Course and Examination Scheme (Vth and VIth Semester)

of NEP 2020 Curriculum

Bachelor of Technology in Electrical Engineering

(Faculty of Science and Technology)

GONDWANA UNIVERSITY, Gadchiroli
MIDC Road Complex, Gadchiroli
PIN-442 605, (M.S.)

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SEMESTER– V																	
Course Category	Board of Studies	Course Code	Name of the Course	Teaching Scheme				Examination Scheme									Credit
				Hours per week				Theory Marks						Practical Marks			
				L	T	P	T	Duration in hrs.	MSE (CA)	IE (CA)	ESE (UA)	Total	Min (CA+UA)	CA	UA	Total	Min (CA+UA)	
MDM	Electrical Engineering	STMDMELE501	Multi-disciplinary Minor-III	3	--	--	3	3	10	10	80	100	40	--	--	--	--	3
OE	Electrical Engineering	STOEELE502	Open Elective- III	2	--	--	2	2	5	5	40	50	20	--	--	--	--	2
PCC	Electrical Engineering	STPCCELE503	Electrical Machine-II	3	--	--	3	3	10	10	80	100	40	--	--	--	--	3
PCC	Electrical Engineering	STPCCELE504	Power System-I	3	--	--	3	3	10	10	80	100	40	--	--	--	--	3
PCC	Electrical Engineering	STPCCELE505	Electrical Machine Design	3	--	--	3	3	10	10	80	100	40	--	--	--	--	3
PEC	Electrical Engineering	STPECELE506A/B	Program Elective - I	3	--	--	3	3	10	10	80	100	40	--	--	--	--	3
PCC	Electrical Engineering	STPCCELE507	Electrical Machine-II Lab. - I	--	--	2	2	--	--	--	--	--	--	25	25	50	25	1
PCC	Electrical Engineering	STPCCELE508	Power System-I Lab.	--	--	2	2	--	--	--	--	--	--	25	25	50	25	1
PEC	Electrical Engineering	STPECELE509A/B	Program Elective – I Lab.	--	--	2	2	--	--	--	--	--	--	25	25	50	25	1
VSEC	Electrical Engineering	STVSECELE510	Soft Skills	--	1	2	3	--	--	--	--	--	--	50	--	50	25	2
Total				**17**	**1**	**8**	**26**	**--**	**55**	**55**	**440**	**550**	**--**	**125**	**75**	**200**	**--**	**22**
Marks Grand Total				**750**														

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SEMESTER–V						
LIST OF OPEN ELECTIVES - III COURSE			LIST OF PROGRAM ELECTIVES - I		LIST OF PROGRAM ELECTIVES – I LAB	
Sr.	**Course Code**	**Name of the course**	**Course Code**	**Name of the course**	**Course Code**	**Name of the course**
A	**STOEMEC502**	**Operations Research Techniques**	**STPECELE506A**	**High Voltage Engineering**	**STPECELE508A**	**High Voltage Engineering Lab**
B	**STOEETC502**	**Automotive Electronics**	**STPECELE506B**	**Digital Electronics Circuits**	**STPECELE508B**	**Digital Electronics Circuits Lab**
C	**STOECSE502**	**Software Project Management**				
D	**STOEINS502**	**Power Plant Instrumentation**				
E	**STOECEC502**	**Remote Sensing and GIS**				
F	**STOEELE502**	**Introduction to Smart Grid**				

Note:

1. Note: The offering of any open elective or Program elective course shall be subject to a minimum enrollment of fifteen (15) students.
2. If a student opts for Program Elective – I (Serial No. A), they will be eligible only for the corresponding Program Elective – I Lab (Serial No. A); the same applies for serial no. B

			
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SEMESTER– VI																			
Course Category	Board of Studies	Course Code	Name of the Course	Teaching Scheme				Examination Scheme											Credit
				Hours per week				Theory Marks						Practical Marks					
				L	T	P	T	Duration in hrs.	MSE (CA)	IE (CA)	ESE (UA)	Total	Min (CA+UA)	CA	UA	Total	Min (CA+UA)	
MDM	Electrical Engineering	STMDMELE601	Multi-disciplinary Minor-IV	3	--	--	3	3	10	10	80	100	40	--	--	--	--	3
PCC	Electrical Engineering	STPCCELE602	Control System	3	--	--	3	3	10	10	80	100	40	--	--	--	--	3
PCC	Electrical Engineering	STPCCELE603	Power Electronics	3	--	--	3	3	10	10	80	100	40	--	--	--	--	3
PCC	Electrical Engineering	STPCCELE604	Power System-II	3	--	--	3	3	10	10	80	100	40	--	--	--	--	3
PEC	Electrical Engineering	STPECELE605A/B	Program Elective - II	3	--	--	3	3	10	10	80	100	40	--	--	--	--	3
PEC	Electrical Engineering	STPECELE606A/B	Program Elective – III	3	--	--	3	3	10	10	80	100	40	--	--	--	--	3
PCC	Electrical Engineering	STPCCELE607	Power Electronics Lab.	--	--	2	2	--	--	--	--	--	--	25	25	50	25	1
PCC	Electrical Engineering	STPCCELE608	Power System– II Lab.	--	--	2	2	--	--	--	--	--	--	25	25	50	25	1
PCC	Electrical Engineering	STPCCELE609	Control System Lab.	--	--	2	2	--	--	--	--	--	--	25	25	50	25	1
Total				**18**	**--**	**6**	**24**	**--**	**60**	**60**	**480**	**600**	**--**	**75**	**75**	**150**	**--**	**21**
Marks Grand Total				**750**															



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LIST OF PROGRAM ELECTIVES - II	
Course Code	**Name of the course**
STPECELE605A	**Electrical Drives**
STPECELE605B	**Power System Operation & Control**

LIST OF PROGRAM ELECTIVES - III	
Course Code	**Name of the course**
STPECELE606A	**Advanced Microprocessor Systems and Microcontroller**
STPECELE606B	**Programming Techniques & Simulation**

Note:

1. **Note: The offering of any Program elective course shall be subject to a minimum enrolment of fifteen (15) students.**

			
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EXIT CRITERIA FOR BACHELOR'S DEGREE IN VOCATION (AFTER THIRD YEAR)																		
Course Category	**Board of Studies**	**Course Code**	**Name of the Course**	**Teaching Scheme**				**Examination Scheme**										**Credit**
				Hours per week				**Theory Marks**						**Practical Marks**				
				L	**T**	**P**	**T**	**Duration in hrs.**	**MSE (CA)**	**IE (CA)**	**ESE (UA)**	**Total**	**Min (CA+UA)**	**CA**	**UA**	**Total**	**Min (CA+UA)**	
EX3	Electrical Engineering	STEXELE621	Installation of Transformer	--	2	12	14	--	--	--	--	--	--	100	100	200	100	8
OR																		
EX3	Electrical Engineering	STEXELE622	Autonomous, Connected, Electric Vehicles (ACE)	--	2	12	14	--	--	--	--	--	--	100	100	200	100	8
OR																		
EX3	Electrical Engineering	STEXELE631	Internship / Technical Project											100	100	200	100	8
Total				**--**	**--**	**16**	**16**	--	--	--	--	--	--	**100**	**100**	**200**	**--**	**8**
Marks Grand Total				**200**														

@ Evaluation based on seminar, internship report, technical project report, skill courses certification etc as mentioned in detailed syllabus.

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Vth Semester B. Tech. Electrical Engineering (NEP 2020)

Course Code: STMDMELE501

Title of Course: **Electrical Drives (Multi-Disciplinary Minor - III (MDM))**

Teaching Scheme					Examination Scheme (Theory)				
Lecture	Tutorial	Practical	Periods/week	Credits	Duration in Hours	MSE	IE	ESE	Total
3	--	--	3	3	3	10	10	80	100

Course Outcomes:

At the end of the course the student will be able to:

CO1 Explain the fundamentals, characteristics, and selection of electric drives.
CO2 Analyze the starting, braking, and speed control of DC motor drives.
CO3 Analyze the control and performance of induction motor drives.
CO4 Calculate motor ratings for different duty cycles using thermal models and load diagrams.
CO5 Evaluate the operation and control of synchronous motor drive

Unit	Content	Hours
I	**Electric Drives** Introduction to electric drives: Advantages of Electric drives, Choice of Electric Drives and Losses. Latest trends in DC & AC Drives, Dynamics, Equivalent values of drive parameters, Load Torque: component, Natures and classification, steady state stability, Speed-torque characteristics, criteria load equalization.	9
II	**DC Motor Drives** Starting, Braking, Speed control of DC motors using single phase fully controlled and half-controlled rectifiers. Three phases fully controlled and half-controlled converter fed DC motor drives. Chopper controlled DC drives. Characteristics of transmission lines. Surge Impedance Loading. Series and Shunt Compensation for transmission lines. **Transformers**: Three-phase connections and Phase shifts. Three-winding transformers, autotransformers, Neutral Grounding transformers. Tap-Changing in transformers. Transformer Parameters. Single phase equivalent to three-phase transformers.	9
III	**Induction Motor Drives** Three phase induction motor drives - ac voltage-controlled drives –- VSI fed induction motor drive – stator side control – scalar control and vector control – rotor side control - slip power recovery scheme - CSI controlled induction motor drives. Regeneration in	9

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	drives: dynamic breaking, regenerative braking, dc injection, plugging.	
IV	**Estimation of Motors Rating** Thermal modeling of motors, Types of duty cycles, Calculation of motor rating for duty cycles, Overload factor calculation for short and intermittent duty cycle, Use of load diagrams.	9
V	**Synchronous Motor Drives** Steady state & dynamic stability limits of synchronous motor drives, True synchronous & self-synchronous modes of operation, Variable frequency control of multiple synchronous motors, Self-controlled synchronous motor drive employing load commutated thruster inverter, Starting of large synchronous machines, Self-controlled synchronous motor drive employing cycloconverters.	9

Textbooks

1. “Fundamentals of Electric Drives”, by G K Dubey, Narosa Publications.

