energy management skills, energy management strategy in respect of electrical power	8
	Cogeneration and Tariff: Definition and scope, topping and bottoming cycles, benefits, industries suitable for cogeneration, agricultural uses of waste heat, use of power plant reject heat for waste water treatment, integrated energy system, potential of cogeneration in India. Need of tariff, Types of Tariff structure LT and HT, Special tariffs, time off day tariff, peak off day tariff, power factor tariff, maximum demand tariff, load factor tariff	10
	Financial Management: Investment-need, appraisal and criteria, financial analysis techniques simple payback period, return on investment, net present value, internal rate of return, cash flows, risk and sensitivity analysis; financing options, energy performance contracts and role of Energy Service Companies (ESCOs) Projects related to this course should be given to students(in groups) in order	6
	Total hours =	48

Recommended Books

1. C.L. Wadhwa, "Generation Distribution & Utilization of Electrical Energy", New Age international,1989.
2. G Petrecca, "Industrial Energy Management: Principles & applications", Kluwer Academic Publisher,1993
3. Iqbal Hussein, "Electric and Hybrid Vehicles: Design Fundamentals", CRC Press, 2003
4. James Larminie, John Lowry, "Electric Vehicle Technology Explained", 2nd Edition, Wiley, 2003.
5. Bureau of Energy Efficiency India, "General Aspects of Energy Management and Energy Audit", Bureau of Energy Efficiency India, 2015
6. Shapiro, Ian M, "Energy audits and improvements for commercial buildings : a guide for energy managers and energy auditors" John Wiley & Sons, 2016

Course Title: **Electric Vehicles Technology**
Course Code: **PEEE-302C**

L	T	P	Credits	Weekly Load
3	1	0	4	4

Course Outcomes:

After successful completion of course, the students should be able to

CO1: Understand the models to describe hybrid vehicles and their performance.
CO2: Identify the different possible ways of energy storage.
CO3: Knowledge of basics of electric train
CO4: Understand the different strategies related to energy storage systems.
CO5: Learn the different strategies related to energy management systems.

CO/PO Mapping: (Strong (3) / Medium (2) / Weak (1) indicates strength of correlation):

COs	Program Outcomes (POs)/Program Special Outcome (PSO's)								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
CO1	3	3	-	-	2	2	1	2	2
CO2	2	-	2	-	2	2	2	2	2
CO3	-	3	2	1	2	2	2	3	2
CO4	1	-	1	1	-	2	-	2	1
CO5	3	2	2	-	3	3	1	3	2

Theory:

Unit	Main Topics and Course Outlines	Hour(s)
Unit-1	**Introduction:** Conventional vehicles: basics of vehicle performance, vehicle power source characterization, transmission characteristics, mathematical models to describe vehicle performance. Introduction to hybrid electric vehicles: history of hybrid and electric vehicles, social and environmental importance of hybrid and electric vehicles, impact of modern drivetrains on energy supplies. Hybrid electric drivetrains: basic concept of hybrid traction, introduction to various hybrid drive-train topologies, power flow control in hybrid drive-train topologies, fuel efficiency analysis.	12
	Electric Trains: Electric drivetrains: basic concept of electric traction, introduction to various electric drive train topologies, power flow control in electric drive-train topologies, fuel efficiency analysis. Electric propulsion unit: introduction to electric components used in hybrid and electric vehicles, configuration and control of dc motor drives, configuration and control of induction motor drives, configuration and control of permanent magnet motor drives, configuration and control of switch reluctance motor drives, drive system efficiency.	12

Unit-2	**Energy Storage:** Energy storage: introduction to energy storage requirements in hybrid and electric vehicles, battery-based energy storage and its analysis, fuel cell-based energy storage and its analysis, super capacitor based energy storage and its analysis, flywheel based energy storage and its analysis, hybridization of different energy storage devices. sizing the drive system: matching the electric machine and the internal combustion engine (ICE), sizing the propulsion motor, sizing the power electronics, selecting the energy storage technology, communications, supporting subsystems	12
	Energy Management Strategies: Energy management strategies: introduction to energy management strategies used in hybrid and electric vehicles, classification of different energy management strategies, comparison of different energy management strategies, implementation issues of energy management strategies. case studies: design of a hybrid electric vehicle (HEV), design of a battery electric vehicle (BEV). Projects related to this course should be given to students (in groups) in order to promote teamwork and ethical values.	12
	Total hours	48

Recommended Books:

1. C. Mi, M. A. Masrur and D. W. Gao, *"Hybrid Electric Vehicles: Principles and Applications with Practical perspectives"*, John Wiley & Sons, 2011.
2. S. Onori, L. Serrao and G. Rizzoni, *"Hybrid Electric Vehicles: Energy Management Strategies"*, Springer, 2015.
3. M. Ehsani, Y. Gao, S. E. Gay and A. Emadi, *"Modern Electric, Hybrid Electric, and Fuel Cell Vehicles:Fundamentals, Theory, and Design"*, CRC Press, 2004.
4. T. Denton, *"Electric and Hybrid Vehicles"*, Routledge.
5. K T Chau, *" Emerging Technologies for Electric and Hybrid Vehicles"*, 2018

Course Title: **Industrial Automation**
Course Code: **PEEE-304A**

L	T	P	Credits	Weekly Load
3	1	0	4	4

Course Outcomes:

After successful completion of course, the students should be able to

CO1: Learn the basics of automation, control system and block diagram representation.
CO2: Understand various components of control system.
CO3: Acquire the knowledge of various types of electrical actuators and their applications.
CO4: Understand various types of controllers, control actions and tuning methods.
CO5: Learn automatic control action using PLC, DCS and SCADA.

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):									
COs	Programme Outcomes (POs)								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
CO1	3	2	2	2	-	1	-	3	3
CO2	1	-	-	1	1	2	1	-	-
CO3	2	2	2	3	3	1	1	1	3
CO4	1	3	3	1	-	3	-	-	1
CO5	1	1	-	1	1	1	1	-	1

Theory:

Unit	Main Topics and Course Outlines		Hour (s)
Unit-1	**Review of basic concepts of Automation and Control System**	Need of automation, Advantages of automation, Basic Requirements for automation, Basic Concept of control system, block diagram and Transfer function, Different terms in control system, Types of control system, Applications of control system, Development of block diagram for simple applications like level, temperature, flow control etc.	8
	Control System Components	Contacts-types, current capacity and load utilization categories, Solenoids-Direct current/ Alternating Current (DC/ AC), *Input* (*I/P) devices*- switches-push buttons, foot switch, selector switch, pilot switch, proximity, photoelectric, temperature actuated, level control, pressure sensing, overload sensing; Relays- electromechanical, reed; *Output* (*O/P) devices*- contactors, valves, pilot lamps; Symbols in power and control circuits; Developing control circuit-basic and thumb rule; Power and control circuit for different applications like hoist, crane, conveyer belt, induction motors	8
	Electrical Actuators	Operating principle and characteristics of various actuators i.e. Potentiometers, AC and DC Servomotors, Synchros - transmitter, control transformer, error detector, PM and variable reluctance Stepper motors, Tacho-generator; Applications of above components in control system.	8

