SHRI VENKATESHWARA UNIVERSITY

Syllabus

Diploma

(Electrical Engineering)
IV SEMESTER
(THREE Years Programme)

(w.e.f. 2019-20)

SCHOOL OF ENGINEERIN & TECHNOLOGY

SEMESTER- IV

Electrical Engineering SEMESTER IV													
Sl. No.	**Subject Codes**	**Subject**	**Periods**			**Evaluation Scheme**				**End Semester**		**Total**	**Credit**
			L	**T**	**P**	**CT**	**TA**	**Total**	**PS**	**TE**	**PE**		
1	**PEE- 401**	Fundamentals of Power Electronics	3	0	0	20	10	30		70		100	3
2	**PEE- 402**	Electric Power Transmission and Distribution	3	0	0	20	10	30		70		100	3
3	**PEE-403**	Induction, Synchronous and Special Electrical Machines	2	1	0	20	10	30		70		100	3
4	**PEE-404**	Switchgear and Protection	3	0	0	20	10	30		70		100	3
5	**PEE-405**	Electric Traction	3	0	0	20	10	30		70		100	3
6	**PEE- 411**	Fundamentals of Power Electronics Lab	0	0	2				10		15	25	1
7	**PEE- 412**	Electric Power Transmission and Distribution Lab	0	0	2				10		15	25	1
8	**PEE- 413**	Induction, Synchronous and Special Electrical Machines Lab	0	0	2				10		15	25	1
9	**PEE- 414**	Switchgear and Protection Lab	0	0	2				10		15	25	1
10	**PEE- 415**	Electric Traction Lab	0	0	2				10		15	25	1
11	**PEE-416**	Minor Project	0	0	4				50			50	2
12	**PMC- 418**	Essence of Indian Knowledge and Tradition	2	0	0								0
	Essence of Indian Knowledge and Tradition - Noncredit Mandatory courses											**675**	**22**

Course Code	:	PEE-412
Course Title	:	ELECTRIC POWER TRANSMISSION AND DISTRIBUTION LAB
Number of Credits	:	1 (L: 0, T: 0, P:2)
Prerequisites	:	NIL
Course Category	:	PC

Course objectives:

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

- Maintain the proper functioning of the electrical transmission and distribution systems.

Course contents:

Laboratory work is not applicable for this course.

Following are the suggested student-related ***co-curricular*** activities which can be undertaken to accelerate the attainment of the various outcomes in this course: Students should conduct following activities in group and prepare reports of about 5 pages for each activity, also collect/record physical evidences for their (student's) portfolio which will be useful for their placement interviews:

a. Prepare a report based on transmission line network in Maharashtra.

b. Collect the information on components of transmission line.

c. Evaluate transmission line performance parameters of a given line.

d. Library/Internet survey of electrical high voltage line and HVDC lines.

e. Visit to 33/11 KV and 11KV/400V Distribution Substation and write a report. Also one micro-project can be assigned to the student.

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

a. Prepare a model showing:

i. Single line diagram of electric supply system.

ii. Single line diagram of a given distribution system.

iii. Short line and medium transmissionline.

iv. Write a report on the same by giving the details of lines in Maharashtra State.

b. Collect different samples of Overhead Conductors, Underground Cables, Line supports and Line Insulators.

c. Prepare a power pointpresentation:

i. Extra High Voltage AC Transmission line.

ii. High Voltage DC Transmission line.

iii. Flexible AC Transmission line.

iv. New trends in wireless transmission of electrical power.

d. Collect information on:

i. A.C Distribution System adjacent to your institute.

ii. Draw a layout diagram of 11KV/400 V substation in your campus/ adjacent substation.

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) Interpret the normaloperation of the electric transmission and distribution systems.

b) Maintain the functioning of the medium and high voltage transmission system.

c) Interpret the parameters of the extra high voltage transmission system.

d) Maintain the functioning of the low voltage AC distribution system.

e) Maintain the components of the transmission and distribution lines.