2. “Power Electronic Circuits, Devices and applications”, by M.H. Rashid, Prentice Hall of India.

3. “Modern Power Electronics and AC Drive”, by B.K. Bose, Pearson Education.

4. “Electric Drives”, N. K. De, P. K. Sen, Prentice Hall of India Eastern Economy Edition.

Reference Books

1. “Thyristor Control of Electric drives” by Vedam Subramanyam, Tata McGraw Hill Publications.

2. “A First course on Electrical Drives”, by S K Pillai, New Age International(P) Ltd.

3. “Electric Drives”, by S.K. Pillai, University Press India, 1993.

4. “Control of electrical drives”, by Werner Leonhard, Springer, 1995.

5. “Electric Drives: Concepts & Application”, by V. Subramanyam, Tata Mc-Graw Hill.

6. “Power semiconductor Drives”, S. B. Dewan & G. R. Stemon & A. Straughen, Wiley Inter Science

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Vth Semester B. Tech. Electrical Engineering (NEP 2020)

Course Code: STOEELE502

Title of Course: **Introduction to smart grid (Open Elective – III)**

Teaching Scheme					Examination Scheme (Theory)				
Lecture	Tutorial	Practical	Periods/week	Credits	Duration in Hours	MSE	IE	ESE	Total
2	--	--	2	2	2	5	5	40	50

Course Outcomes:
At the end of the course the student will be able to:

CO1 To understand the concepts and design of Smart grid.
CO2 To understand the various communication and measurement technologies in smart grid.
CO3 To study the smart meters used in smart grid.
CO4 To learn the renewable energy resources and storages integrated with smart grid.
CO5 To familiarize the high-performance computing for Smart Grid applications.

Unit	Content	Hours
I	**Introduction** Introduction to Smart Grid: Evolution of Electric Grid, Concept of Smart Grid, Definitions, Need of Smart Grid, Functions of Smart Grid, Opportunities & Barriers of Smart Grid, Difference between conventional & smart grid, Concept of Resilient & Self-Healing Grid, Present development & International policies in Smart Grid. Case study of Smart Grid. CDM opportunities in Smart Grid.	8
II	**Smart Grid Technologies** Introduction to Smart Meters, Real Time Prizing, Smart Appliances, Automatic Meter Reading (AMR), Outage Management System (OMS), Plug in Hybrid Electric Vehicles (PHEV), Vehicle to Grid, Smart Sensors, Home & Building Automation.	8
III	**Smart Meters** Introduction to Smart Meters, Advanced Metering infrastructure (AMI) drivers and benefits, AMI protocols, standards and initiatives, AMI needs in the smart grid, Phasor Measurement Unit (PMU), Intelligent Electronic Devices (IED) & their application for monitoring & protection.	7
IV	**Estimation of Motors Rating** Thermal modeling of motors, Types of duty cycles, Calculation of motor rating for duty cycles, Overload factor calculation for short and intermittent duty cycle, Use of load	7

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	diagrams.	

Text Books

1. Ali Keyhani, Mohammad N. Marwali, Min Dai, "Integration of Green and Renewable Energy in Electric Power Systems", Wiley.
2. Clark W. Gellings, "The Smart Grid: Enabling Energy Efficiency and Demand Response", CRC Press.
3. Janaka Ekanayake, Nick Jenkins, KithsiriLiyanage, Jianzhong Wu, Akihiko Yokoyama, "Smart Grid:
4. Technology and Applications", Wiley.
5. Jean Claude Sabonnadiere, NouredineHadjsaid, "Smart Grids", Wiley Blackwell 19.
6. Stuart Borlase, "Smart Grids (Power Engineering)", CRC Press.

Reference Books

1. Andres Carvallo, John Cooper, "The Advanced Smart Grid: Edge Power Driving Sustainability",Artech House Publishers July 2011.
2. James Northcote, Green, Robert G. Wilson "Control and Automation of Electric Power Distribution Systems (Power Engineering)", CRC Press.
3. MladenKezunovic, Mark G. Adamiak, Alexander P. Apostolov, Jeffrey George Gilbert "SubstationAutomation (Power Electronice and Power Systems)", Springer
4. R.C. Dugan, Mark F. McGranghan, Surya Santoso, H. Wayne Beaty, "Electrical Power System Quality", 2nd Edition, McGraw Hill Publication.

			
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Vth Semester B. Tech. Electrical Engineering (NEP 2020)

Course Code: STPCCELE503

Title of Course: **Electrical Machine-II**

Teaching Scheme					Examination Scheme (Theory)				
Lecture	Tutorial	Practical	Periods/week	Credits	Duration in Hours	MSE	IE	ESE	Total
3	--	--	3	3	3	10	10	80	100

Course Outcomes:

At the end of the course the student will be able to:

- CO1 Analyze the performance and control of induction motors
- CO2 Explain the construction, operation, and characteristics of synchronous machines
- CO3 Evaluate the performance and voltage regulation of synchronous machines
- CO4 Analyze the power flow, stability, efficiency, and parallel operation of synchronous machine
- CO5 Analyze the transient behavior of synchronous machines and explain the operation of special AC motors

Unit	Content	Hours
I	**Induction Motor** Construction and principle of operation of three-phase induction motors. Torque–slip characteristics. Starting methods: Direct-On-Line (DOL), Star-Delta, Autotransformer, Rotor resistance starting. Braking methods: Regenerative braking, Plugging, Dynamic braking. Speed control methods: Pole changing, Frequency control, Rotor resistance control, Supply voltage control. **Single-phase induction motors:** Double field revolving theory, equivalent circuit, split-phase motor, shaded pole motor. No-load and blocked rotor tests.	9
II	**Synchronous Machines – Construction & EMF** Constructional features of salient and cylindrical pole rotor machines. Armature and field windings. Principle of operation as generator and motor. EMF equation, distribution factor, pitch factor, harmonics in induced EMF. Torque equation and starting of synchronous motor.	9
III	**Synchronous Machine Analysis** Cylindrical pole machines: Phasor diagrams and equivalent circuits of motor and	9

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	generator, armature reaction, OC and SC tests, SCR, voltage regulation by synchronous impedance method and Potier's triangle method, synchronous condenser. Salient pole machines: Two-reaction theory, phasor diagrams, equivalent circuits, slip test, determination of direct and quadrature axis reactance	
IV	**Power Flow & Parallel Operation** Power flow equations and power angle characteristics of cylindrical and salient pole machines. Losses and efficiency. V and inverted V curves. Hunting and damper winding. Parallel operation of alternators and load sharing	9
V	**Transients & Special Motors** Sudden three-phase short circuit. Transient and sub-transient reactance and their measurement. Time constants and equivalent circuit. Sequence reactance and their determination. **Special motors (elementary treatment):** Schrage motor, Universal motor, AC series motor, Reluctance motor, Repulsion motor, Hysteresis motor	9

Textbooks

1. Electric Machines, By I.J.Nagrath and D.P.Kothari, Tata McGraw Hill
2. Electrical machinery by Dr.P. S. Bimbhra, Khanna Publisher
3. Generalized Theory of Electrical Machines by Dr.P. S. Bimbhra, Khanna Publisher
4. Electrical Machines by Dr. P.K. Mukherjee & S. Chakravarti, Dhanpat Rai and Sons

Reference Books

1. Electric Machinery by A.E. Fitzgerald, C.Kingsley Jr and Umans, McGraw Hill
2. Performance & Design Of AC Machines By M.G Ray, CBS Publishers & Distributors
3. Fundamentals of Electrical Machines, by B.R. Gupta & Vandana Singhal, New Age International

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Vth Semester B. Tech. Electrical Engineering (NEP 2020)

Course Code: STPCCELE504

Title of Course: **Power System -I**

Teaching Scheme					Examination Scheme (Theory)				
Lecture	Tutorial	Practical	Periods/week	Credits	Duration in Hours	MSE	IE	ESE	Total
3	--	--	3	3	3	10	10	80	100

Course Outcomes:

At the end of the course the student will be able to:

CO1 Understand the various power system components
CO2 Evaluate fault currents for different types of faults.
CO3 Understand the generation of over-voltages and insulation coordination
CO4 Understand basic protection schemes
CO5 Understand concepts of HVDC power transmission and renewable energy generation.

