SHRI VENKATESHWARA UNIVERSITY

Syllabus

Diploma

(Electrical Engineering)

III SEMESTER

(THREE Years Programme)

(w.e.f. 2019-20)

SCHOOL OF ENGINEERING & TECHNOLOGY

SEMESTER- III

ELECTRICAL ENGINEERING- III[rd] SEMESTER													
Sl. No.	**Subject Codes**	**Subject**	**Periods**			**Evaluation Scheme**				**End Semester**		**Total**	**Credit**
			L	**T**	**P**	**CT**	**TA**	**Total**	**PS**	**TE**	**PE**		
1	**PEE - 301**	Introduction to Electric Generation Systems	3	0	0	20	10	30		70		100	3
	PEE-302	Electrical Circuits	2	1	0	20	10	30		70		100	3
3	**PEE-303**	Electrical and Electronic Measurements	2	1	0	20	10	30		70		100	3
4	**PEE - 304**	Electric Motors and Transformers	2	1	0	20	10	30		70		100	3
5	**PEE-305**	Renewable Energy Power Plants	**3**	**0**	**0**	20	10	30		70		100	**3**
6	**PEE -311**	Introduction to Electric Generation Systems Lab	0	0	2				10		15	25	1
7	**PEE -312**	Electrical Circuits Lab	0	0	2				10		15	25	1
8	**PEE -313**	Electrical and Electronic Measurements Lab	0	0	2				10		15	25	1
9	**PEE -314**	Electric Motors and Transformers Lab	0	0	2				10		15	25	1
10	**PEE -315**	Renewable Energy Power Plants Lab	0	0	2				10		15	25	1
11	**PEE-316**	Summer Internship - I	0	0	0				50			50	2
												675	**22**
Summer Internship-I (4 weeks) after IInd Sem													

Course Code	:	PEE-312
Course Title	:	ELECTRIC CIRCUITS LABORATORY
Number of Credits	:	1 (L: 0, T: 0, P:2)
Prerequisites	:	NIL
Course Category	:	PC

Course objectives:

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

- Maintain electrical systems applying AC and DC circuit fundamentals.

Practicals:

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

16. Use voltmeter, ammeter to determine load resistance for maximum power transfer for a giv- en circuit by applying maximum power transfer theorem.

Course outcomes:

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

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

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

c) Troubleshoot problems related to three phasecircuits.

d) Use principles of circuit analysis to troubleshoot electric circuits.

e) Apply network theorems to troubleshoot electric circuits.

Course Code	:	PEE-302
Course Title	:	ELECTRIC CIRCUITS
Number of Credits	:	3 (L: 2, T: 1, P:0)
Prerequisites (Course code)	:	NIL
Course Category	:	PC

Course Objectives:

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

- Maintain electrical systems applying AC and DC circuit fundamentals.

Course Contents:

Unit – I Single Phase A.C Series Circuits

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

Unit – II Single Phase A.C Parallel Circuits

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

Unit–III Three Phase Circuits

Phasor and complex representation of three phase supply Phase sequence and polarity

Types of three-phase connections, Phase and liner quantities in three phase star and delta system, Balanced and unbalanced load, neutral shift in unbalanced load, Three phase power, active, reactive and apparent power in star and delta system.

Unit– IV Network Reduction and Principles of Circuit Analysis

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

Unit– V Network Theorems

Superposition theorem, Norton’s theorem

Course Code	:	PEE-314
Course Title	:	ELECTRIC MOTORS AND TRANSFORMERS LABORATORY
Number of Credits	:	1 (L: 0, T: 0, P: 2)
Prerequisites	:	NIL
Course Category	:	PC

Course objectives:

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

- Use electric motors and transformers.

Practicals:

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

Course outcomes:

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

Competency:

a) Maintain different types of DC generators.

b) Maintain different types of DC motors.

c) Maintain single phase transformer.

d) Maintain three phase transformers.

e) Maintain different types of special purpose transformers used in different applications.

Course Code	:	PEE-304
Course Title	:	ELECTRIC MOTORS AND TRANSFORMERS
Number of Credits	:	3 (L: 2, T: 1, P: 0)
Prerequisites	:	NIL
Course Category	:	PC

Course objectives:

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

- Maintain electric motors and transformers.