Unit – 2	**Controllers**	*Hydraulic Controllers*-advantages and disadvantages, hydraulic servomotor, types of pumps used, control valves, components like accumulator, filter, seals; *Pneumatic Controllers*-resistance and capacitance of pressure system, pneumatic flapper-nozzle system, pneumatic relays, actuating valves, cylinders, comparison between pneumatic and hydraulic systems; *Electrical and electronic controllers*-brief overview of op-amps, inverting, non-inverting, lead-lag networks; *Digital controllers*-brief overview of microprocessor and micro-controller to be worked as controller	8
	Control actions	On-Off control, Proportional (P), Integral (I), Proportional Integral (P-I), Proportional Derivative (P-D), Proportional Integral Derivative (P-I-D) control actions; P-I-D action using hydraulic, pneumatic and electronic controllers; Tuning of these controllers	8
	Programmable Logic Controller (PLC), Distributed Control System (DCS) and SCADA	Introduction, Advantages and disadvantages, PLC Vs Personal Computer (PC), Block diagram of PLC, Basic blocks like CPU, Input / Output (I/O) modules, bus system, power supplies and remote I/Os; Different PLCs available in market; development of Ladder logic; some simple programs such as I/O connections, starting of Induction Motor (IM), stepper motor control; Introduction to Distributed Control System (DCS) and Supervisory Control and Data Acquisition (SCADA)- brief introduction to its hardware and software.	8
		Total hours	48

Recommended Books-

1. Jacob, *Industrial Control Engg*, PHI.
2. J. Stenerson, *Industrial automation and process control*, PHI.
3. Kothari and Nagrath, *Electrical Machines*, TMH.
4. Nagrath and Gopal, *Control System Engg.*, Wiley Eastern.
5. R. Shell, *Handbook of Industrial automation*, Taylor and Francis.
6. Webb and Reis, *Programmable Logic Controller: Principle and applications*, Wiley Eastern.

Course Title: **Control Systems**
Course Code: **PEEE-304B**

L	T	P	Credits	Weekly Load
3	0	0	3	3

Course Outcomes:
After successful completion of course, the students should be able to
CO1: Develop the theoretical aspects of Control systems and feedbacks.
CO2: Understand DC and AC servo motors, Elements of measurement system and CRO forMeasurement.
CO3: Determine transfer function from block diagram reduction technique and mason's gain formula.
CO4: Analyze the time domain response for various standard test signals.
CO5: Understand the frequency response and to perform stability analysis in frequency domain

CO/PO Mapping: (Strong (3) / Medium (2) / Weak(1) indicates strength of correlation):									
	Programme Outcomes (POs)/ Program Specific Outcomes								
Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
CO1	3	3	-	-	-	-	-	1	2
CO2	3	-	-	3	3	-	2	-	3
CO3	2	2	-	3	3	-	-	2	2
CO4	2	-	2	3	2	-	2	-	2
CO5	1	2	-	-	-	2	-	1	2

Theory:

Unit	Main Topics	Course Outlines	Lecture(s)
Unit-1	**Introduction:**	Basic elements of a feedback control system, open loop, feedback and feed-forward, linear and non-linear, continuous and sampled-data control systems, digital control, practical examples of the above. Control system components, Direct current (DC) and Alternating Current (AC) Servo motors, techo- generator, potentiometer, synchros, stepper motor, AC position control system, Elements of generalized measurement system, characteristics of instruments, accuracy, precision, sensitivity, range span. Construction and working of Cathode Ray Tube (CRT), Block diagram of Cathode Ray Oscilloscope (CRO), measurement of voltage and frequency with CRO.	12
	Mathematical models for Physical Systems:	Differential equations of simple mechanical, electrical, thermal, linearization of a non-linear mathematical model, transfer function derivation of physical systems, Block diagram, Signal flow graphs.	12

Unit - 2	**Time Response Analysis:**	Standard test signals, time response of first and second-order systems, time response specifications, steady- state errors and error constants, error performance indices. Stability of Systems**,** Concept of stability, condition for stability, Routh's Hurwitz's ability criteria.	12
	Frequency Response Analysis	Co-relations between time and frequency response, frequency response specification.	12
		Total hours =	48

Recommended Books-

1. Bakshi and Goyal, *Theory and Problems of Feedback Control Systems*, TMH
2. Kuo, *Modern Control Engineering*, PHI
3. Nagrath I. J. ,and Gopal, *Control System Engineering*, Wiley Eastern
4. Ogata, *Automatic Control Systems*, PHI
5. Schaum Series, *Theory and Problems of Feedback Control Systems*, TMH

Course Title: **Smart-grid Systems**
Course Code: **PEEE-304C**

L	T	P	Credits	Weekly Load
3	1	0	4	4

Course Outcomes:

After successful completion of course, the students should be able to
CO1: Express the knowledge of Microgrid Technology, issues and standards
CO2: Describe operational issues of Grid connection of DG systems.
CO3: Explain the operation, control and modeling of Microgrids.
CO4: Describe the reliability of Microgrid Technology
CO5: Examine issues and standards of DGs.

CO/PO Mapping: (Strong (3) / Medium(2) / Weak(1) indicates strength of correlation):									
COs	Programme Outcomes (POs)								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
CO1	3	-	-	1	-	-	-	2	1
CO2	2	1	1	-	3	2	2	2	-
CO3	-	3	2	3	2	2	2	3	-
CO4	-	2	1	1	3	-	2	-	2
CO5	-	2	1	1	2	-	3	-	3

Theory:

Unit	Main Topics and Course Outlines	Hour(s)
Unit-1	**BASICS OF A MICROGRID:** Concept and definition of microgrid, microgrid drivers and benefits, review of sources of microgrids, typical structure and configuration of a microgrid, microgrid systems, Power Electronics interfaces in microgrid systems.	14
	OPERATIONAL FEATURES OF GRID CONNECTED DG SYTEMS: Grid interconnection issues for grid connected operation of various types of DG systems. Constraints on operational parameters: voltage, frequency, THD, response to grid abnormal operating conditions, islanding issues. Reliability, stability and power quality issues involved in grid connected operation of various DGs.	10
Unit-2	**OPERATION, CONTROL AND MODELLING OF MICROGRID:** Concept and definition of microgrid, review of sources of microgrids, typical structure and configuration of a microgrid, microgrid implementation in Indian and international scenario, AC and DC microgrids, Power Electronics interfaces in DC and AC microgrids, communication infrastructure, modes of operation and control of microgrid: grid connected and islanded mode operation, anti-islanding schemes. Control techniques for voltage, frequency, active and reactive power control of microgrid system, Computer aided Modelling of microgrid.	10
	INTRODUCTION TO RELIABILITY AND MARKET ISSUES OF MICROGRID: Power quality issue, THD reduction techniques, protection and	6

	stability analysis of microgrid, regulatory standards, introduction to microgrid reliability. Features of microgrid economy and market. LVDC Microgrid.	
	INTERCONNECTION ISSUES AND STANDARDS OF DGs: Concept of distributed generations (DG) or distributed energy resources (DERs), topologies, selection of source, dependence on storage facilities, regulatory standards/ framework, standards for interconnecting DGs to electric power systems: IEEE 1547. DG installation classes, security issues in DG implementations. Grid code and Islanding & non-islanding system.	8
	Total hours =	48

Recommended Books:

1. *Renewable Energy- Power for a sustainable future*, third edition, Edited by Godfrey Boyle, Oxford UniversityPress, 2013.
2. Amirnaser Yezdani, and Reza Iravani, *"Voltage Source Converters in Power Systems: Modeling, Control andApplications"*, IEEE John Wiley Publications, 2009.
3. Dorin Neacsu, *"Power Switching Converters: Medium and High Power"*, CRC Press, Taylor & Francis, 2006.New Delhi.
4. *Microgrids: Architectures and Control*, Nikos Hatziargyriou (Editor), ISBN: 978-1-118-72068-4, 340 pages,December 2013, Wiley-IEEE Press
5. *Microgrids and Active Distribution Networks*, S. Chowdhury, S.P. Chowdhury and P. Crossley, The Institutionof Engineering and Technology, London, U.K, 2009.
6. Salkuti, Surender Reddy, and Ray, Papia. *Next Generation Smart Grids.* Singapore, Springer Singapore Pte.Limited, 2022.
7. Belu, Radian. *Smart Grid Fundamentals: Energy Generation, Transmission, and Distribution*. UnitedStates, CRC Press, 2022.