Unit	Content	Hours
I	**Basic Concepts** Evolution of Power Systems and Present-Day Scenario. Structure of a power system: Bulk Power Grids and Micro-grids. Generation: Conventional and Renewable Energy Sources. Distributed Energy Resources. Energy Storage. Transmission and Distribution Systems: Line diagrams, transmission and distribution voltage levels and topologies (meshed and radial systems). Synchronous Grids and Asynchronous (DC) interconnections. Review of Three-phase systems. Analysis of simple three-phase circuits. Power Transfer in AC circuits and Reactive Power	9
II	**System Components** Overhead Transmission Lines and Cables: Electrical and Magnetic Fields around conductors, Corona. Parameters of lines and cables. Capacitance and Inductance calculations for simple configurations. Travelling-wave Equations. Sinusoidal Steady state representation of Lines: Short, medium and long lines. Power Transfer, Voltage Profile and Reactive Power. Characteristics of transmission lines. Surge Impedance Loading. Series and Shunt Compensation of transmission lines. **Transformers:** Three-phase connections and Phase shifts. Three-winding transformers, autotransformers, Neutral Grounding transformers. Tap-Changing in transformers. Transformer Parameters. Single phase equivalent of three-phase transformers	9

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III	**Voltages and Insulation Requirements** Generation of Over-voltages: Lightning and Switching Surges. Protection against Over-voltages, Insulation Coordination. Propagation of Surges. Voltages are produced by travelling surges. Bewley Diagrams. **Voltages and Insulation Requirements** Generation of Over-voltages: Lightning and Switching Surges. Protection against Over-voltages, Insulation Coordination. Propagation of Surges. Voltages are produced by travelling surges. Bewley Diagrams.	9
IV	**Fault Analysis and Protection Systems** Method of Symmetrical Components (positive, negative and zero sequences). Balanced and Unbalanced Faults. Representation of generators, lines and transformers in sequence networks. Computation of Fault Currents. Neutral Grounding. **Switchgear:** Types of Circuit Breakers. Attributes of Protection schemes, Back-up Protection. Protection schemes (Over-current, directional, distance protection, differential protection) and their application.	9
V	**Introduction to DC Transmission & Renewable Energy Systems** **DC Transmission Systems:** Line-Commutated Converters (LCC) and Voltage Source Converters (VSC). LCC and VSC based dc link, Real Power Flow control in a dc link. Comparison of ac and dc transmission. **Solar PV systems:** I-V and P-V characteristics of PV panels, power electronic interface of PV to the grid. Wind Energy Systems: Power curve of wind turbine. Fixed and variable speed turbines. Permanent Magnetic Synchronous Generators and Induction Generators. Power Electronics interfaces of wind generators to the grid	9

Text / References:

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 Education, 2003.
5. B. M. Weedy, B. J. Cory, N. Jenkins, J. Ekanayake and G. Strbac, “Electric Power Systems”, Wiley, 2012.

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Vth Semester B. Tech. Electrical Engineering (NEP 2020)

Course Code: STPCCELE505

Title of Course: **Electrical Machine Design**

Teaching Scheme					Examination Scheme (Theory)				
Lecture	Tutorial	Practical	Periods/week	Credits	Duration in Hours	MSE	IE	ESE	Total
3	--	--	3	3	3	10	10	80	100

Course Outcomes:

At the end of the course the student will be able to:

CO1 Discuss the fundamentals of Electrical machine design and analyse the thermal aspects
CO2 Design single phase and three phase transformers.
CO3 Design three phase induction motor
CO4 Design Three phase synchronous machine
CO5 Compute the performance of machine from design data

Unit	Content	Hours
I	**General Aspects of Electrical Machine Design** Review of materials used in construction of electrical machines, classification of insulating materials based on permissible temperature rise, Properties of Transformer oil, Ratings & specifications of Machines, Heating & Cooling characteristics.	9
II	**Transformer design:** Output equations of single phase & three phase transformers, Voltage per turn for winding, need of stepped core, Specific loading, Window space factor & window dimension, Main dimension, core, yoke, windings design.	9
III	**Operating Characteristics of Transformer:** Evaluation of resistance, leakage reactance of windings, no load current, estimation of loses, regulation, different methods of cooling in transformer, design of cooling tanks, Different mechanical forces acting on transformer.	9
IV	**Induction Machine:** Output equations, specific electrical & magnetic loadings, turns per phase, number of stator slots, calculation of main dimensions and stator design parameters, various stator slots used in induction motor, choice of number of slots, winding design, slot combination for rotor	9

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	of cage rotor and wound rotor design, current and other performance from characteristics for design data.	
V	**Synchronous Machine:** air gap length, method of obtaining sinusoidal output voltage, field coil design for salient pole machine and turbo generator rotor. Ventilation of synchronous generator, cooling air circuits, closed ventilation, quantity of cooling medium-hydrogen and water as cooling media.	9

Textbooks:

1. M. G. Say, "Performance and design of A.C. Machines", Third Edition,2002, CBS Publisher.
2. A. K. Sawhney, "Electrical Machine Design", 2013, Dhanpat Rai and sons.
3. S. K. Sen, "Principles of Electrical Machine Design", 2nd Edition, 2006, Oxford & IBH Publication.
4. R.K Agrawal, "Principles of Electrical Machine Design" SK Kataria &Sons.

Reference Books

1. M.V. Deshpande, "Electrical Machine Design" Third Edition, 2009, PHI Learning Pvt Ltd.
2. J. Pyrhonen, T. Jokinen and V. Hrabovcova, "Design of Rotating Electrical Machines", Wiley,2009.

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Vth Semester B. Tech. Electrical Engineering (NEP 2020)

Course Code: STPECELE506A

Title of Course: **High Voltage Engineering**

Teaching Scheme					Examination Scheme (Theory)				
Lecture	Tutorial	Practical	Periods/week	Credits	Duration in Hours	MSE	IE	ESE	Total
3	--	--	3	3	3	10	10	80	100

Course Outcomes:

At the end of the course the student will be able to:

CO1 Understand the breakdown phenomenon in different insulating mediums
CO2 Identify the over voltages in power systems and mechanism of lightning & its protection
CO3 Describe and analyze various generation techniques for high Voltages and Currents
CO4 Describe measurement of various techniques for high Voltages and Currents
CO5 Understand the Testing of Various electrical equipment's

Unit	Content	Hours
I	**Breakdown in Gases & Liquid Dielectrics** Properties of Insulating materials, Breakdown voltage and Dielectric strength, Ionization process, Townsend's criteria for B.D., Breakdown in electro-negative gases, SF6 as a dielectric, Steamer Theory, Paschen's Law, Time Lag, Vacuum Insulation. Classification and Properties of Liquid Dielectric, Breakdown in Pure and Commercial Liquids, Purification and Reconditioning of Liquid-Dielectrics	9
II	**Breakdown in Solid Dielectrics & Lightning & Switching Over Voltage & Protection** Factors Affecting the Breakdown of Solid, Intrinsic breakdown, Electromechanical breakdown, Thermal breakdown, Treeing and Tracking, Partial Discharge. Mechanism of lightning, Mechanism of Lightning strokes, types of strokes. Origin of Switching surges, Characteristics of switching surges, Power frequency over voltages, Control of over voltages due to switching. Protection of lines by ground wires, Tower Footing resistance, Protection by lightning arrester, gap type and gapless L.A., Selection and ratings of L.A., Surge Absorbers.	9
III	**Generation of High voltages & Current** Generation of High D.C. voltages by rectifiers, Voltage doubler Circuits and multiplier	9

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	circuits (Derivations of expression not required). Electrostatic Machines, Generation of high A.C. Voltages by Cascade Transformers, Resonant transformers. Generation of High-Frequency A.C. High Voltages, **Generation of Impulse Voltages:** Standard Impulse Wave shapes, Circuits for producing Impulse Waves, Marx Circuit, Generation of Switching Surges, Generation of Impulse Current	
IV	**Measurement of High Voltages & Current** Measurement of high AC and DC voltages by micro ammeter, generating voltmeters, resistance and capacitance potential divider, Series impedance voltmeter, CVT, Magnetic type potential transformers, Electrostatic voltmeter, Peak reading AC voltmeter, Sphere Gap arrangement. Measurement of Impulse voltage by potential dividers and peak reading voltmeters. Measurement of high AC, DC currents, measurement of high frequency and impulse current by resistive shunts (Bifiliar strip shunt only)	9
V	**Non-Destructive & High Voltage Testing** **Non-destructive testing:** Measurement of DC Resistivity, Measurement of Dielectric constant and loss- factor (low and power frequency only), Schering bridge for high charging circuits, for high dissipation factor, Transformer ratio arm bridges. Partial discharge measurements by balance detectors. **High Voltage Testing**: Testing of insulators, bushings, isolators, circuit breakers, cables transformers, lightning arresters and power capacitors	9

Textbooks

1. High Voltage Engineering by M. S. Naidu and V. Kamaraju, Tata McGraw Hill
2. Fundamentals of High Voltage Engineering by S. K. Singh, Dhanpat Rai & Co.
3. High Voltage engineering by C.L. Wadhawa, Wiley Eastern Ltd.