Course contents:

Unit –I DC Generators

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

Unit – II D.C. Motors

DC motor: Types of DC motors. Fleming's left hand rule, Principle of operation of, Back e.m.f. and its significance, Voltage equation of DC motor, Torque and Speed; Armature torque, Shaft torque, BHP, Brake test, losses, efficiency. DC motor starters: Necessity, two point and three point starters.
Speed control of DC shunt and series motor: Flux and Armature control. Brushless DC Motor: Construction and working.

Unit–III Single Phase Transformers

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

Transformer: Principle of operation, EMF equation of transformer: Derivation, Voltage trans- formation ratio, Significance of transformer ratings, Transformer No-load and on-load phasor diagram, Leakage reactance, Equivalent circuit of transformer: Equivalent resistance and reactance, Voltage regulation and Efficiency: Direct loading, OC/SC method, All day efficiency.

Unit– IV Three Phase Transformers

Bank of three single phase transformers, Single unit of three phase transformer, Distribution and Power transformers. Construction, cooling, Three phase transformers connections as per IS:2026 (part IV)-1977, Three phase to two phase conversion (Scott Connection), Selection of transformer as per IS: 10028 (Part I)-1985, Criteria for selection of distribution transformer, and power transformer, Amorphous Core type Distribution Transformer, Specifications of three-phase distribution transformers as per IS:1180 (part I)-1989, Need of parallel operation of three phase transformer, Conditions for parallel operation, Polarity tests on mutually inductive coils and single phase transformers; Polarity test, Phasing out test on Three-phase transformer.

Unit– V Special Purpose Transformers

Single phase and three phase auto transformers: Construction, working and applications. Instrument Transformers: Construction, working and applications of Current transformer and Potential transformer.

Isolation transformer: Constructional Features and applications, Single phase welding transformer: constructional features and applications. Pulse transformer: constructional features and applications, 'K' factor of transformers: overheating due to non-linear loads and harmonics.

References:

1. G.C. Garg & P.S. Bimbhra, Electrical Machines, Vol-I, II, Khanna Book Publishing House (ISBN: 978-9386173-447, 978-93-86173-607), New Delhi
2. Mittle, V.N. and Mittle, Arvind., Basic Electrical Engineering, McGraw Hill Education, New Delhi, ISBN:9780070593572
3. Kothari, D. P.and Nagrath, I. J., Electrical Machines, McGraw Hill Education. New Delhi, ISBN: 9780070699670
4. Bhattacharya, S.K., Electrical Machines, McGraw Hill Education, New Delhi,ISBN:9789332902855
5. Mehta, V.K. and Mehta, Rohit, Principles of Electrical Machines, S. Chand and Co. Ltd., New Delhi, ISBN: 9788121930888
6. Theraja, B.L., Electrical Technology Vol-II (AC and DC machines), S. Chand and Co. Ltd., New Del- hi, ISBN: 9788121924375
7. Bandyopadhyay, M. N., Electrical Machines Theory and Practice, PHI Learning Pvt. Ltd., New Delhi, ISBN: 9788120329973 Vi
8. Murugesh Kumar, K., DC Machines and Transformers, ISBN: 9788125916055

Course outcomes:

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

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

Course Code	:	PEE-313
Course Title	:	ELECTRICAL AND ELECTRONIC MEASUREMENTS LABORATORY
Number of Credits	:	1 (L: 0, T: 0, P: 2)
Prerequisites	:	NIL
Course Category	:	PC

Course objectives:

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

- Use relevant measuring instrument in different electrical applications.

Practicals:

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

COURSE OUTCOMES:

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

a) Check the working of the electrical measuring instrument.

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

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

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

e) Use different types of electrical instruments for measuring electrical parameters of various ranges.

Course Code	:	PEE-303
Course Title	:	ELECTRICAL AND ELECTRONIC MEASUREMENTS
Number of Credits	:	3 (L: 2, T: 1, P: 0)
Prerequisites	:	NIL
Course Category	:	PC

Course objectives:

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

- Use relevant measuring instrument in different electrical applications.

Course contents:

Unit – I Fundamentals of Measurements

Measurement: Significance, units, fundamental quantities and standards Classification of Instrument Systems: Null and deflection type, instruments Absolute and secondary instruments Analog and digital instruments, Static and dynamic characteristics, types of errors Calibration: need and procedure, Classification of measuring instruments: indicating, recording and integrating instruments, Essential requirements of indicating instruments.

Unit – II Measurement of voltage and current

DC Ammeter: Basic, Multi range, Universal shunt, DC Voltmeter: Basic, Multi range, concep t of loading effect and sensitivity AC voltmeter: Rectifier type (half wave and full wave), CT and PT: construction, working and applications. Clamp-on meter.