Course Code	:	PEE-402
Course Title	:	ELECTRIC POWER TRANSMISSION AND DISTRIBUTION
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:

- Maintainthe proper functioningof the electricaltransmission anddistribution systems.

Course contents:

Unit – I Basics of Transmission and Distribution

Single line diagrams with components of the electric supply transmission and distribution systems, Classification of transmission lines: Primary and secondary transmission; standard voltage Level used in India, Classification of transmission lines: based on type of voltage, voltage level, length and others Characteristics of high voltage for power transmission, Method of construction of electric supply transmission system – 110 kV, 220 kV, 400 kV. Method of construction of electric supply distribution systems – 220 V, 400V, 11 kV, 33 kV

Unit – II Transmission Line Parameters and Performance

Line Parameters: Concepts of R, L and Coflineparameters and types of lines. Performance of short line: Efficiency, regulation andits derivation, effect of power factor, vector diagram for different power factor, Performance of medium line: representation, nominal 'T', nominal'π' and end condenser method, Transposition of conductors and its necessity. Skin effect and proximity effect.

Unit– III Extra High VoltageTransmission

Extra High Voltage AC (EHV AC) transmission line: Necessity, high voltage substation components such as transformers and other switchgears, advantages, limitations and applications and lines in India. Ferranti and Corona effect, High Voltage DC (HVDC) Transmission Line: Necessity, components, advantages, limitations and applications. Layout of mono polar, bi-Polar and homo-polar transmission lines, Lines in India, Features of EHVAC and HVDC transmission line. Flexible AC Transmission line: Features, d types of FACTS controller, New trends in wireless transmission of electrical power.

Unit– IV A.C Distribution System

AC distribution: Components classification, requirements of an ideal distribution system, primary and secondary distribution system, Feeder and distributor, factors to be considered in design of feeder and distributor, Types of different distribution schemes: radial, ring, and grid, layout, advantages, disadvantages and applications, Voltage drop, sending end and receiving end voltage, Distribution Sub-Station: Classification, site selection, advantages, disadvantages and applications, Single Line diagram (layout) of 33/11KV Sub-Station, 11KV/400V sub-station, Symbols and functions of their components.

Unit– V Components of Transmission and Distribution Line

Overhead Conductors: Properties of material, types of conductor with trade names, significance of sag, Line supports: Requirements, types of line structures and their specifications, methods of erection, Line Insulators: Properties of insulating material, selection of material, types of insulators and their applications, causes of insulator failure, derivation of equation of string

efficiency for string of three suspension insulator, methods of improving string efficiency. Underground Cables: Requirements, classification, construction, comparison with overhead lines, cable laying and cable jointing.

References:

1. G.C. Garg, Utilization of Electric Power & Electric Traction, Khanna Book Publishing Co., New Delhi (ISBN: 978-93-86173-355)
2. Mehta, V.K., Principles of Power System, S. Chand and Co. New Delhi, ISBN: 9788121924962
3. Soni;Gupta; Bhatnagar, A Course in Electrical Power, Dhanpat Rai andSons New Delhi, ISBN: 9788177000207
4. Gupta,J.B., A Course in Power Systems, S.K. Kataria and sons, New Delhi, ISBN: 9788188458523
5. Theraja, B.L.; Theraja, A.K., ATextbookof Electrical Technology Vol.III, S.Chand and Co. New Delhi, ISBN : 9788121924900
6. Uppal,S.L., ACourse in Electrical Power,S.K.Khanna Publisher New Delhi, ISBN: 9788174092380
7. Sivanagaraju S.; Satyanarayana S., Electrical Power Transmission and Distribution,PearsonEd-ucation,New Delhi,,ISBN:9788131707913
8. NedMohan,Electrical PowerSystem:A FirstCourse,Wiley IndiaPvt.Ltd. New Delhi, ISBN:9788126541959
9. Gupta,B.R.,PowerSystemAnalysisandDesign,S.ChandandCo.NewDelhi,ISBN: 9788121922388
10. Kamraju, V., Electrical Power Distribution System, Tata McGraw- Hill, New Delhi, ISBN:9780070151413

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) Interpret the normaloperation oftheelectric transmission and distribution systems.
b) Maintain the functioning of the medium and high voltage transmission system.
c) Interpret the parameters of the extra high voltage transmission system.
d) Maintain the functioning of the low voltage AC distribution system.
e) Maintain the components of the transmission and distribution lines.