Reference Books

1. High Voltage Engineering by M. P. Chaurasia, Khanna Publishers.
2. An Introduction to High Voltage Engineering by Subir Ray, Prentice Hall of India.
3. High Voltage Engineering - Theory & Practice by M. Khalifa, Marcel Dekker

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Vth Semester B. Tech. Electrical Engineering (NEP 2020)

Course Code: STPECELE506B

Title of Course: **Digital Electronics Circuits**

Teaching Scheme					Examination Scheme (Theory)				
Lecture	Tutorial	Practical	Periods/week	Credits	Duration in Hours	MSE	IE	ESE	Total
3	--	--	3	3	3	10	10	80	100

Course Outcomes:

At the end of the course the student will be able to:

CO1 Understand the working of logic families and logic gates
CO2 Design and implement Combinational and Sequential logic circuits
CO3 Implement the conversion between converters
CO4 Design logical circuits using different flip flops
CO5 Discuss the Semiconductor Memories and Programmable Logic Devices

Unit	Content	Hours
I	**Fundamentals of Digital Systems and Logic Families**: Digital signals, Digital circuits, AND, OR, NOT, NAND, NOR and Exclusive-OR operations. Boolean algebra, Examples of IC gates, Number systems-binary, Signed binary, Octal hexadecimal number, Binary arithmetic, One's and Two's complements arithmetic.	9
II	**Combinational Circuits-I:** Standard representation for logic functions, K-map representation and simplification of logic functions using K- map, Minimization of logical functions, don't care conditions, Multiplexer, De-Multiplexer.	9
III	**Combinational Circuits-II:** Adders, Subtractors, Carry look ahead adder, Digital comparator, Parity checker/generator, Code converters, Priority encoders, Decoders/Drivers for display devices, Q-M method of function realization.	9
IV	**Sequential Circuits:** Introduction to flip-flops, SR, JK, T and D type's flip-flops, Shift registers, Conversion of flip-flops, Ring counter, Ripple (Asynchronous) counters, Synchronous counters	9
V	**Semiconductor Memories and Programmable Logic Devices:** Memory organization and operation, expanding memory size, classification and	9

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	characteristics of memories, sequential memory, read-only memory (ROM), ROM types, Read and write memory (RAM) types, Programmable logic array, Programmable array logic, Field Programmable Gate Array (FPGA).	

Text Books:

1. A. Kumar, "Fundamentals of Digital Circuits",4th Edition, Prentice Hall India, 2016.
2. M. M. Mano, "Digital logic and Computer design", Pearson Education India, 2016.
3. M. Morris Mano and Michael D. Ciletti, “Digital Design”, 5th Edition, Pearson, 2014.
4. Anil K. Maini, “ Digital Electronics”, Wiley, 2014.

Reference Books:

1. R.S. Sedha, “A Textbook of Digital Electronics”, S.Chand, 2005
2. R. P. Jain, "Modern Digital Electronics", McGraw Hill Education,2009.
3. Charles H. Roth, “ Fundamental of Logic Design”, 6th Edition, Thomson Learning, 2013.
4. Thomas L. Floyd, “ Digital Fundamentals”, 10th Edition, Pearson Education Inc,2011.

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Vth Semester B. Tech. Electrical Engineering (NEP 2020)

Course Code: STPCCELE507

Title of Course: Electrical Machine-II Lab

Teaching Scheme					Examination Scheme (Practical)			
Lecture	Tutorial	Practical	Periods/week	Credits	Duration in Hours	CA	UA	Total
--	--	2	2	1	--	25	25	50

Course outcomes:

After completing the course, the students will be able to.

CO1 Perform tests on induction motors to determine performance and equivalent circuit parameters.

CO2 Analyze the starting and speed control methods of three-phase induction motors.

CO3 Perform alternator tests to determine voltage regulation and machine parameter.

CO4 Evaluate the performance of synchronous motors using standard characteristic tests.

CO5 Investigate alternator reactance and demonstrate synchronization and parallel operation

Lab Activities: A minimum of eight Practical should be performed from the topics listed below.

List of practical:

1. No-load and Blocked Rotor Test on Three-Phase Induction Motor
2. Load Test on Three-Phase Induction Motor
3. Speed Control of Three-Phase Induction Motor (V/f control or rotor resistance method)
4. Starting Methods of Three-Phase Induction Motor (DOL, Star-Delta, Autotransformer)
5. Brake Test on Three-Phase Induction Motor
6. Load Test on Single-Phase Induction Motor (Split Phase / Capacitor Start)
7. Open Circuit (OC) and Short Circuit (SC) Test on Alternator

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8. Voltage Regulation of Alternator by Synchronous Impedance Method
9. Voltage Regulation of Alternator by Potier's Triangle Method
10. Slip Test on Salient Pole Synchronous Machine
11. V and Inverted V Curves of Synchronous Motor
12. Load Test on Synchronous Motor
13. Determination of Transient and Sub-Transient Reactance of Alternator
14. Parallel Operation of Alternators.

A Journal/Report on practical conducted shall be submitted by each student. University Practical examination shall be on viva-voce of 10 marks and practical performance or objective test of 15 marks.

			
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Vth Semester B. Tech. Electrical Engineering (NEP 2020)

Course Code: STPCCELE508

Title of Course: Power System Lab-I Lab

Teaching Scheme					Examination Scheme (Practical)			
Lecture	Tutorial	Practical	Periods/week	Credits	Duration in Hours	CA	UA	Total
--	--	2	2	1	--	25	25	50

Course outcomes:

After completing the course, the students will be able to.

CO1 Understand the concepts measurement of power and power factor of system

CO2 Analyze the performance of transmission lines.

CO3 Analyze the various faults of transmission lines**.**

CO4 Get apprehensive to various types of circuit breaker and protection scheme.

CO5 Get apprehensive to various types HVDC power transmission and renewable energy generation

Lab Activities: A minimum of eight Practical should be performed from the topics listed below.

List of practical:

1. To perform measurement of analysis of Active and Reactive power of three phase circuit under different loads on system.
2. To perform measurement of analysis Power factor of three phase circuit under different loads on system
3. To perform analysis of short transmission line by two port representation
4. To perform analysis of medium short transmission line by nominal-pi representation
5. To perform analysis of medium short transmission line by nominal-T representation
6. To perform analysis of long, short transmission line by nominal-pi representation

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7. To perform analysis of long, short transmission line by nominal-T representation
8. To perform measurement of Sequence components analysis of Voltage and Current under L-G fault
9. To perform measurement of Sequence components analysis of Voltage and Current under L-L-G fault
10. To perform measurement of Sequence components analysis of Voltage and Current under L-L-L-G fault
11. Study of different parts of circuit breakers
12. Study of types of circuit breakers as per arc extinguishing media.
13. To perform over current protection scheme for transmission line.
14. To perform distance protection scheme for transmission line

A Journal/Report on practical conducted shall be submitted by each student. University Practical examination shall be on viva-voce of 10 marks and practical performance or objective test of 15 marks.

			
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Vth Semester B. Tech. Electrical Engineering (NEP 2020)

Course Code: STPECELE509A

Title of Course: High Voltage Engineering Lab

Teaching Scheme					Examination Scheme (Practical)			
Lecture	Tutorial	Practical	Periods/week	Credits	Duration in Hours	CA	UA	Total
--	--	2	2	1	--	25	25	50

Course outcomes:

After completing the course, the students will be able to.

CO1 To conduct test and study breakdown in different types of dielectrics.

CO2 Analyze and compare various methods for generation and measurement of high voltages and currents in power system.

CO3 Analyze and compare various methods for measurement of high voltages and currents in high voltage engineering.

CO4 Identify different techniques used for high voltage testing of electrical apparatus

CO5 Ability to understand the concepts of high voltage engineering and submit a report

Lab Activities: A minimum of eight Practical should be performed from the topics listed below.

List of practical:

1. Measurement of Breakdown strength of liquid dielectric
2. Measurement of breakdown strength of solid dielectric.
3. Effect of electrode configuration on breakdown of an air (uniform gaps)
4. Effect of electrode configuration on breakdown of an air (non-uniform gaps)
5. Study of horn gap arrester
6. Peak voltage measurement using sphere gap

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7. Study of impulse wave shape of standard lightning and switching impulse.
8. Flashover and breakdown test on insulator.
9. Simulation of Voltage Doubler Circuit for Generating the High DC Voltage.