Unit–III Measurement of Electric Power

Analog meters: Permanent magnet moving coil (PMMC) and Permanent magnet moving iron(PMMI) meter, their construction, working, salient features, merits and demerits, Dynamometer type wattmeter: Construction and working Range: Multiplying factor and extension of range using CT and PT Errors and compensations, Active and reactive power measurement: One, two and three wattmeter method. Effect of Power factor on wattmeter reading in two wattmeter method, Maximum Demand indicator

Unit– IV Measurement of Electric Energy

Single and three phase electronic energy meter: Constructional features and working principle, Errors and their compensations. Calibration of single phase electronic energy meter using direct loading.

Unit– V Circuit Parameter Measurement, CRO and Other Meters

Measurement of resistance: Low resistance: Kelvin's double bridge, Medium Resistance: Voltmeter and ammeter method. High resistance: Megger and Ohm meter: Series and shunt Measurement of inductance using Anderson bridge (no derivation and phasor diagram) Measurement of capacitance using Schering bridge (no derivation and phasor diagram) Single beam/single trace CRO, Digital storage Oscilloscope: Basic block diagram, working, Cathode ray tube, electrostatic deflection, vertical amplifier, time base generator, horizontal amplifier, measurement ofvoltage/ amplitude/ time period/ frequency/ phase angle delay line, specifications. Other meters: Earth tester, Digital Multimeter; L-C-R meter, Frequency meter (ferromagnet- ic and Weston type), Phase sequence indicator, power factor meter (single phase and three phase dynamometer type), Synchro scope, Tri-vector meter, Signal generator: need, working and basic block diagram. Function generator: need, working and basic block diagram, function of symmetry.

References:

1. Theraja B. L., Theraja A. K., A Text Book of Electrical Technology Vol-I(Basic Electrical Engg.), S.Chand and Co. New Delhi, ISBN: 9788121924405
2. Mittle V.N., Basic Electrical Engineering, McGraw-Hill New Delhi, ISBN : 978-0-07- 0088572-5,
3. Edward Hughes, Electrical Technology, Pearson Education, New Delhi, ISBN- 13: 978- 0582405196
4. Rajput R.K., Electrical and Electronic Measurement and Instrumentation, S.Chand and Co. New Delhi, ISBN : 9789385676017
5. Sawhney A.K., Electrical and Electronics Measurements and Instrumentation., Dhanpai Raiand Sons,New Delhi, ISBN : 9780000279744
6. Suryanarayna N.V., Electrical Measurements and Measuring Instruments, S.Chand and Co. New Delhi , ISBN :8121920116

Course outcomes:

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

a) Check the working of the electrical measuring instrument.

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

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

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

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

Course Code	:	PEE-311
Course Title	:	INTRODUCTION TO ELECTRIC GENERATION SYSTEMS LABORATORY
Number of Credits	:	1 (L: 0, T: 0, P: 2)
Prerequisites	:	NIL
Course Category	:	PC

Course Objectives:

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

- Maintain the efficient operation of various electric power generating plants.

Practicals:

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

Course Ouctomes:

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

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

Course Code		PEE-301
Course Title		INTRODUCTION TO ELECTRIC GENERATION SYSTEMS
Number of Credits		3 (L: 3, T: 0, P:0)
Prerequisites		NIL
Course Category		PC

Course Objectives:

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

- Maintain the efficient operation of various electric power generating plants.

Course Contents:

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

Layout and working of a typical thermal power plant with steam turbines and electric generators, Properties of conventional fuels used in the energy conversion equipment used in thermal power plants: Coal, Gas/ diesel, Nuclear fuels –fusion and fission action Safe Practices and working of various thermal power plants: coal-based, gas-based, diesel-based, nuclear-based.
Functions of the following types of thermal power plants and their major auxiliaries: Coal fired boilers: fire tube and water tube. Gas/diesel based combustion engines
Types of nuclear reactors: Disposal of nuclear waste and nuclear shielding. Thermal power plants in Maharashtra.

Unit – II Large and Micro-Hydro Power Plants

Energy conversion process of hydro power plant, Classification of hydro power plant: High, medium and low head. Construction and working of hydro turbines used in different types of hydro power plant:
High head – Pelton turbine, Medium head – Francis turbine, Low head – Kaplan turbine. Safe Practices for hydro power plants.
Different types of micro- hydro turbines for different heads: Pelton, Francis and Kaplan turbines Locations of these different types of large and micro- hydropower plants in Maharashtra Potential locations of micro-hydro power plants in Maharashtra.