Course Title: **Energy Auditing and Management**
Course Code: **OEEE-202A**

L	T	P	Credits	Weekly Load
3	0	0	3	3

Course Outcomes:
After successful completion of course, the students should be able to
CO1: Acquire in-depth knowledge about the energy management and auditing.
CO2: Recognize how energy can be conserved and managed in industries.
CO3: Acquire a comprehensive idea on tariffs in Transmission & Distribution systems.
CO4: Be competent to handle the Energy auditing procedure.
CO5: Be competent to handle the Energy Management project.

CO/PO Mapping: (Strong (3) / Medium(2) / Weak(1) indicates strength of correlation):

COs	Program Outcomes (POs)/Program Special Outcome (PSO's)								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
CO1	3	-	1	1	-	2	-	2	1
CO2	3	2	2	-	3	3	1	3	2
CO3	2	-	2	-	2	3	2	3	3
CO4	3	2	2	2	2	3	-	3	2
CO5	3	3	3	-	3	3	-	2	3

Theory:

Unit	Main Topics and Course Outlines	Hour(s)
Unit-1	**Energy Audit Methodology and Instruments:** General philosophy, need of energy audit, economics of implementation of energy optimization projects, it's constraints, barriers and limitations, report-writing, preparations and presentations of energy audit reports, post monitoring of energy conservation projects, MIS, case-studies / report studies of energy audits. guidelines for writing energy audit report, data presentation in report, findings recommendations, impact of renewable energy on energy audit recommendations, Instruments for audit and monitoring energy and energy savings, types and accuracy,	12
	Energy Conservation in Electrical Installation system: Technical losses, caused and measure to reduce by controlling I^2 R losses, optimizing distribution voltage, balancing phase currents. Significance of Power Factor in energy conservation. Energy conservation equipment's: Maximum Demand controller, KVAR Controller, Automatic Power Factor controller (APFC)), automatic star delta convertor. Energy Conservation in Lighting System: Replacing Lamp Sources, using energy efficient luminaries, using light	12

	controlled gears, installation of separate servo stabilizer for lighting, periodic survey an adequate maintenance program. Energy conservation techniques in fans, electronic regulators and amorphous core transformer.	
Unit-2	**Energy Management:** Need of energy management. definition and objective of energy management, general principles of energy management, energy management skills, energy management strategy in respect of electrical power plants.	8
	Cogeneration and Tariff: Definition and scope, topping and bottoming cycles, benefits, industries suitable for cogeneration, agricultural uses of waste heat, use of power plant reject heat for wastewater treatment, integrated energy system, potential of cogeneration in India. Need of tariff, Types of Tariff structure LT and HT, Special tariffs, time off day tariff, peak off day tariff, power factor tariff, maximum demand tariff, load factor tariff and availability-based tariff. Application of tariff system to reduce energy bill.	8
	Financial Management: Investment-need, appraisal and criteria, financial analysis techniques simple payback period, return on investment, net present value, internal rate of return, cash flows, risk and sensitivity analysis; financing options, energy performance contracts and role of Energy Service Companies (ESCOs) Projects related to this course should be given to students (in groups) in order to promote team work and ethical values.	8
	Total hours =	48

Recommended Books:

1. C.L. Wadhwa, "*Generation Distribution & Utilization of Electrical Energy*", New Age international,1989.
2. G Petrecca, "*Industrial Energy Management: Principles & applications*", Kluwer Academic Publisher,1993
3. Iqbal Hussein, "*Electric and Hybrid Vehicles: Design Fundamentals*", CRC Press, 2003
4. James Larminie, John Lowry, "*Electric Vehicle Technology Explained*", 2nd Edition, Wiley, 2003.
5. Bureau of Energy Efficiency India, "*General Aspects of Energy Management and Energy Audit*", Bureau ofEnergy Efficiency India, 2015
6. Shapiro, Ian M, "*Energy audits and improvements for commercial buildings: a guide for energy managers andenergy auditors*" John Wiley & Sons, 2016.

Subject Code : **OEEE-203B**
Title of the course: **Renewable Energy Source**

L	T	P	Credits	Weekly Load
3	0	0	3	3

Course Outcomes:
After successful completion of course, the students should be able to
CO1: knowledge of India's power scenario, power system structure and related agencies.
CO2: acquire the knowledge of solar power utilization.
CO3: gain the knowledge of electric power generation from wind power.
CO4: acquire the knowledge of system of transfer of electrical power from renewable source.
CO5: **k**now the harnessing power from bio and other renewable sources.

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):									
COs	Program Outcomes (POs)/Program Special Outcome (PSO's)								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO 1	PSO 2
CO1	3	-	1	-	1	2	1	2	1
CO2	3	3	3	1	2	3	-	3	3
CO3	2	3	3	-	2	3	3	3	3
CO4	3	3	3	1	2	3	3	3	3
CO5	2	2	-	-	1	2	3	1	1

Unit	Main Topics and Course Outlines	Hour(s)
Unit-1	**Renewable Energy (RE) Sources:** Environmental consequences of fossil fuel use, importance of renewable sources of energy, sustainable design and development, types of RE sources, limitations of RE sources, present Indian and international energy scenario of conventional and RE sources.	10
	Wind Power Generation: wind surveys, basic principles of wind energy conversion, wind data and energy estimation, site selection, basic components of wind energy conversion systems (WECS), wind machines, schemes of wind power generation and control, different types of WPPs and	14
Unit-2	**Solar Power Generation:** Solar radiations, solar energy collectors; flat plate and focusing type, energy balance equation and collector efficiency, photovoltaic cells, MPPT techniques, applications of solar energy; solar pumping, solar furnace, solar cooking solar green houses	10
	Biomass Energy: Introduction-Bio mass resources –energy from bio mass: conversion process-biomass cogeneration-environmental benefits. geothermal energy: basics, direct use, geothermal electricity. mini/micro hydro power: classification of hydropower schemes, classification of water turbine, turbine	7

	Other Energy Sources: Tidal Energy: Energy from the tides, barrage and non barrage tidal power systems. wave energy: energy from waves, wave power devices. ocean thermal energy conversion (OTEC)- hydrogen production and storage- fuel cell: principle of working- various types – construction and applications. energy storage system- hybrid energy systems. Projects related to this course should be given to students(in groups) in order to promote team	7
	Total hours	48

Recommended Books:

1. A. Chakrabarti, M. L. Soni, P. V. Gupta and Bhatnagar U. S., Power System Engineering, Dhanpat Rai & Co. Pvt Ltd, 2009.
2. B. R. Gupta, Generation of Electrical Energy, S. Chand Publishing, New Delhi, 2011
3. C. A. Simon, Alternate Source of Energy, Rowman and Little Field Publishers Inc., 2007.
4. G.D. Rai, Non-Conventional Energy Sources, Khanna Publishers, 2005.
5. S. Rao and B.B. Parulekar, Energy Technology: Non-Conventional, Renewable and Conventional, Khanna Publishers, 2005.
6. V.A. Venikov and E.V. Putyain, Introduction to Energy Technology, Mir Publishers, 1990.
7. Tiwari, Gopal Nath, and Kumar Mishra, Rajeev. Advanced Renewable Energy Sources. United Kingdom, Royal Society of Chemistry, 2015.
8. Nadeem, Farwa, et al. Renewable and Alternative Energy Resources. Netherlands, Elsevier Science, 2021.