A Journal/Report on practical conducted shall be submitted by each student. University Practical examination shall be on viva-voce of 10 marks and practical performance or objective test of 15 marks.

			
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Vth Semester B. Tech. Electrical Engineering (NEP 2020)

Course Code: STPECELE509B

Title of Course: Digital Electronics Circuits Lab

Teaching Scheme					Examination Scheme (Practical)			
Lecture	Tutorial	Practical	Periods/week	Credits	Duration in Hours	CA	UA	Total
--	--	2	2	1	--	25	25	50

Course outcomes:

After completing the course, the students will be able to.

CO1 Explain the fundamental concepts and techniques used in digital electronics.

CO2 Analyze various number systems and perform conversions for digital design applications.

CO3 Analyze and design combinational and sequential digital circuits.

CO4 Identify design requirements and develop cost-effective digital systems using flip-flops, registers, and counters

CO5 Explain and evaluate the operation and performance of various digital electronic circuits

Lab Activities: A minimum of eight Practical should be performed from the topics listed below.

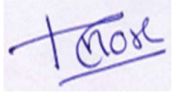
List of practical:

1. Study of Logic gates – AND, OR, NOT, NAND, NOR, EX-OR, EXNOR.
2. To realize and minimize 5 & 6 variables using K-Map Method
3. To design and implement multiplexer and demultiplexer using logic gates and study of IC 74150 and IC 74154.
4. To design and implement of 2-bit and 8-bit magnitude comparator.
5. Verification of state tables of SR, JK, D flip-flops using NAND & nor gates.
6. To verify the operation of bi-directional shift register.
7. To design & verify the operation of 3-bit synchronous counter.

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8. Design and verification of the truth table of Half adder and Full adder circuits.
9. Design and verification of the truth table of Half subtractor and Full subtractor circuits.
10. To verify the NAND and NOR gates using universal gates.
11. To verify Binary to Gray code conversion.
12. To verify Gray to Binary code conversion.

A Journal/Report on practical conducted shall be submitted by each student. University Practical examination shall be on viva-voce of 10 marks and practical performance or objective test of 15 marks.

			
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Vth Semester B. Tech. Electrical Engineering (NEP 2020)

Course Code: STVSECELE510

Title of Course: Soft Skills

Teaching Scheme					Examination Scheme (Practical)			
Lecture	Tutorial	Practical	Periods/week	Credits	Duration in Hours	CA	UA	Total
--	01	02	02	02	--	50	--	50

Course outcomes:

After completing the course, the students will be able to.

CO1 Explain the concept of attitude and apply techniques to develop a positive attitude.

CO2 Demonstrate effective communication skills in professional and social contexts.

CO3 Prepare and perform confidently in various types of selection interviews.

CO4 Apply emotional intelligence and professional ethics for effective workplace behavior

Unit	Content	Hours
I	**Positive Attitude**: Attitude, features of attitudes, formation of attitude, psychological factors, change of attitudes, ways of changing attitude in a person, the power of positive attitude, the benefits of positive attitude, developing positive attitude, obstacles in developing positive attitude, negative attitude, the causes of negative attitude, the consequences of negative attitude, how to change negative attitude	8
II	**Communication Skills**: Communication process, types of communication, barriers to effective communication, listening skills, speaking skills, Non-verbal communication, dealing with conflict Barriers to communication, overcoming barriers, importance of tone of voice, voice clarity, verbal expressiveness, tips to develop communication skills, government initiatives, job roles	8
III	**Selection Interview**: Introduction, interview-meaning, interview structure, interview panel, types of interviews, questions looked for in interviews, preparation before interview, Body language, dos and don'ts, standard interview questions, your answer to questions	7
IV	**Emotional Intelligence & Workplace Professionalism**: Meaning of Emotional Intelligence (EI), Components of EI (Self-awareness, Self-regulation, Motivation,	7

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	Empathy, Social skills), Managing stress and emotions at workplace, Time management and work-life balance, Professional ethics and workplace behaviour, Teamwork and leadership skills, Workplace etiquette (email writing, meeting behaviour, dress code), Corporate expectations and workplace culture, Handling workplace pressure and criticism	

Textbooks:

1. Raman, M. & Singh, P., *Business Communication*, Oxford University Press.
2. Rizvi, M. A., *Effective Technical Communication*, McGraw Hill Education.

Reference Books:

1. R. R. Gaur, R. Sangal, and G. P. Bagaria, *Professional Ethics and Human Values*. New Delhi, India: Excel Books.
2. Aggarwal, R. S., *A Modern Approach to Verbal & Non-Verbal Reasoning,* S. Chand Publishing
3. Carnegie, D., *How to Win Friends and Influence People*, Simon & Schuster.
4. Arihant Experts, *How to Crack Test of Group Discussion & Personal Interview*, Arihant Publications.

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VIth Semester B. Tech. Electrical Engineering (NEP 2020)

Course Code: STMDMELE601

Title of Course: **Power System Protection (Multi-Disciplinary Minor – IV(MDM-IV))**

Teaching Scheme					Examination Scheme (Theory)				
Lecture	Tutorial	Practical	Periods/week	Credits	Duration in Hours	MSE	IE	ESE	Total
3	--	--	3	3	3	10	10	80	100

Course Outcomes:

At the end of the course the student will be able to:

CO1 Explain the fundamentals of arc interruption and the operation of circuit breakers.
CO2 Explain the principles and applications of protective relays and overcurrent protection schemes.
CO3 Analyze transmission line protection using distance and carrier current protection schemes.
CO4 Analyze the protection schemes for transformers, generators, busbars, and induction motors.
CO5 Explain the operation and applications of static and microprocessor-based digital relays

Unit	Content	Hours
I	**Fundamentals of Arc Interruption** Fundamentals of Arc Interruption: Current interruption in AC circuit breaker, high & low resistance principles, arc interruption theories, arc voltage, recovery voltage, restricting voltage and RRRV, current chopping, interruption of capacitive and inductive current	9
II	**Fundamentals of Protective Relaying** Fundamentals of Protective Relaying: Need for protective system, nature & causes of fault, types of faults, effects of faults, evolution of protective relaying, zones of protection. Attracted armature and Induction disc type electromagnetic relays.	9
III	**High voltage line protection** Introduction to distance protection, impedance relay, reactance relay and mho relay, Methods of relay settings Connections of impedance, reactance and mho relays, Effect of arc resistance, Line length and source impedance and power swing on performance of distance relays, Carrier current protection.	9
IV	**Equipment protection**	9

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	Transformer Protection: Types of faults in transformers. Percentage differential protection in transformers, Inrush phenomenon, percentage differential relay with harmonic restraint. Restricted E/F protection. Buchholz relay, Phenomenon of over fluxing in transformers, protection against over fluxing. Generator Protection: Various faults, abnormal operating conditions- stator faults, longitudinal percentage differential scheme and transverse percentage differential scheme. Rotor faults- abnormal operating conditions, inter turn fault, unbalance loading, over speeding, loss of excitation, protection against loss of excitation using offset Mho relay, loss of prime mover. **Protection of induction motor**: Abnormal operating conditions and causes of failures in induction motors, Protection against overloads, unbalance and single phasing, stator fault protection.	
V	**Introduction to static and Microprocessor based Digital relay** Introduction to static relay: Comparison of static and electromechanical relays, two input amplitude and phase comparator and their duality. Generation of various distance and over current relay characteristics using comparators. **Microprocessor based Digital Relaying:** Introduction, Digital logic communication, Direct relay to relay digital logic communication, Digital message security, Relay interface with utility, Microprocessor based over current, impedance, reactance and mho relay, Applications of Microprocessor based relays.	9

Textbooks

1. S. Rao, “Switchgear Protection and Power Systems”, Khanna Publications
2. Y. G. Paithankar, S. R. Bhide, “Fundamentals of Power System Protection”, Prentice Hall of India
3. Badri Ram, D. N. Vishwakarma, “Power System Protection and Switchgear”, Tata McGraw Hill
4. Ravindra P.Singh, “Switchgear and Power System Protection” Prentice Hall of India

Reference Books

1. C.R.Mason, “Art and science of protective relaying” Wiley Eastern Ltd.
2. C.L.Wadhwa, Electrical Power Systems, New Age international (P) Limited, Publishers
3. B.L.Soni, Gupta, Bhatnagar, Chakrabarthy, A Text book on Power System Engineering, Dhanpat Rai & Co.