Course Code	:	PEE-411
Course Title	:	FUNDAMENTALS OF POWER ELECTRONICS LAB
Number of Credits	:	1 (L: 0, T: 0, P:2)
Prerequisites	:	NIL
Course Category	:	PC

Course objectives:

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

- Maintain the proper functioning of power electronic devices.

Practicals:

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

Course outcomes:

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

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

Course Code	:	PEE-401
Course Title	:	Fundamentals of Power Electronics
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 proper functioning of power electronic devices.

Course contents:

Unit – I Power Electronic Devices

Power electronic devices, Power transistor: construction, working principle, V-I characteristics and uses. IGBT: Construction, working principle, V- I characteristics and uses, Concept of single electron transistor (SET) - aspects of Nano- technology.

Unit – II Thyristor Family Devices

SCR: construction, two transistor analogy, types, working and characteristics, SCR mounting and cooling, Types of Thyristors: SCR, LASCR, SCS, GTO, UJT, PUT, DIAC and TRIAC, Thyristor family devices: symbol, construction, operating principle and V-I characteristics, Protection circuits: over-voltage, over-current, Snubber, Crowbar.

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

SCR Turn-On methods: High Voltage thermal triggering, Illumination triggering, dv/dt triggering, Gate triggering, Gate trigger circuits – Resistance and Resistance-Capacitance circuits, SCR triggering using UJT, PUT: Relaxation Oscillator and Synchronized UJT circuit. Pulse transformer and opto-coupler based triggering, SCR Turn-Off methods: Class A- Series resonant commutation circuit, Class B-Shunt Resonant commutation circuit, Class C-Complimentary Symmetry commutation circuit, Class D –Auxiliary commutation, Class E-External pulse commutation, Class F- Line or natural commutation.

Unit– IV Phase Controlled Rectifiers

Phase control: firing angle, conduction angle, Single phase half controlled, full controlled and midpoint controlled rectifier with R,RL load: Circuit diagram, working, input-output waveforms, equations for DC output and effect of freewheeling diode. Different configurations of bridge controlled rectifiers: Full bridge, half bridge with common anode, common cathode, SCRs in one arm and diodes in another arm.

Unit– V Industrial Control Circuits

Applications: Burglar's alarm system, Battery charger using SCR, Emergency light system, Temperature controller using SCRand; Illumination control / fan speed control TRIAC, SMPS, UPS: Offline and Online, SCR based AC and DC circuit breakers.

References:

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

Course outcomes:

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

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

Course Code	:	PEE-413
Course Title	:	INDUCTION, SYNCHRONOUS AND SPECIAL ELECTRIC CHINES LABORATORY
Number of Credits	:	1 (L: 0, T: 0, P: 2)
Prerequisites (Course code)	:	NIL
Course Category	:	PC

Course objectives:

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

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

Practical:

1. Identify the different parts (along with function and materials) for the given single phase and three phase induction motor.
2. Connect and run the three phase squirrel cage induction motors (in both directions) using the DOL, star-delta, auto-transformer starters (any two)
3. Perform the direct load test on the three phase squirrel cage induction motor and plot the efficiency versus output,
   ii) power factor versus output,
   iii) power factor versus motor current and
   iv) torque – slip/speed characteristics.
4. Conduct the No-load and Blocked-rotor tests on given3- squirrel cage induction motor and determine the equivalent circuit parameters.
5. Conduct the No-load and Blocked-rotor tests on given3- squirrel cage induction motor and plot the Circle diagram.
6. Control thespeed of the giventhree phase squirrel cage/slip ringinduction motor using the applicable methods: i) auto-transformer, ii) VVVF.
7. Measure the open circuit voltage ratio of the three phase slip ring induction motor.
8. Conduct the direct load test to determine the efficiency and speed regulation for different loads on the given single phase induction motor; plot the efficiency and speed regulation curves with respect to the output power.
9. Perform the direct loading test on the given three phase alternator and determine the regulation and efficiency.
10. Determine the regulation and efficiency of the given three phase alternator from OC and SC tests (Synchronous impedance method)
11. Conduct the test on load or no load to plot the 'V' curves and inverted 'V' curves (at no-load) of 3- synchronousmotor.
12. Dismantling and reassembling of single phase motors used for ceiling fans, universal motor for mixer.
13. Control the speed and reverse the direction of stepper motor
14. Control the speed and reverse the direction of the AC servo motor
15. Control the speed and reverse the direction of the DC servo motor