Course Title: **Electrical Engineering Materials**
Course Code: **OEEE-301A**

L	T	P	Credits	Weekly Load
3	0	0	3	3

Course Outcomes:

After successful completion of course, the students should be able to
CO1: Develop understanding of classification of materials according to their atomic structure.
CO2: Learn features of conducting materials along with important terminologies.
CO3: Understand insulating materials and their properties.
CO4: Identify magnetic materials and categorize them.
CO5: Be conversant in semiconductor materials and special purpose materials.

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):									
Cos	Programme Outcomes (POs)								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
CO1	3	-	2	-	-	1	3	3	2
CO2	2	1	-	3	3	-	3	-	3
CO3	-	-	2	-	2	1	2	3	-
CO4	-	1	-	3	-	-	-	-	-
CO5	1	-	3	-	1	3	1	2	2

Theory:

Unit	Main Topics	Course Outlines	Hour (s)
Unit-1	**Classification**	Classification of materials into conducting, semiconducting and insulating materials with reference to their atomic structure and energy bands.	6
	Conducting materials:	Conducting Materials: Resistivity and factors affecting resistivity, such as temperature, alloying. Super conductivity and super conducting material. Low resistivity materials e.g. copper, aluminum and steel, their general properties as conductor e.g. resistivity, temperature co-efficient, mechanical properties, corrosion, solar ability, contact resistance and practical application. High resistivity materials: manganin, carbon, tungsten, their practical applications.	9

	Insulating Materials	Properties of insulating material: - Electrical properties, Mechanical properties, Physical properties, Thermal properties, Chemical properties, insulating materials and their application-Definition and classification of Thermo setting materials e.g. Phenol Formaldehyde, Resins (i.e. Bakelite), Thermo Plastic materials e.g. Polyvinyl Chloride (P.V.C.), Natural Insulating Materials- Mica and Asbestos, Gaseous Materials e.g. Air, Hydrogen and SF6.	9
Unit - 2	**Magnetic Materials:**	B-H curve of magnetic materials, Classification of magnetic materials into soft and hard magnetic materials. Soft magnetic materials - high silicon alloy steel for transformers and low silicon alloy steel, for electric rotating machine cold rolled grain oriented and non-oriented steel, Nickel iron alloy, soft ferrites, their properties and uses. Hard magnetic materials - tungsten steel, chrome steel, cobalt steel, hard ferrites, their properties and applications.	8
	Semiconductor Materials	Introduction, semiconductor and their applications, Different semiconductor materials used in manufacturing various semiconductors (Si and Ge), Material used for electronic components like resister, capacitor, diode, transistors and inductors.	8
	Special Purpose Materials:	Thermocouple, bimetals, lead soldering and fuses material, mention their applications, Introduction of various engineering materials necessary for fabrication of electrical machines such as motors, generators, transformers etc.	8
		Total hours =	48

Recommended Books-

1. A. J. Dekker, *Electrical Engineering materials*
2. G. P. Chhalotra, *Electrical Engineering Materials*
3. S. P. Seth and P.V. Gupta., *Electrical Engineering materials*
4. Martinez-Vega, Juan, ed. *Dielectric materials for electrical engineering.* John Wiley & Sons, 2013.

Course Title: **Energy Conservation Practice**
Course Code: **OEEE-301B**

L	T	P	Credits	Weekly Load
3	0	0	3	3

Course Outcomes:

After successful completion of course, the students should be able to
CO1: Understand the basic concept of energy conservation, energy audit and their need.
CO2: Acquire knowledge of energy conversation in transmission, distribution system and minimizationof losses
CO3: Learn the idea of tariff, energy conversation in industries and their relation.
CO4: Be conversant with relation between energy, environment and society, its importance.
CO5: Understand the procedure of energy audit, related rules and Electricity act 2003.

CO/PO Mapping : (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):									
Cos	Programme Outcomes (POs)								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
CO1	3	3	-	3	3	2	2	2	3
CO2	3	-	3	-	-	2	-	2	-
CO3	2	-	-	-	-	3	-	-	2
CO4	2	-	-	-	1	3	3	3	2
CO5	-	-	3	1	2	-	-	1	-

Theory:

Unit	Main Topics	Course Outlines	Hour (s)
Unit-1	**Basics of Energy Conservation**	Review of various energy sources, Need of energy conservation and energy audit; Lighting energy: methods/Techniques of efficient lighting, Heating: methods/Techniques of energy Saving in Furnaces, Ovens and Boilers; Cooling: Methods/ Techniques of Energy Saving in Ventilating systems and Air Conditioners; Motive power, Energy Efficient Motors, and Efficient use of energy in motors with the help of voltage reducers, automatic star/delta converters; Power factor improvement devices and soft starters/Variable Frequency Drives; Amorphous Core Transformers; Cogeneration -Types and Advantages	16
	Energy Conservation In Transmission and Distribution	Reactive power compensation, demand side management, system voltage optimization and phase current balancing, Losses in transmission and distribution system and its minimization	08

	Systems		
Unit - 2	**Tariff and Energy Conservation in Industries**	Energy cost and Recent Electricity Board tariffs, Application of Tariff System to reduce Energy bill, Energy Conservation by improving load factor and power factor;	06
	Energy and the Environment	Environment and social concerns related to energy utilization, The greenhouse effect, Global Warming and its effect, Pollution, Acid Rains, Global Energy and environment Management	06
	Energy Audit	Procedure of Energy audit, Activity based costing (ABC) analysis, Energy Flow Diagram and its importance, Measurements in energy audit and various measuring instruments, Questionnaires for the energy audit, internal energy audit checklist, Equipment used for energy conservation, Calculation of payback period for energy conservation equipment. Indian Electricity (IE) rules and regulations for energy audit, Electricity act 2003	12
		Total hours	48

Recommended Books-

1. C. L. Wadhawa, *Generation Distribution and Utilization of Electrical Energy*, New Age
2. G. Petrecca, *Industrial Energy Management: Principles and applications*, Kluwer AcademicPublisher
3. Patrick, Dale R., Stephen W. Fardo, Ray E. Richardson, and Brian W. Fardo. *Energy conservation guidebook*. River Publishers, 2020.
4. Shinskey, Francis. *Energy conservation through control*. Elsevier, 2012.

Course Title: **Electric Vehicles Technology**
Course Code: **OEEE-302A**

L	T	P	Credits	Weekly Load
3	0	0	3	3

Course Outcomes:

After successful completion of course, the students should be able to

CO1: Understand the models to describe hybrid vehicles and their performance.
CO2: Identify the different possible ways of energy storage.
CO3: Knowledge of basics of electric train
CO4: Understand the different strategies related to energy storage systems.
CO5: Learn the different strategies related to energy management systems.