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VIth Semester B. Tech. Electrical Engineering (NEP 2020)

Course Code: STPCCELE602

Title of Course: **Control System**

Teaching Scheme					Examination Scheme (Theory)				
Lecture	Tutorial	Practical	Periods/week	Credits	Duration in Hours	MSE	IE	ESE	Total
3	--	--	3	3	3	10	10	80	100

Course Outcomes:

At the end of the course the student will be able to:

CO1 Model different types of systems.
CO2 Analyze linear control system in time domain and frequency domain.
CO3 Apply different techniques and methods to determine the stability of linear control system.
CO4 Design linear controllers
CO5 Design compensator to achieve desired performance for linear control system

Unit	Content	Hours
I	**Mathematical modeling of physical systems** State variable and Transfer function representations; Examples of modeling different types of systems (e.g. Electrical, mechanical etc.), Duality between the elements of different types of systems, Linearity and linearization, Transfer function and its interpretation in terms of impulse and frequency responses, Block-diagram and signal flow graph manipulations	**9**
II	**Characterization of systems** System types, time domain response for first order and second order systems; Steady state errors; Effect of dominant poles and zeros on system response; Frequency domain response of LTI system; peaking frequency, bandwidth; Link between time and frequency domain response indices.	**9**
III	**Stability Analysis of closed loop systems** Stability and relative stability, Stability analysis using Routh-Hurwitz, Root-locus approach, Bode and Nyquist plots.	**9**
IV	**State space modelling and state feedback control** State space modelling, Controllability and observability, State feedback and observer design.	**9**

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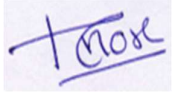
V	**Compensator design** Approaches and Preliminary consideration, Need for compensation, Common compensating network, Transfer function of Lag, Lead and Simple Lag-Lead network, Analysis and design of compensator in time and frequency domain using root locus and Bode Plot, Physical realization of compensators using Active and Passive elements, PID Controller Design	**9**

Text / References:

1. Franklin, G. F., Powell J. D., and Emami-Naeini, A. E., (2002), Feedback Control
2. of Dynamic Systems, Prentice Hall Inc.
3. Nise, N., (2007), Control Systems Engineering, Wiley India
4. Gopal, M., (2008), Control Systems; Tata McGraw Hill

Self-Learning Material

1. Gopal, M., Control Engineering, NPTEL Course Material, Department of Electrical Engineering, Indian Institute of Technology Delhi, https://nptel.ac.in/courses/108102043/

			
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VIth Semester B. Tech. Electrical Engineering (NEP 2020)

Course Code: STPCCELE603

Title of Course: **Power Electronics**

Teaching Scheme					Examination Scheme (Theory)				
Lecture	Tutorial	Practical	Periods/week	Credits	Duration in Hours	MSE	IE	ESE	Total
3	--	--	3	3	3	10	10	80	100

Course Outcomes:

At the end of the course the student will be able to:

CO1 Understand the characteristics and operation of power electronics switches such as diode, SCR, MOSFET, and IGBT.

CO2 Analyze operation and performance of different power electronics converter such as rectifiers, choppers, and inverters.

CO3 Apply the principles of power electronics to control and convert electrical power in various applications.

CO4 Evaluate the performance of power electronic circuits with respect to efficiency, harmonics, and power factor.

CO5 Design basic power electronic converter circuits for different applications such as motor drives and power supplies

Unit	Content	Hours
I	**Power Electronic Switches, connections, protection and switching circuits** Thyristor Family, Two Transistor model of SCR, Gate Characteristic, Turn On, Turn Off Mechanisms of SCRs, Review of diode, BJT, MOSFET, IGBT as switching devices, SCR switching circuits, Basic Firing Circuits for SCR, AC Power control using TRIAC- DIAC, Need & methods of multiple connections of SCRs, Design of Equalizing Circuits, Firing Circuits during multiple connection, Gate protection, over current & over voltage protections of SCR, Design of Snubber Circuit	**9**
II	**Controlled rectifiers** Single phase-controlled rectifiers with R, R-L, R-L-E load, effect of source inductance, three phase rectifiers, dual converters, power factor, and harmonics in single phase and three phase rectifiers.	**9**

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III	**DC-DC converters: (10 Lectures)** Step-up and step-down converters with various type of loads, buck, boost, buck boost and cuk regulators, isolated DC-DC converters. Introduction to switched-mode, resonant and bidirectional AC and DC power supplies	**9**
IV	**Inverters:** Voltage source inverter: Principle of operation, single-phase and three-phase bridge inverter, 120° and 180° conduction, series and parallel inverter, voltage control & PWM strategies and implementation aspects, space-vector-modulation, current source inverters: single phase and three phase power circuit configuration and analysis, other converter topologies: PWM rectifiers, dual active bridge topology, introduction to multilevel inverters	**9**
V	**AC voltage controller** AC voltage Control: Principle of ON-OFF and phase control, single phase and three phase controllers, Cycloconverter: Basic Principle of Operation, Single-phase to Single-phase Cycloconverter, Three-phase Half-wave Cycloconverters, Cycloconverter Circuits for Three-Phase Output, Load-Commutated Cycloconverter	**9**

Textbook

1. Rashid, M.H., (2004), Power Electronics Circuits, Devices, and Applications, 3rd Edition,Pearson Education Inc.
2. Hart, D.W., (2011), Power Electronics, Tata McGraw-Hill Education Private Limited.
3. Mohan, N., (2007), First Course on Power Electronics and Drives, MNPERE.

Self-Learning Material

1. Bhuvaneswari, G., Power Electronics, NPTEL Course Material, Department of Electrical Engineering, Indian Institute of Technology Delhi, https://nptel.ac.in/courses/108/102/108102145/

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VIth Semester B. Tech. Electrical Engineering (NEP 2020)

Course Code: STPCCELE604

Title of Course: **Power System -II**

Teaching Scheme					Examination Scheme (Theory)				
Lecture	Tutorial	Practical	Periods/week	Credits	Duration in Hours	MSE	IE	ESE	Total
3	--	--	3	3	3	10	10	80	100

Course Outcomes:

At the end of the course the student will be able to:

CO1 Use numerical methods to analyse a power system in steady state.
CO2 Understand stability constraints in a synchronous grid
CO3 Understand methods to control the voltage, frequency and power flow
CO4 Understand the monitoring and control of a power system
CO5 Understand the basics of power system economics

Unit	Content	Hours
I	**Power Flow Analysis** Review of the structure of a Power System and its components. Analysis of Power Flows: Formation of Bus Admittance Matrix. Real and reactive power balance equations at a node. Load and Generator Specifications. Application of numerical methods for solution of non-linear algebraic equations – Gauss Seidel and Newton-Raphson methods for the solution of the power flow equations. Computational Issues in Large-scale Power Systems	**9**
II	**Stability Constraints in synchronous grids** Swing Equations of a synchronous machine connected to an infinite bus. Power angle curve. Description of the phenomena of loss of synchronism in a single-machine infinite bus system following a disturbance like a three-phase fault. Analysis using numerical integration of swing equations (using methods like Forward Euler, Runge-Kutta 4th order methods), as well as the Equal Area Criterion. Impact of stability constraints on Power System Operation. Effect of generation rescheduling and series compensation of transmission lines on stability.	**9**
III	**Control of Frequency and Voltage** Turbines and Speed-Governors, Frequency dependence of loads, Droop Control and	**9**

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	Power Sharing. Automatic Generation Control. Generation and absorption of reactive power by various components of a Power System. Excitation System Control in synchronous generators, Automatic Voltage Regulators. Shunt Compensators, Static VAR compensators and STATCOMs. Tap Changing Transformers. Power flow control using embedded dc links, phase shifters.	
IV	**Monitoring and Control** Overview of Energy Control Centre Functions: SCADA systems. Phasor Measurement Units and Wide-Area Measurement Systems. State- estimation. System Security Assessment. Normal, Alert, Emergency, Extremis states of a Power System. Contingency Analysis. Preventive Control and Emergency Control.	**9**
V	**Power System Economics and Management** Basic Pricing Principles: Generator Cost Curves, Utility Functions, Power Exchanges, Spot Pricing. Electricity Market Models (Vertically Integrated, Purchasing Agency, Whole-sale competition, Retail Competition), Demand Side-management, Transmission and Distributions charges, Ancillary Services. Regulatory framework	**9**

Text / References:

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. 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 Education, 2003.
5. M. Weedy, B. J. Cory, N. Jenkins, J. Ekanayake and G. Strbac, “Electric Power Systems”, Wiley, 2012

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VIth Semester B. Tech. Electrical Engineering (NEP 2020)

Course Code: STPECELE605A

Title of Course: **Electrical Drives**

Teaching Scheme					Examination Scheme (Theory)				
Lecture	Tutorial	Practical	Periods/week	Credits	Duration in Hours	MSE	IE	ESE	Total
3	--	--	3	3	3	10	10	80	100

Course Outcomes:

At the end of the course the student will be able to:

CO1 Explain fundamentals of electric drives and load characteristics.
CO2 Analyze performance of DC motor drives using power electronic converters.
CO3 Evaluate control techniques of induction motor drives.
CO4 Calculate motor ratings for different duty cycles.
CO5 Assess operation and stability of synchronous motor drives