Course outcomes:

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

a) Maintain three phase induction motor used in different applications.
b) Maintain single phase induction motor used in different applications.
c) Maintain three phase alternators used in different applications.
d) Maintain synchronous motors used in different applications.
e) Maintain FHP motors used in different applications.

Course Code	:	PEE-403
Course Title	:	INDUCTION, SYNCHRONOUS AND SPECIAL ELECTRIC CHINES
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 Induction, Synchronous and FHP Machines used in different applications.

Course contents:

Unit – I Three Phase Induction Motor

Working principle: production of rotating magnetic field, Synchronous speed, rotor speed and slip, Constructional details of 3phaseinduction motors: Squirrel cage induction motor and Slip ring induction motor, Rotor quantities: frequency, induced emf, power factor at starting and running condition, Characteristics of torque versus slip (speed), Torques: starting, full load and maximum with relations among them, Induction motor as a generalized transformer with phasor diagram. Four quadrant operation, Power flow diagram

Starters: need and types; stator resistance, auto transformer, star delta, rotor resistance and soft starters, Speed control methods: stator voltage, pole changing, rotor resistance and VVVF. Motor selection for different applications as per the load torque-speed requirements. Maintenance of three phase induction motors

Unit – II Single phase induction motors

Double field revolving theory, principle of making these motors self-start, Construction and working: Resistance start induction run, capacitor start induction run, capacitor start capacitor run, shaded pole, repulsion type, series motor, universal motor, hysteresis motor, Torque-speed characteristics for all of the above motors, Motor selection for different applications as per the load torque-speed requirements. Maintenance of single phase induction motors

Unit–III Three phase Alternators

Principle of working, moving and stationary armatures, Constructional details: parts and their functions, rotor constructions. Windings: Single and Double layer, E.M.F. equation of an Alternator with numerical by considering short pitch factor and distribution factor, Alternator loading: Factors affecting the terminal voltage of alternator; Armature resistance and leakage reactance drops, Armature reaction at various power factors and synchronous impedance. Voltage regulation: direct loading and synchronous impedance methods. Maintenance of alternators

Unit– IV Synchronous motors

Principle of working /operation, significance of load angle, Torques: starting torque, running torque, pull in torque, pullout torque, Synchronous motor on load with constant excitation (numerical), effect of excitation at constant load (numerical), V-Curves and Inverted V- Curves, Hunting and Phase swinging,

Methods of Starting of Synchronous Motor, Losses in synchronous motors and efficiency (numerical).

Unit– V Fractional horse power (FHP) Motors

Construction and working: Synchronous Reluctance Motor, Switched Reluctance Motor, BLDC, Permanent Magnet Synchronous Motors, stepper motors, AC and DC servomotors. Torque speed characteristics of above motors, Applications of above motors.