CO/PO Mapping: (Strong (3) / Medium (2) / Weak (1) indicates strength of correlation):

COs	Program Outcomes (POs)/Program Special Outcome (PSO's)								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
CO1	3	3	-	-	2	2	1	2	2
CO2	2	-	2	-	2	2	2	2	2
CO3	-	3	2	1	2	2	2	3	2
CO4	1	-	1	1	-	2	-	2	1
CO5	3	2	2	-	3	3	1	3	2

Theory:

Unit	Main Topics and Course Outlines	Hour(s)
Unit-1	**Introduction:** Conventional vehicles: basics of vehicle performance, vehicle power source characterization, transmission characteristics, mathematical models to describe vehicle performance. Introduction to hybrid electric vehicles: history of hybrid and electric vehicles, social and environmental importance of hybrid and electric vehicles, impact of modern drivetrains on energy supplies. Hybrid electric drivetrains: basic concept of hybrid traction, introduction to various hybrid drive-train topologies, power flow control in hybrid drive-train topologies, fuel efficiency analysis.	12
	Electric Trains: Electric drivetrains: basic concept of electric traction, introduction to various electric drive train topologies, power flow control in electric drive-train topologies, fuel efficiency analysis. Electric propulsion unit: introduction to electric components used in hybrid and electric vehicles, configuration and control of dc motor drives, configuration and control of induction motor drives, configuration and control of permanent magnet motor drives, configuration and control of switch reluctance motor drives, drive system efficiency.	12

Unit-2	**Energy Storage:** Energy storage: introduction to energy storage requirements in hybrid and electric vehicles, battery-based energy storage and its analysis, fuel cell-based energy storage and its analysis, super capacitor based energy storage and its analysis, flywheel based energy storage and its analysis, hybridization of different energy storage devices. sizing the drive system: matching the electric machine and the internal combustion engine (ICE), sizing the propulsion motor, sizing the power electronics, selecting the energy storage technology, communications, supporting subsystems	12
	Energy Management Strategies: Energy management strategies: introduction to energy management strategies used in hybrid and electric vehicles, classification of different energy management strategies, comparison of different energy management strategies, implementation issues of energy management strategies. case studies: design of a hybrid electric vehicle (HEV), design of a battery electric vehicle (BEV). Projects related to this course should be given to students (in groups) in order to promote teamwork and ethical values.	12
	Total hours	48

Recommended Books:

1. C. Mi, M. A. Masrur and D. W. Gao, *"Hybrid Electric Vehicles: Principles and Applications with Practical perspectives"*, John Wiley & Sons, 2011.
2. S. Onori, L. Serrao and G. Rizzoni, *"Hybrid Electric Vehicles: Energy Management Strategies"*, Springer, 2015.
3. M. Ehsani, Y. Gao, S. E. Gay and A. Emadi, *"Modern Electric, Hybrid Electric, and Fuel Cell Vehicles:Fundamentals, Theory, and Design"*, CRC Press, 2004.
4. T. Denton, *"Electric and Hybrid Vehicles"*, Routledge.
5. K T Chau, *" Emerging Technologies for Electric and Hybrid Vehicles"*, 2018

Course Title: **Electrical Safety and Applications**
Course Code: **OEEE-302B**

L	T	P	Credits	Weekly Load
3	0	0	3	3

Course Outcomes:
After successful completion of course, the students should be able to
CO1. Describe electrical hazards and protection equipments
CO2. Analyze and apply various grounding and bonding techniques.
CO3..Understand Power Safety measures
CO4. Participate in a safety team.
CO5. Carry out proper maintenance of electrical equipment by understanding various standards.

CO/PO Mapping: (Strong (3) / Medium(2) / Weak(1) indicates strength of correlation):

COs	Program Outcomes (POs)								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
CO1	3	-	2	-	3	3	-	3	3
CO2	2	3	3	3	3	3	1	-	2
CO3	3	2	3	2	3	3	-	2	3
CO4	3	-	2	-	-	2	-	2	-
CO5	3	3	3	3	3	2	-	2	3

Theory:

Unit	Main Topics and Course Outlines	Hour(s)
Unit-1	**Electrical Hazards:** Electrostatic, Electromagnetism, Energy leakage, Clearance and creepage, insulation breakdown, Current surges –	6
	Electrical causes of fire and explosion – Human resistance to electricity Primary and secondary hazards- Shocks, Flashover, arc flash, arc blast,	6
	Electrical Protection and Maintenance: safety equipment- flash and thermal protection, head and eye protection- rubber insulating equipment, hot sticks, insulated tools, barriers and signs, safety tags, locking devices- voltage measuring instruments- proximity and contact testers-safety electrical one line diagram- electrician's safety kit.	6
	Grounding and Bounding Safety Measure: General requirements for grounding and bonding, Purpose of System grounding, equipment grounding, grounding electrode system, grounding conductor	6
Unit – 2	**Power System Operation Safety Measure:** The six step safety methods- pre job briefings - hot-work decision tree-safe switching of power system- lockout tag out approach distances- the one-minute safety audit.	6

	Company Safety Structure: Electrical safety Program company safety team- safety policy Program implementation- - safety audit accident prevention- first aid- rescue techniques-accident investigation	8
	Standards and Requirements: reliability centered maintenance (RCM) - eight step maintenance Program frequency of maintenance- regulatory bodies- national electrical safety code- Indian Electricity Acts related to Electrical Safety	10
	Total hours	48

Recommended Books-

1. John Cadick, Mary Capelli-Schellpfeffer, Dennis Neitzel, Al Winfield, "*Electrical Safety Handbook*", McGraw-Hill Education, 4thEdition, 2012.
2. Maxwell Adams.J, "*Electrical Safety- a guide to the causes and prevention of electric hazards*", The Institutionof Electric Engineers, IET 1994.
3. Ray A. Jones, Jane G. Jones, "*Electrical Safety in the Workplace*", Jones & Bartlett Learning, 2000.
4. S. Rao, R. K. Jain and H. L. Saluja, "*Electrical Safety, Fire Safety Engineering and Safety Management*"Khanna Publishers,1997.
5. J. Maxwell Adams, "*Electrical Safety a guide to the causes and prevention of electrical hazards*" The Institutionof Electrical Engineers, London, U K,2004.
6. El-Sharkawi, Mohamed A, "*Electric safety: practice and standards*", CRC Press, 2014

Subject Code : QPEE-101
Title of the course : Junior Mechanic Electrical/Electronics/ Instruments (Module-1)

L	T	P	Credits	Weekly Load
0	0	8	1	08

Course Outcomes (COs):
After successful completion of the course, the students should be able to

CO1: Discuss the fundamentals of electrical, electronic, and instrumentation engineering.
CO2: Demonstrate the procedure to efficiently use the measuring instruments and tools.
CO3: Analyze the circuit diagrams and engineering drawings of electrical, electronic, and instrumentation systems.
CO4: Implement the knowledge to diagnose the faults in various types of machines and equipments.
CO5: Demonstrate the appropriate tools and methodology to fix the faults.

CO/PO Mapping: (Strong (3) / Medium (2) / Weak (1) indicates strength of correlation)									
COs	**Program Outcomes (POs)/Program Specific Outcome (PSO's)**								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
CO1	1	2	-	-	2	2	-	-	-
CO2	-	2	3	-	-	2	3	-	2
CO3	3	-	-	2	3	2	-	3	2
CO4	-	2	2	3	-	-	2	-	-
CO5	3	2	3	3	2	2	2	2	3

Topics	Hands-on Practicals	Hour(s)
Basics of electricity	Familiarization with tools used in Electrical works	32
	Electrical safety precautions	
	Make connections and joints, like T, straight, and Britannia	
	Active and passive components and their connections in electrical circuits	
	Electrical wiring practices (House wiring)	
	Distribution of electrical energy in a domestic electrical installation	
Measurement	Resistance (very low to very high) measurement methods	24
	Measurement of various characteristic values of a Sinusoidal waveform with the	

	help of Cathode Ray Oscilloscope	
	Use of multi-meter for measuring Ac/DC voltage and current	
	Connecting appropriate instruments at the supply of an installation to measure supply voltage, frequency, power, maximum demand, Phase sequence and energy consumed	
Basic Laws	Verification of equivalent resistances in series and parallel connections	24
	Verification of Ohm's Law, Kirchoff's laws (KCL and KVL).	
Safety Measures	Study of various types of earthings and grounding.	24
	Study of various types of protection devices e.g. fuses, MCBs and ELCBs	
Electric Machines	Study of various types of DC motors and their starters	24
	Study of various types of AC motors and their starters	
	Study of various types of transformers and Verification of turns ratio	
	Total hours	128

Subject Code : QPEE-102

Title of the course : Junior Mechanic Electrical/Electronics/ Instruments (Module-2)

L	T	P	Credits	Weekly Load
0	0	8	1	08

Course Outcomes (COs):

After successful completion of the course, the students should be able to

CO1: To acquire the knowledge about circuit defects.
CO2: Learn about the tools for maintenance.
CO3: Understanding about the safety rules and protocols.
CO4: To apply knowledge for maintenance of equipment's and protection devices.
CO5: Apply the acquired knowledge for testing of various machines.