Unit– III Solar and Biomass based PowerPlants

Solar Map of India: Global solar power radiation. Solar Power Technology, Concentrated Solar Power (CSP) plants, construction and working of: Power Tower, Parabolic Trough, Parabolic Dish, Fresnel Reflectors, Solar Photovoltaic (PV) power plant: layout, construction, working.
Biomass-based Power Plants, Layout of a Bio-chemical based (e.g. biogas) power plant: Layout of a Thermo-chemical based (e.g. Municipal waste) power plant, Layout of an Agro-chemical based (e.g. bio-diesel) power plant, Features of the solid, liquid and gas biomasses as fuel for biomass power plant.

Unit– IV Wind Power Plants

Wind Map of India: Wind power density in watts per square meter Layout of Horizontal axis large wind power plant: Geared wind power plant, Direct-drive wind power plant. Salient Features of electric generators used in large wind power plants: Constant Speed Electric Generators: Squirrel Cage Induction Generators (SCIG), Wound Rotor Induction Generator (WRIG)
Variable Speed Electric Generators: Doubly-fed induction generator (DFIG), wound rotor synchronous generator (WRSG), permanent magnet synchronous generator (PMSG)

Unit–V Economics of Power Generation and Interconnected Power System

Related terms: connected load, firm power, cold reserve, hot reserve, spinning reserve. Base load and peak load plants; Load curve, load duration curve, integrated duration curve, Cost of generation: Average demand, maximum demand, demand factor, plant capacity factor, plant use factor, diversity factor, load factor and plant load factor. Choice of size and number of generator units, combined operation of power station. Causes and Impact and reasons of Grid system fault: State grid, national grid, brownout and black out; sample blackouts at national and international level

References:

1. Nag. P.K.Power Plant Engineering, McGraw Hill, New Delhi, ISBN:978- 9339204044
2. Tanmoy Deb, Electrical Power Generation, Khanna Publishing House, Delhi (Ed. 2018)
3. Gupta, B.R., Generation of Electrical Energy, S. Chand& Co. New Delhi,
4. Rachel, Sthuthi; Earnest, Joshua – Wind Power Technologies, PHI Learning, New Delhi, ISBN: 978-93-88028-49- 3; E-book 978-93-88028-50-9
5. Solanki, Chetan Singh, – Solar Photovoltaics: Fundamentals, Technologies and Applications, PHILearning, New Delhi, ISBN: 9788120351110
6. Hau, Erich, Wind Turbines, Springer-Verlag, Berlin Heidelberg, Germany, ISBN:978-3-642- 27150-2
7. Gipe, Paul, Wind Energy Basics, Chelsea Green Publishing Co; ISBN: 978-1603580304
8. Wizelius, Tore; Earnest, Joshua – Wind Power Plants and Project Development, PHI
9. Gupta, J.B. A Course in Electrical Power– S. K Kataria and Sons, New Delhi. 2014,
10. Soni, Gupta, Bhatnagar, A Course in Electrical Power. – Dhanpatrai and Sons
11. System, S.Chand & Co. New Delhi, 2005, ISBN: 9788121924962

Course Outcomes:

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

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

Course Code	:	PEE-315
Course Title	:	Renewable Energy Power Plants Laboratory
Number of Credits	:	1 (L: 0, T: 0, P: 2)
Prerequisites	:	NIL
Course Category	:	PC

Course objectives:

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

- Maintain the efficient operation of various renewable energy power plants.

Practicals:

1. Dismantle the parabolic trough CSPplant.
2. Assemble the parabolic trough Concentrated Solar Power (CSP) plant.
3. Assemble the parabolic dish CSPplant.
4. Dismantle the parabolic dish CSP plant.
5. Assemble the solar PV plant to produceelectric power.
6. Dismantle the solar PV plant.
7. Identify the routine maintenance parts of the large wind power plant after watching a video programme.
8. Assemble a horizontal axis small wind turbine to produce electric power
9. Dismantle a horizontal axis small windturbine.
10. Assemble a vertical axis small wind turbine to produce electric power
11. Dismantle a vertical axis small windturbine.
12. Identify the routine maintenance partsof the micro hydropowerplant after watching a videoprogramme.
13. Assemble a micro hydro power plant.
14. Dismantle a micro hydro power plant.
15. Assemble a small biogas plant to generate electric power
16. Dismantle the biogas plant.