References:

1. P.S.Bimbhra, Electric Machines, Khanna Book Publishing Co., New Delhi (ISBN: 978-93-86173- 294)
2. Mittle, V.N. and Mittle, Arvind., Basic Electrical Engineering, 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. Theraja, B.L., Electrical Technology Vol-II (AC and DC machines), S.Chand and Co. Ltd., New Del- hi, ISBN : 9788121924375
6. Sen, S. K., Special Purpose Electrical Machines, Khanna Publishers, New Delhi, ISBN: 9788174091529
7. JanardananE.G,SpecialElectricalMachines,PrenticeHallIndia,New DelhiISBN: 9788120348806
8. Hughes E., Electrical Technology,ELBS
9. Cotton H., Electrical Technology,ELBS

Course outcomes:

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

a) Maintain three phase induction motor used in different applications.
b) Maintain single phase induction motor used in different applications.
c) Maintain three phase alternators used in different applications.
d) Maintain synchronous motors used in different applications.
e) Maintain FHP motors used in different applications.

Course Code	:	PEE-404
Course Title	:	SWITCHGEAR AND PROTECTION
Number of Credits	:	3 (L: 3, T: 0, P: 0)
Prerequisites	:	NIL
Course Category	:	PE

Course objectives:

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

- Maintain switchgear and protection schemes used in electrical power systems.

Course contents:

Unit – I Basics of Protection

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

Unit – II Circuit Interruption Devices

Isolators- Vertical break, Horizontal break and Pantograph type. HRC fuses – Construction, working, characteristics and applications.

Arc formation process, methods of arc extinction (High resistance and Low resistance), Arc voltage, Recovery voltage, Re-striking voltage, RRRV.

HT circuit breakers (Sulphur-hexa Fluoride (SF6), Vacuum circuit breaker) - Working, construction, specifications and applications.

L.T. circuit breaker (Air circuit breakers (ACB), Miniature circuit breakers (MCB), Moulded case circuit breakers (MCCB) and Earth leakage circuit breaker (ELCB)) - Working and appli- cations.

Selection of LT and HT circuit breakers (ratings), Selection of MCCB for motors. Gas insulated switchgear.

Unit– III Protective Relays

Fundamental quality requirements: Selectivity, Speed, Sensitivity, Reliability, Simplicity, Economy.

Basic relay terminology- Protective relay, Relay time, Pick up, Reset current, current setting, Plug setting multiplier, Time setting multiplier.

Protective relays: Classification, principle of working, construction and operation of – Electromagnetic (Attracted armature type, Solenoid type, Watt-hour meter type) relay, Thermal relay. Block diagram and working of Static relay.

Overcurrent relay-Time current characteristics, Microprocessor based over current relays: Block diagram, working. Distance relaying- Principle, operation of Definite distance relays. Directional relay: Need and operation.

Operation of current and voltage differential relay.

Unit– IV Protection of Alternator and Transformer

Alternator Protection: Faults, Differential protection, Over current, earth fault, overheating and field failure, protection, Reverse power protection.

Transformer Protection: Faults, Differential, over current, earth fault, over heating protection, Limitations of differen- tial protection, Buchholz relay: Construction, operation, merits and demerits.

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

Faults, Short circuit protection, Overload protection, Single phase preventer, Bus bar and Transmission line, Faults on Bus bar and Transmission Lines.

Bus bar protection: Differential and Fault bus protection. Transmission line: Over current, Distance and Pilot wire protection.

References:

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

Course outcomes:

The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry oriented COs associated with the above mentioned competency:Identify various types of faults in power system.

a) Select suitable switchgears for different applications.

b) Test the performance of different protective relays.

c) Maintain protection systems of alternators and transformers.

d) Maintain protection schemes for motors and transmission lines.

e) Maintain protection schemes for power system against overvoltages.

Course Code	:	PEE-414
Course Title	:	SWITCHGEAR AND PROTECTION LABORATORY
Number of Credits	:	1 (L: 0, T: 0, P: 2)
Prerequisites	:	NIL
Course Category	:	PE

Course objectives:

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

- Maintain switchgear and protection schemes used in electrical power systems.

Course contents:

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

Course outcomes:

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

a) Identify various types of faults in power system.
b) Select suitable switchgears for different applications.
c) Test the performance of different protective relays.
d) Maintain protection systems of alternators and transformers.