CO/PO Mapping: (Strong (3) / Medium (2) / Weak (1) indicates strength of correlation)									
COs	**Program Outcomes (POs)/Program Specific Outcome (PSO's)**								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
CO1	-	2	-	3	2	-	2	3	2
CO2	2	-	3	3	-	2	-	3	-
CO3	-	2	-	2	3	2	3	-	2
CO4	1	-	-	-	3	-	2	2	3
CO5	-	2	3	3	2	2	2	-	3

Topics	Hands-on Practical's	Hour(s)
Basics of various faults	Familiarization with tools used in Electrical maintenance	28
	Electrical safety precautions	
	Components and their connections in electrical circuits	
	Specifications and grades of lubricants	
Tools for maintenance	Measurement methods of electrical circuits	28
	Methods to lay the removed components out in a logical sequence to aid re-assembly	
	Use of multi-meter for measuring various parameters	
	Usage of tools and equipment to minimize & reduce any risk	
Safety Rules	Understand the various parameters of the safety rules	28

	Understand the various risk management protocols	
Protection Devices	Maintenance of the electrical equipment's.	24
	Study of various types of protection devices and their connections	
Testing of Electric Machines	Various performance test of the DC Motors	20
	Various performance tests of Induction motors	
	Various performance tests of transformers	
	Total hours	128

Subject Code : QPEE-103

Title of the course : Junior Mechanic Electrical/ Electronics/ Instruments (Module-3)

L	T	P	Credits	Weekly Load
0	0	24	3	24

Course Outcomes (COs):

After successful completion of the course, the students should be able to

CO1: To assist in inspecting and testing electrical systems and equipment.
CO2: Learn about the tools, spare parts, equipment and supplies for repair work.
CO3: Understanding about the installing new fuses, electrical cables, or power sources.
CO4: To apply knowledge for remove or repair circuit defects.
CO5: Apply the acquired knowledge for handle and dispose waste based on environmental guidelines.

CO/PO Mapping: (Strong (3) / Medium (2) / Weak (1) indicates strength of correlation)									
COs	**Program Outcomes (POs)/Program Specific Outcome (PSO's)**								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
CO1	-	2	-	3	2	-	2	3	2
CO2	2	-	3	3	-	2	-	3	-
CO3	-	2	-	2	3	2	3	-	2
CO4	1	-	-	-	3	-	2	2	3
CO5	-	2	3	3	2	2	2	-	3

Topics	**Hands-on Practical's**	**Hour(s)**
Basics of manufacturer's components	Identification of Electrical/ Electronics/ Instrumentation parts in use. i.e.: Energy meter, MCB, Fuses, Relays, etc. • Familiarization of Active and Passive elements.	32
	Components of Electrical/ Electronics/ Instrumentation systems. i.e.: Moving iron, PMMC instruments, electro dynamo type meters, etc.	
	Study of Common symbols used in Electrical/ Electronics/ Instrumentation circuit diagrams. • Fluorescent tube light connection. • House wiring. • Godown and stair case wiring, etc. • Single and double switch connections.	
	Techniques to read and interpret Electrical/ Electronics/ Instrumentation circuit diagrams.	

	• Resistance color coding (3/4 band)	
Power Sources	Identification of different types of power sources. Familiarization of batteries. (Lead acid, Li Ion, NiCd etc.)	28
	Methods to maintain and safely charge different battery types.	
	Measure and document voltage before and after charging.	
	Safely connect and charge lead-acid and lithium-ion batteries.	
Safety Devices	Understanding the usage of safety devices, e.g. circuit protection, fuses, MCB, safety switches, etc.	28
	Wiring of power distribution arrangement using single phase MCB distribution board with ELCB, main switch and Energy meter.	
	Understand the usage of the control panel. Operate a control panel to power on/off a system.	
Troubleshooting	Understand the techniques used to diagnose the faults through visual inspection. • Geyser, electric iron • 1-phase fan etc.	24
	Methods to remove components from Electrical/Electronic system without damage to the components or surrounding structure.	
	Calibration of voltmeter and ammeter using DC potentiometer.	
	Component removal and reassemble the system and verify functionality.	
Cleanliness and Safety	Techniques to Clean/service different electrical/electronic/instrumentation parts.	32
	Clean contacts, connectors, and other parts using proper tools.	
	Spot potential risks during fault diagnosis.	
	Methods to check that the tools and equipment to be used are correctly calibrated, and are in a safe, tested and serviceable condition.	
	Usage of tools and equipment to minimize & reduce any risk.	
	Total hours	144

Subject Code : QPEE-201
Title of the course : Electrical Repair and Maintenance Technician (Industrial and Home Appliances) (Module-1)

L	T	P	Credits	Weekly Load
0	0	8	1	8

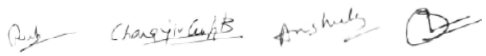
Course Outcomes (COs):
After successful completion of the course, the students should be able to

CO1: Discuss the use of personal protective equipment.
CO2: Identification to various protective devices.
CO3: Analyze the circuit diagrams of electrical instrumentation systems.
CO4: Implement the knowledge to repair and maintenance of the electrical equipment's.
CO5: Demonstrate the various quality checks and troubleshooting in wiring systems.

CO/PO Mapping: (Strong (3) / Medium (2) / Weak (1) indicates strength of correlation)									
COs	**Program Outcomes (POs)/Program Specific Outcome (PSO's)**								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
CO1	-	3	3	-	2	3	2	-	-
CO2	2	-	2	-	2	2	-	-	2
CO3	3	2	3	2	-	3	2	2	-
CO4	-	3	-	-	2	-	2	2	-
CO5	3	3	3	2	2	3	2	-	3

Topics	Hands-on Practicals	Hour(s)
Safety Signs, Symbols and Regulations	Identify safety signs and symbols associated with electrical hazards	20
	Identify and interpret safety and other regulatory requirements	
	Scale reading of the instruments. Use of multimeters, ammeters, voltmeters, and other diagnostic equipment to test and measure electrical parameters.	
Electrical Tools and Safety Precaution	Proper use of electrical tools, safety procedures, and compliance with electrical codes (such as NEC). Identify the uses of equipment with frayed cords and identify working area. Handling high power supply while working with electrical equipment's	16

Electrical Protective Equipment	Demonstration uses of Personal Protective Equipment (PPE's) equipment's, Maintain and/ or replace tool insulation, Describe electrical hazards and apply the protection procedures for electrical requirements. Rating of the electrical Protective Equipment's	20
Wiring System and Installation	Types of wiring and wiring accessories, Training in residential, commercial, and industrial wiring, including installation techniques for electrical systems like lighting, motors, and control systems etc. Protection of wiring System	20
Troubleshooting and Repair	Diagnosing faults in electrical equipment and systems, and repairing or replacing faulty components. Use of Circuit Breaker. Study of AC and DC motors, transformers, and their applications in electrical systems. Use of inverters and converters	20
	Total hours	128



Subject Code : QPEE-202

Title of the course : Electrical Repair and Maintenance Technician (Industrial and Home Appliances) (Module-2)

L	T	P	Credits	Weekly Load
0	0	8	1	08

Course Outcomes (COs):

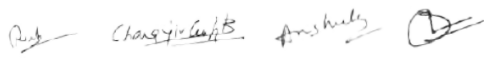
After successful completion of the course, the students should be able to

CO1: Explain various methods of jointing and soldering of wires and cables.
CO2: Identification to various electrical circuits and their installation procedure.
CO3: Demonstrate the various quality checks and troubleshooting in wiring systems.
CO4: Identification of the various faults findings techniques.
CO5: Implement the knowledge to repair and maintenance of the electrical equipment's.