Course outcomes:

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

a) Maintain the optimised working of solar PV and CS power plants.

b) Maintain the optimised working of large wind power plants

c) Maintain the optimised working of small wind turbines.

d) Maintain the optimised working of micro hydro power plants.

e) Maintain the optimised working of biomass-based power plants.

Course Code	:	PEE-305
Course Title	:	Renewable Energy Power Plants
Number of Credits	:	3 (L: 3, T: 0, P:0)
Prerequisites (Course code)	:	NIL
Course Category	:	PC

Course objectives:

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

- Maintain the efficient operation of various types of renewable energy power plants.

Course contents:

Unit – I Solar PV and Concentrated Solar Power Plants

Solar Map of India: Global solar power radiation, Solar PV Concentrated Solar Power (CSP) plants, construction and working of: Power Tower, Parabolic Trough, Parabolic Dish, Fresnel Reflectors Solar Photovoltaic (PV) power plant: components layout, construction, working. Rooftop solar PV power system

Unit – II Large Wind Power Plants

Wind Map of India: Wind power density in watts per square meter Lift and drag principle; long path theory. Geared type wind power plants: components, layout and working. Direct drive type wind power plants: Components, layout and working.

Constant Speed Electric Generators: Squirrel Cage Induction Generators (SCIG), Wound Rotor Induction Generator (WRIG); Variable Speed Electric Generators: Doubly-fed induction generator (DFIG), wound rotor synchronous generator (WRSG), permanent mag- net synchronous generator (PMSG).

Unit– III Small Wind Turbines

Horizontal axis small wind turbine: direct drive type, components and working Horizontal axis small wind turbine: geared type, components and working, Vertical axis small wind turbine: direct drive and geared, components and working Types of towers and installation of small wind turbines on roof tops and open fields. Electric generators used in small wind power plants

Unit– IV Micro-hydro Power Plants

Energy conversion process of hydro power plant, Classification of hydropower plant: High, medium and low head. Layouts of micro-hydro power plants, Construction and working of hydro turbines used in different types of hydro power plant:

- High head – Pelton turbine
- Medium head – Francis turbine
- Low head – Kaplanturbine.

Safe Practices for micro hydro power plants.

Unit– V Biomass-based Power Plants

Properties of solid fuel for biomass power plants: bagasse, wood chips, rice husk, municipal waste
Properties of liquid and gaseous fuel for biomass power plants: Jatropha, bio-diesel gobar gas, Layoutofa Bio-chemical based (e.g. biogas) power plant:

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

References:

1. Deambi, Suneel: From Sunlight to Electricity: a practical handbook on solar photovoltaic applica- tion; TERI, New Delhi ISBN:9788179935736
2. David M. Buchla, Thomas E. Kissell, Thomas L. Floyd - Renewable Energy Systems, Pearson Edu- cation New Delhi , ISBN: 9789332586826,
3. Rachel, Sthuthi; Earnest, Joshua – Wind Power Technologies, PHI Learning, New Delhi, ISBN: 978-93-88028-49- 3; E-book 978-93-88028-50-9
4. Khoiyangbam, RSNavindu; Gupta and Sushil Kumar; Biogas Technology: Towards Sustainable Development; TERI, New Delhi; ISBN: 9788179934043
5. Gipe, Paul: Wind Energy Basics, Chelsea Green Publishing Co; ISBN: 978-1603580304
6. Wizelius, Tore&Earnest, Joshua -PHI Learning, New Delhi, ISBN: 978-8120351660
7. Kothari, D.P. et al: Renewable Energy Sources and Emerging Technologies, PHI Learning, New Delhi, ISBN:-978-81-203-4470-9
8. Bhadra, S.N., Kastha, D., Banerjee, S, Wind Electrical Systems installation; Oxford University Press,
9. New Delhi, ISBN: 9780195670936.
10. O.P. Gupta, Energy Technology, Khanna Publishing House, New Delhi (ISBN: 978-9386173- 683)

Course outcomes:

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

a) Maintain the optimised working of solar PV and CS power plants.
b) Maintain the optimised working of large wind power plants
c) Maintain the optimised working of small wind turbines.
d) Maintain the optimised working of micro hydro power plants.
e) Maintain the optimised working of biomass-based power plants.