Unit	Content	Hours
I	**Electric Drives** Introduction to electric drives: Advantages of Electric drives, Choice of Electric Drives and Losses. Latest trends in DC & AC Drives, Dynamics, Equivalent values of drive parameters, Load Torque: component, Natures and classification, steady state stability, Speed-torque characteristics, criteria load equalization	**9**
II	**DC Motor Drives** Starting, Braking, Speed control of DC motors using single phase fully controlled and half-controlled rectifiers. Three phases fully controlled and half-controlled converter fed DC motor drives. Chopper controlled DC drives.	**9**
III	**Induction Motor Drives** Three phase induction motor drives, ac voltage-controlled drives, VSI fed induction motor drive, stator side control, scalar control and vector control, rotor side control, slip power recovery scheme, CSI controlled induction motor drives. Regeneration in drives: dynamic braking, regenerative braking, dc injection, plugging.	**9**
IV	**Estimation of Motors Rating**	**9**

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	Thermal modeling of motors, Types of duty cycles, Calculation of motor rating for duty cycles, Overload factor calculation for short and intermittent duty cycle, Use of load diagrams	
V	**Synchronous Motor Drives** Steady state & dynamic stability limits of synchronous motor drives, True synchronous & self-synchronous modes of operation, Variable frequency control of multiple synchronous motors, Self-controlled synchronous motor drive employing load commutated thruster inverter, starting of large synchronous machines, Self-controlled synchronous motor drive employing cycloconverters	**9**

Textbooks

1. "Fundamentals of Electric Drives", by G K Dubey, Narosa Publications.
2. "Power Electronic Circuits, Devices and applications", by M.H.Rashid, Prentice Hall of India.
3. "Modern Power Electronics and AC Drive", by B.K. Bose, Pearson Education.
4. "Electric Drives", N. K. De, P. K. Sen, Prentice Hall of India Eastern Economy Edition.

Reference Books

1. "Thyristor Control of Electric drives" by Vedam Subramanyam, Tata McGraw Hill Publilcations.
2. "A First course on Electrical Drives", by S K Pillai, New Age International(P) Ltd. 2
3. "Electric Drives", by S.K.Pillai, University Press India, 1993.
4. "Control of electrical drives", by Werner Leonhard, Springer, 1995.
5. "Electric Drives: Concepts & Application", by V. Subramanyam, Tata Mc-Graw Hill.
6. "Power semiconductor Drives", S. B. Dewan & G. R. Stemon& A. Straughen, Wiley Inter Science.
7. "Power Electronics, Devices,Circuits and Industrial Applications", V.R.Moorthi,"Oxford UniversityPress,2005

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VIth Semester B. Tech. Electrical Engineering (NEP 2020)

Course Code: STPECELE605B

Title of Course: **Power System Operation and Control**

Teaching Scheme					Examination Scheme (Theory)				
Lecture	Tutorial	Practical	Periods/week	Credits	Duration in Hours	MSE	IE	ESE	Total
3	--	--	3	3	3	10	10	80	100

Course Outcomes:

At the end of the course the student will be able to:

CO1 Understand importance of frequency and real power control.
CO2 Evaluate various reactive power control methods in power systems.
CO3 Analyze economic load dispatch problems using analytical and iterative methods to minimize the total cost of power generation.
CO4 Understand the concept of unit commitment
CO5 Discuss the real-time functions of SCADA and EMS

Unit	Content	Hours
I	**Load Frequency Control:** Speed governing mechanisms, load sharing between parallel machines, and control area concepts, Static and dynamic analysis of single and two-area systems (controlled vs. uncontrolled), State-variable models and frequency bias control for tie-lines.	9
II	**Reactive Power Voltage Control:** Excitation system modelling, generation/absorption of reactive power, and stability compensation, Tap-changing transformers (OLTC), generator voltage magnitude settings, and switched capacitor MVAR injection, maintaining voltage profiles and minimizing transmission losses.	9
III	**Economic Operation of Power Systems:** Economic dispatch problem, incremental cost curves, and coordination equations (with/without losses), Direct method and λ-iteration method, Load/duration curves, diversity, capacity, and utilization factors.	9
IV	**Unit Commitment:**	

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	Spinning reserves, thermal/hydro/fuel constraints, and scheduling requirements, Priority List method (using full-load average production cost) and Forward Dynamic Programming.	9
V	**Computer Control of Power Systems:** Necessity of computer control and Energy Control Centres (ECC), Load Dispatch Centre operations, SCADA (Supervisory Control and Data Acquisition), and EMS (Energy Management System) functions.	9

Text Books:

1. D.P. Kothari and I.J. Nagrath, 'Modern Power System Analysis', Third Edition, Tata McGraw Hill Publishing Company Limited, New Delhi, 2003.
2. Olle. I. Elgerd, 'Electric Energy Systems Theory: An Introduction', Tata McGraw Hill Publishing Company Ltd, New Delhi, 30th reprint,2007.
3. J. Wood, B. F. Wollenberg, & G. B. Sheble, Power Generation, Operation, and Control', John Wiley & Sons.

Reference Books:

1. Chakrabarti & Haldar, "Power System Analysis: Operation and Control", Prentice Hall of India, 2004 Edition.
2. C. L. Wadhwa, 'Power System Analysis', New Age International- 6th Edition, 2010.
3. Robert Miller, James Malinowski, 'Power System Operation', Tata McGraw Hill Publishing Company Ltd, New Delhi, 3E, JUN-09.
4. P. Kundur, Neal J. Balu, 'Power System Stability & Control', IEEE, 1998. 5. Power System Analysis by Hadi Saadat – TMH Edition.

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VIth Semester B. Tech. Electrical Engineering (NEP 2020)

Course Code: STPECELE606A

Title of Course: **Advanced Microprocessor System and Microcontroller**

Teaching Scheme					Examination Scheme (Theory)				
Lecture	Tutorial	Practical	Periods/week	Credits	Duration in Hours	MSE	IE	ESE	Total
3	--	--	3	3	3	10	10	80	100

Course Outcomes:

At the end of the course the student will be able to:

CO1 Explain advanced microprocessor architectures, memory organization, and performance enhancement techniques.

CO2 Design and analyze memory and peripheral interfacing schemes for microprocessor-based systems.

CO3 Apply programming concepts and architectural features of advanced microcontrollers and ARM Cortex-M processors.

CO4 Develop embedded system applications using communication protocols, sensors and actuators

CO5 Design and implement embedded solutions for industrial automation, IoT, energy management, and real-time control applications

Unit	Content	Hours
I	**Advanced Microprocessors Architecture** Review of microprocessor fundamentals, Architecture of 8086 and Pentium processors, Pipelining and superscalar concepts, Cache memory organization and memory hierarchy, Virtual memory concepts, Interrupt handling mechanisms, Direct Memory Access (DMA).	**9**
II	**Memory and Peripheral Interfacing** Memory interfacing techniques, Address decoding methods, Programmable Peripheral Interface (8255), Programmable Interval Timer (8254), Programmable Interrupt Controller (8259), USART (8251) and serial communication. DMA Controller (8237).	**9**
III	**Advanced Microcontrollers and ARM Architecture** Introduction to embedded systems, Architecture and features of 8051 microcontroller,	**9**

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	enhanced 8051 family, ARM Cortex-M architecture and programming model, register organization and instruction set, Timers, counters, watchdog timers, interrupt handling and power management techniques.	
IV	**Embedded System Design and Communication Protocols** Embedded C programming concepts, Development environments and debugging tools, GPIO programming, ADC, DAC and PWM techniques. UART, SPI and I²C communication protocols, Sensor and actuator interfacing	**9**
V	**Applications of Advanced Microcontrollers** IoT-enabled embedded systems, Smart energy management applications, Industrial automation and process control, Motor control applications.	**9**

Suggested Textbooks

1. Ramesh S. Gaonkar, Microprocessor Architecture, Programming and Applications with the 8085, Penram Publications.
2. Douglas V. Hall, Microprocessors and Interfacing, McGraw-Hill.
3. Muhammad Ali Mazidi, Janice Mazidi and Danny Causey, The 8051 Microcontroller and Embedded Systems, Pearson.
4. Jonathan W. Valvano, Embedded Systems: Introduction to ARM Cortex-M Microcontrollers, Cengage Learning.

Reference Books

1. Raj Kamal, Embedded Systems: Architecture, Programming and Design, McGraw-Hill.
2. Andrew N. Sloss, Dominic Symes and Chris Wright, ARM System Developer's Guide, Morgan Kaufmann.
3. Kenneth J. Ayala, The 8051 Microcontroller, Cengage Learning.
4. Frank Vahid and Tony Givargis, Embedded System Design, Wiley.