CO/PO Mapping: (Strong (3) / Medium (2) / Weak (1) indicates strength of correlation)									
COs	**Program Outcomes (POs)/Program Specific Outcome (PSO's)**								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
CO1	-	3	3	-	2	3	3	3	-
CO2	2	-	2	-	2	2	3	-	2
CO3	3	2	3	2	2	-	3	2	3
CO4	2	-	3	-	2	2	2	-	3
CO5	3	3	3	2	2	3	2	2	-

Topics	Hands-on Practicals	Hour(s)
Jointing and Soldering of Wire and Cable	Making various types of joints	8
	Soldering of wire	6
	Desoldering of components	6
	Cutting of wire and Heating of cable	6
Electrical Circuit and Installation	Check loose connection of basic circuit making	6
	Demonstrate Layout plan for installation of basic circuits	8

	Installation of energy meter	8
	Installation of 3-phase circuits	8
Testing and Troubleshooting	Demonstrate the procedure of testing of equipment's by visual inspection	8
	Domestic Wiring Testing method	8
Remove Faults	Demonstrate the reason of short circuit and leakage current	8
	Identify the fault-finding techniques and testing procedures	8
Repairing of Electrical Equipment's	Repairing of the Electric Iron	8
	Repairing of the Electric Fan	12
	Repairing of the other basic electrical equipment's	20
	Total hours	128



Subject Code : QPEE-201
Title of the course : Solar PV Installer - Electrical (Module-1)

L	T	P	Credits	Weekly Load
0	0	8	1	08

Course Outcomes (COs):
After successful completion of the course, the students should be able to

CO1: Discuss the basics of solar energy and its terminology.
CO2: Understand the basics of the solar photovoltaic systems.
CO3: Identification and the use of different tools used for installation of solar PV system.
CO4: Implement the knowledge of site survey for installation of solar PV system.
CO5: Demonstrate the installation of various electrical component of the solar. PV systems.

CO/PO Mapping: (Strong (3) / Medium (2) / Weak (1) indicates strength of correlation)									
COs	**Program Outcomes (POs)/Program Specific Outcome (PSO's)**								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
CO1	3	-	3	-	-	3	-	3	3
CO2	-	3	-	2	3	-	-	-	3
CO3	3	-	-	2	-	3	2	3	-
CO4	-	3	-	-	3	3	-	-	3
CO5	3	-	2	3	-	3	2	2	3

Topics	Hands-on Practicals	Hour(s)
Basics of Solar Energy	Understand basics of electricity and electrical concepts	8
	Perform basic calculations to derive power and energy	12
	Understand the movement of sun and its effect	12
	Understand terminology used in the solar industry	12
Solar Photovolatic Systems	Components of Solar PV system and its basic operation	12
	Types of different types of modules	12
	Specifications of the various modules of the solar accessories	12
	Types of solar batteries and allied accessories	12

Tools Used for the Installation of the Solar PV System	Demonstration of the installation of the solar PV systems	12
	Different tools to handle during installation	8
Site Survey for Installation of solar PV system	Understand sun path diagram and shading analysis	8
	Understand and assess the site conditions	8
Prepare Load Profile	Identify the load to be connected to the solar PV system	8
	Calculation of the basic requirement and budget constraints	12
	Calculate the size of the system with mathematical tools	12
	Total hours	160

Subject Code : QPEE-202
Title of the course : Solar PV Installer – Electrical (Module-2)

L	T	P	Credits	Weekly Load
0	0	8	1	08

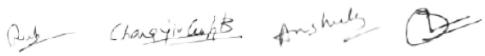
Course Outcomes (COs):
After successful completion of the course, the students should be able to

CO1: Discuss the basics of installation of electrical components of solar PV systems.
CO2: Understand the basics of the testing of solar photovoltaic systems.
CO3: Identification and the use of different tools used for installation of solar PV system.
CO4: Implement the knowledge of basics of safety rules for installation of solar PV system.
CO5: Demonstrate the installation of various electrical component of the solar. PV systems.

CO/PO Mapping: (Strong (3) / Medium (2) / Weak (1) indicates strength of correlation)									
COs	**Program Outcomes (POs)/Program Specific Outcome (PSO's)**								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
CO1	3	2	3	1	-	3	-	3	1
CO2	2	3	-	-	3	2	2	-	3
CO3	-	2	-	2	3	-	2	1	2
CO4	-	3	-	-	-	3	-	-	-
CO5	3	2	2	3	3	3	2	2	3

Topics	Hands-on Practicals	Hour(s)
Installation of the Electrical components	Read and Interpret the Single Line Diagram, Layout Diagrams.	12
	Understand the DO's and Don'ts of material handling	8
	Understand the installing of the electrical components including inverter, batteries, junction boxes, energy meters and other electrical components	8
	Demonstration of installation of cables and conduits	8
Tools & tackles used for cable and conduit installation	Understand different types of Earthing and its installation	8
	Understand and identify significance and types of earth faults as per standards	8

	Understand regulations & Standards for interconnection	8
	Demonstration of the tool kit	8
Testing of Solar components	Fault finding and analysis including continuity checks, polarity check and other commissioning activities	8
	Handling of the various tools for installation	8
Safety at Project Site	Identify the requirements for safe work area	8
	Basics of first aid	8
Hazards associated with photovoltaic installation	Identify work safety procedures and instructions for working at height	8
	Understand Occupational health & Safety standards and regulations for installation of Solar PV system	12
	Identify the personal protective equipment	8
	Total hours	128



Subject Code : QPEE-301
Title of the course : Foreman Electrical Works (Module-1)

L	T	P	Credits	Weekly Load
0	0	8	1	08

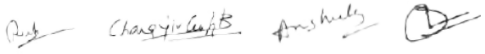
Course Outcomes (COs):
After successful completion of the course, the students should be able to

CO1: Discuss the efficiency of cable routing techniques.
CO2: Identification the impact of the load balancing on electrical circuits.
CO3: Analyze the various safety protocols for electrical installations.
CO4: Implement the impact of environmental conditions on the electrical installations.
CO5: Understand the various wired and wireless systems and calculation of energy consumption.