Course Code	:	PEE-405
Course Title	:	ELECTRIC TRACTION
Number of Credits	:	3 (L: 3, T: 0, P: 0)
Prerequisites	:	NIL
Course Category	:	PE

Course objectives:

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

- Maintain electric traction systems.

Course contents:

Unit – I Basics of Traction

General description of Electrical Traction system in India.

Advantages and Disadvantages of Electric Drive, Diesel Electric Drive, Battery Drive Problems associated with AC traction System and remedies for it.

Voltage balance, current balance, production of harmonics, induction effects. Metro rail system, features

Unit – II Power Supply Arrangements

Constituents of supply system:-

- Substation: layout, list of equipment and their functions
- Feeding post: list of equipment and their functions
- Feeding and sectioning Arrangements
- Sectioning and paralleling post
- Sub sectioning and Paralleling post
- Sub sectioning post
- Elementary section

Major equipment at substation, Miscellaneous equipment at control post or Switching station Protection system for traction transformer and 25 kV centenary construction

Unit– III Overhead Equipment

Different types of overhead equipments Pentagonal OHE Centenary Construction

Different Types of Centenary according to speed Limit OHE Supporting Structure, Cantilever assembly diagram

Overhead system- Trolley collector, Bow collector, Pantograph Collector Types and construction of pantograph

Unit– IV Electric Locomotive

Classification and Nomenclature of Electric Locomotive

Block diagram of AC locomotive Power Circuit of AC Locomotive

Equipment (List and Function only) used in auxiliary circuit of AC Locomotive Loco bogie classification according to wheel arrangements, Maintenance of AC systems.

Unit– V Traction Motors and Train Lighting

Desirable characteristics of traction motor.

Types of motors used for traction with their characteristics and features Control of motors used for traction and methods to control Requirements of braking, types of braking

Electric braking, Regenerative braking

Systems of train lighting, Single battery, double battery parallel block system SG, HOG, End on generation

Unit VI. Signalling and Supervisory Control
Requirements of signaling systems Types of signals, track circuits Advantages of remote control Systems of remote control, equipment and network Metro rail-supply systems, advantages, schemes in India

References:

1. G.C. Garg, Utlization of Electric Power & Electric Traction, Khanna Book Publishing Co., New Delhi (ISBN: 978-93-86173-355) Revised Ed. 2018
2. Gupta J.B., S.K.Kataria and Son, Utilization of Electric power and traction
3. Partab H., Dhanpat Rai and Co,' Art and Science of Utilization of Electrical Energy
4. Partab H., Dhanpat Rai and Co, Modern Electric Traction
5. Suryanarayana N.V., New Age International Publishers, Reprint 2010
6. Open Shaw Taylor, Orient Longman ltd., Utilisation of electrical energy.

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) Interpret the traction layout and its systems
b) Maintain the power supply arrangements.
c) Maintain the function of the overhead equipment for electric traction
d) Maintain the different components of the electric locomotive.
e) Maintain the traction motor and train lighting system
f) Maintain the signalling and supervisory control systems.

Course Code	:	PEE-415
Course Title	:	ELECTRIC TRACTION LABORATORY
Number of Credits	:	1 (L: 0, T: 0, P: 2)
Prerequisites (Course code)	:	NIL
Course Category	:	PE

Course objectives:

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

Maintain electric traction systems

Practical:

1. Dismantle a traction motor
2. Assemble a traction motor
3. Troubleshoot a traction motor
4. Visit electric-traction train lighting system installation, identify components of system and prepare report
5. Visit electric-traction loco shed, investigate working of each section & prepare report
6. Visit to Traction Substation or feeding post (for layout and OHE) and write a report
7. Visit to Railway Station (for signalling and train lighting) and writing a report on visit
8. Draw traction substation Layout on drawing sheet and prepare report
9. Draw Pentagonal OHE Catenary, different Catenaries according to speed limit, OHE supporting structure on drawing sheet and prepare report
10. Draw Power Circuit of AC Locomotive on drawing sheet and prepare report.

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) Interpret the traction layout and its systems
b) Maintain the power supply arrangements.
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