CO/PO Mapping: (Strong (3) / Medium (2) / Weak (1) indicates strength of correlation)									
COs	**Program Outcomes (POs)/Program Specific Outcome (PSO's)**								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
CO1	3	-	3	2	-	-	-	3	-
CO2	-	3	-	3	-	2	3	3	-
CO3	3	2	3	-	-	3	-	-	3
CO4	-	3	3	3	3	-	3	-	3
CO5	3	3	-	2	3	3	3	-	3

Topics	Hands-on Practicals	Hour(s)
Cable routing methods	Understand the traditional cable routing methods	16
	Demonstrate the automated cable routing methods	
	Demonstrate the methods for better time and resource efficiency	
	Understand the basics of the cable routing methods	
Load Balancing on Electrical Circuits	Understand the basics of load balancing	16
	Understand the impact of the load balancing	
	Investigate the impact of the load balancing on stability	

	Investigate the impact of the load balancing on performance	
Safety Protocols Adherence	Understand the various safety protocols	20
	Analyze the effectiveness of various safety protocols in reducing workplace accidents during electrical installations.	
Impact of Environmental Conditions on Electrical Installations	Examine how different environmental conditions (humidity, temperature, dust) affect the performance and longevity of electrical systems	20
	Understand various methods to handle the environmental conditions	
Energy Consumption of Various Lighting Systems	Compare the energy efficiency of LED, fluorescent, and incandescent lighting systems in a construction setting	20
	Understand the circuit diagram for the lighting systems	
	Calculation of the power ratings of the various lighting systems	
Wireless vs. Wired Control Systems	Evaluate the reliability, installation time, and maintenance costs of wireless control systems.	20
	Evaluate the reliability, installation time, and maintenance costs of wired systems.	
	Difference between wired and wireless control systems	
Efficiency of Different Grounding Techniques	Test various grounding techniques for their effectiveness in ensuring electrical safety and system reliability	16
	Various Electrical Safety and system reliability	
	Various protocols for the system protocols	
	Total hours	128



Subject Code : QPEE-302
Title of the course : Foreman Electrical Works (Module-2)

L	T	P	Credits	Weekly Load
0	0	8	1	08

Course Outcomes (COs):
After successful completion of the course, the students should be able to

CO1: Discuss the various tools for electrical faults.
CO2: Identification of the various battery backup systems.
CO3: Analyze the impact of electrical noise on construction equipment.
CO4: Implement the integration of renewable energy sources and electrical supply chains.
CO5: Understand the various emerging technologies of automation for electrical foreman.

CO/PO Mapping: (Strong (3) / Medium (2) / Weak (1) indicates strength of correlation)									
COs	**Program Outcomes (POs)/Program Specific Outcome (PSO's)**								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
CO1	3	-	-	2	-	3	2	-	2
CO2	-	3	2	3	-	2	-	3	2
CO3	3	2	-	2	3	3	-	-	-
CO4	-	-	3	-	3	-	3	-	3
CO5	3	3	3	2	3	-	-	2	-

Topics	Hands-on Practicals	Hour(s)
Tools for Electrical Faults	Understand the various electrical faults	20
	Assess the accuracy and efficiency of advanced diagnostic tools (e.g., thermal imaging cameras, smart sensors) in detecting electrical faults.	
	Handling of the various diagnostic tools	
	Introduction to smart sensors	
Battery Backup Systems	Evaluate the performance of various battery backup systems under different load conditions.	20
	Evaluate the reliability of various battery backup systems under different load conditions.	
	Understand various battery backup systems	

	Maintenance of the battery backup systems	
Impact of Electrical Noise	Investigate the effects of electrical noise on the performance of sensitive construction equipment	16
	Investigate the effects of electrical noise on the lifespan of sensitive construction equipment	
Integration of Renewable Energy Sources:	Test the feasibility of integrating renewable energy sources (solar panels, wind turbines) into construction site electrical systems	16
	Test the feasibility of integrating renewable energy sources (solar panels, wind turbines) into construction site electrical systems	
Optimization of Electrical Supply Chains	Understanding of electrical supply chains	16
	Analyze the impact of optimized supply chain management on the cost.	
	Availability of electrical materials and components	
Smart Grid Technologies	Understanding the smart grid technologies	16
	Evaluate the benefits of implementing smart grid technologies in construction sites for improved energy management	
	Evaluate the challenges of implementing smart grid technologies in construction sites for improved energy management	
Technological Advancements on Foreman Roles	Understanding the emerging technologies (IoT, AI, automation) for electrical foremen in construction	24
	Total hours	128

Subject Code : QPEE-301
Title of the course : Electrical Design Developer (Module-1)

L	T	P	Credits	Weekly Load
0	0	8	1	08

Course Outcomes (COs):
After successful completion of the course, the students should be able to

CO1: Understand the basics of power systems.
CO2: Identification of the various component's symbols and electrical drawings.
CO3: Analyze the various electrical equipment selection sizing and protections.
CO4: Analyze the datasheets of the various electrical equipment's.
CO5: Understand the different ways of cables selection, sizing and cable routing.

CO/PO Mapping: (Strong (3) / Medium (2) / Weak (1) indicates strength of correlation)									
COs	**Program Outcomes (POs)/Program Specific Outcome (PSO's)**								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
CO1	3	-	3	-	-	3	2	3	2
CO2	-	3	-	3	3	2	-	-	2
CO3	-	2	3	-	-	3	3	2	3
CO4	2	-	3	3	3	2	-	-	-
CO5	3	3	-	2	3	3	3	2	3

Topics	Hands-on Practicals	Hour(s)
Introduction to Basics of Power Systems	Various forms of energy and energy conversion	4
	Renewable Power Sources	8
	Overview of codes and standards	8
	Environmental and design considerations	4
Electrical Drawings	Introduction to Single line and three-line diagrams	6
	Cabling and Wiring diagrams	8
	Layout design for various lighting applications	8
	Earthing layout design	8
Electrical Equipment Protections	Selection of Electrical equipment's	8
	Data sheet for the various electrical equipment's	8
Cables Selection and Routing	Voltage drop consideration	8

	Cable routing layout	8
Plant Illumination Design	Lighting Layout Design	8
	Indoor illumination calculation	8
	Energy Efficiency concepts	8
Software for Designing	Calculations on software	8
	Layout for the design of electrical equipment's.	8
	Total hours	128

Subject Code : QPEE-302
Title of the course : Electrical Design Developer (Module-2)

L	T	P	Credits	Weekly Load
0	0	8	1	08

Course Outcomes (COs):

After successful completion of the course, the students should be able to

CO1: Understand the fundamentals of plant earthing design.
CO2: Identification of the various methods for the surge protection.
CO3: Understand the basics of the types of protection for hazardous areas.
CO4: Analyze the design of the substation.
CO5: Understand the layout of various substation and its equipment.

CO/PO Mapping: (Strong (3) / Medium (2) / Weak (1) indicates strength of correlation)									
COs	**Program Outcomes (POs)/Program Specific Outcome (PSO's)**								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
CO1	-	3	-	2	-	3	-	3	-
CO2	2	-	2	-	3	-	3	-	2
CO3	-	2	3	2	-	3	3	2	-
CO4	2	-	3	3	-	2	-	-	3
CO5	3	3	-	-	3	3	3	-	3

Topics	Hands-on Practicals	Hour(s)
Plant Lighting & Illumination Design	Lighting layout design	8
	Lighting Installation Design	8
	Indoor Illumination calculation	8
	Outdoor Illumination Calculation	8
Electrical Drawings	Earthing Design Calculations	8
	Earthing Installation Details	8
	Lighting Layout Design	8
Surge Protection	Surges: Types and methods of coupling	12
	Protection of electrical components against surges	12
Substation Layout	Substation Layout and its equipment	16
Short Circuit Analysis	Fault calculation, Harmonics Study, Load flow analysis	16
Software for Designing	Calculations and design using software	16
	Total hours	128