			
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VIth Semester B. Tech. Electrical Engineering (NEP 2020)

Course Code: STPECELE606B

Title of Course: **Programming Techniques & Simulation**

Teaching Scheme					Examination Scheme (Theory)				
Lecture	Tutorial	Practical	Periods/week	Credits	Duration in Hours	MSE	IE	ESE	Total
3	--	--	3	3	3	10	10	80	100

Course Outcomes:

At the end of the course the student will be able to:

CO1 Understand fundamental programming concepts and structured programming techniques.
CO2 Develop modular programs using functions, arrays, pointers, and structures.
CO3 Apply object-oriented programming principles for problem solving
CO4 Design and implement basic simulation models using appropriate programming tools
CO5 Analyze, validate, and interpret simulation results for real-world system

Unit	Content	Hours
I	**Fundamentals of Programming** Problem-solving approaches and algorithms, Flowcharts and pseudocode, Basics of C/C++ programming, Data types, variables, operators, Input/output statements, Control structures (if, switch, loops)	**9**
II	**Fundamentals of Programming** Problem-solving approaches and algorithms, Flowcharts and pseudocode, Basics of C/C++ programming, Data types, variables, operators, Input/output statements, Control structures (if, switch, loops)	**9**
III	**Object-Oriented Programming Concepts** Principles of OOP, Classes and objects, Constructors and destructors, Inheritance, Polymorphism, Function overloading and operator overloading, File handling basics	**9**
IV	**Modular Programming & Data Structure** System concepts and models, Types of simulation models, Steps in simulation study, Random number generation, Monte Carlo simulation, Probability and statistical concepts in simulation	**9**

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V	**Modelling & Simulation Applications** Discrete-event simulation, Continuous simulation, Queueing models, Inventory models, Simulation software tools overview (e.g., MATLAB / Python), Model validation and verification, Analysis and interpretation of results	**9**

Reference Books

1. Let Us C – Yashavant Kanetkar
2. Object-Oriented Programming with C++ – E. Balagurusamy
3. Simulation Modelling and Analysis – Averill M. Law & W. David Kelton
4. Discrete-Event System Simulation – Jerry Banks et al.
5. Theory of Modelling and Simulation – Bernard P. Zeigler

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VIth Semester B. Tech. Electrical Engineering (NEP 2020)

Course Code: STPCCELE607 (PCC)

Title of Course: Power Electronics Laboratory

Teaching Scheme					Examination Scheme (Practical)			
Lecture	Tutorial	Practical	Periods/week	Credits	Duration in Hours	CA	UA	Total
--	--	2	2	1	--	25	25	50

Course outcomes:

After completing the course, the students will be able to.

CO1 Understand and analyze the characteristics and operation of basic power semiconductor switches such as diode, SCR, MOSFET, and IGBT.

CO2 Perform experiments on controlled and uncontrolled rectifiers and analyze their output voltage and current characteristics.

CO3 Study the operation of DC–DC converters (choppers) and evaluate their performance under different operating conditions.

CO4 Investigate the working of DC–AC inverters and analyze their output waveform and performance.

CO5 Develop practical skills in using power electronic circuits, measuring instruments, and simulation tools for analysing power electronic systems.

Lab Activities: A minimum of eight Practical should be performed from the topics listed below.

List of practical:

1. To study the V–I characteristics of an SCR and determine its latching current and holding current.
2. To study the characteristics of a TRIAC in its four modes of operation.
3. To study gate pulse generation circuits for SCR using R, RC, and UJT triggering circuits
4. To study the transfer and output characteristics of a Power MOSFET.

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5. To study the operation of a single-phase half wave fully controlled rectifier with different loads
6. To study the operation of a single-phase full wave fully controlled rectifier with different loads
7. To study the operation of a three-phase full wave fully controlled rectifier with different loads
8. To study step-down and step-up choppers
9. To the operation of a single-phase full-bridge inverter.
10. To the operation of a three-phase full-bridge inverter in different modes
11. To study the operation of a single-phase PWM inverter.
12. To study the operation of a single-phase & three phase ac voltage controller.
13. To demonstrate the operation of a single-phase cycloconverter with a resistive load.
14. To study the speed control of a DC shunt motor using a single-phase semi-converter.

A Journal/Report on practical conducted shall be submitted by each student. University Practical examination shall be on viva-voce of 10 marks and practical performance or objective test of 15 marks.

			
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VIth Semester B. Tech. Electrical Engineering (NEP 2020)

Course Code: STPCCELE608

Title of Course: Power System Lab-II Lab

Teaching Scheme					Examination Scheme (Practical)			
Lecture	Tutorial	Practical	Periods/week	Credits	Duration in Hours	CA	UA	Total
--	--	2	2	1	--	25	25	50

Course outcomes:

After completing the course, the students will be able to.

CO1 Use numerical methods to analyze a power system in steady state

CO2 Use numerical methods to analyze power system stability

CO3 Use phasors measurement to analyze a power system in steady state

CO4 Understand the effect of shunt and series compensation on power system

CO5 Use numerical methods to analyze a power system in steady state

Lab Activities: A minimum of eight Practical should be performed from the topics listed below.

List of practical:

1. To study the formulation of bus impedance matrix.
2. To study the formulation of bus admittance matrix
3. To perform Power flow analysis by Gauss Seidel method
4. To perform Power flow analysis by Newton-Raphson method
5. To study the numerical solution of swing equations using Forward Euler method
6. To study the numerical solution of swing equations using Runge-Kutta 4th order method
7. To study the application of equal area criteria to check stability for sudden change method

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8. To Study the series compensation effect on IEEE-5 bus for generation scheduling
9. To Study the Shunt compensation effect on IEEE-5 bus generation scheduling
10. To study of the Power flow control using embedded dc links.
11. To study the Phasor Measurement of Voltage and current of transmission line network
12. To study the Phasor Measurement of Voltage and current of distribution line network

A Journal/Report on practical conducted shall be submitted by each student. University Practical examination shall be on viva-voce of 10 marks and practical performance or objective test of 15 marks.

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VIth Semester B. Tech. Electrical Engineering (NEP 2020)

Course Code: STPCCELE609

Title of Course: Control System Laboratory

Teaching Scheme					Examination Scheme (Practical)			
Lecture	Tutorial	Practical	Periods/week	Credits	Duration in Hours	CA	UA	Total
--	--	2	2	1	--	25	25	50

Course outcomes:

After completing the course, the students will be able to.

CO1 Analyze & Sketch step & impulse response for a first order, second order and higher order feedback system.

CO2 Design & Develop P, PI & PID Controller and investigate their effect on system performance.

CO3 Sketch Root Locus, Polar Plot, Bode Plot and Nyquist Plot and evaluate stability of linear control system.

CO4 Design & Develop compensators and controllers to achieve desired performance for linear control system.

CO5 Understand operation of various control system components like AC servomotor, Synchro Pair etc and discover their applications in automatic control and positioning systems

Lab Activities: A minimum of eight Practical should be performed from the topics listed below.

List of practical:

1. Determination of Step & Impulse Response for a First Order Feedback System.
2. Determination of Step & Impulse Response for a Second Order Feedback System.
3. Determination of Step & Impulse Response for a Type ‘0’, Type ‘1’, Type ‘2’ Systems.
4. Stability Analysis of Linear Control System Using Nyquist Plot with the help of MATLAB Control System Toolbox.

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5. Determination and Analysis of Bode Plot of linear control system using MATLAB Control System Toolbox.
6. Determination and Analysis of Root Locus Plot of linear control system using MATLAB Control System Toolbox.
7. Design and study the effect of P, PI, and PID controllers on the performance of a linear control system
8. Study the effect of addition of zeros and poles to the forward path transfer function of a closed loop system.
9. To study the AC Position Control System.
10. To study the DC Position Control System.
11. To study the characteristics of AC servomotor.
12. To study the characteristics of Synchro Pair.
13. To study the Temperature Control System
14. Design and Analysis of state feedback controller with the help of MATLAB Control System Toolbox
15. Design and Analysis of Observer with the help of MATLAB Control System Toolbox

A Journal/Report on practical conducted shall be submitted by each student. University Practical examination shall be on viva-voce of 10 marks and practical performance or objective test of 15 marks.

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Two-year UG Diploma in Engineering/Technology

Exit Course after Third Year of B.Tech. Electrical Engineering

Course Code: STEXELE621

Title of Course: Installation of Transformer

Teaching Scheme					Examination Scheme (Practical)			
Lecture	Tutorial	Practical	Periods/week	Credits	Duration in Hours	CA	UA	Total
-	2	12	14	8	--	100	100	200

Course Description

This course covers the fundamentals of Installation of Transformer, including all site testing of transformer Testing, Commissioning and Protection, Operation, Maintenance and Troubleshooting case studies and practical exercises.

Course outcomes:

After completing the course, the students will be able to;

CO1 Explain transformer construction, working principles, specifications, and application.
CO2 Identify suitable installation sites and prepare foundations, earthing, and safety arrangements for transformer installation.
CO3 Perform transformer installation procedures including assembly, oil filling, cable termination, and accessory mounting
CO4 Conduct testing and commissioning of transformers and evaluate protection schemes
CO5 Apply maintenance practices and troubleshoot common transformer faults to ensure reliable operation

Unit	Content	Hours
I	**Fundamentals of Transformers** Principle of operation of transformers, Constructional details of power and distribution transformers, Types of transformers, Transformer ratings and specifications, Transformer losses and efficiency	8
II	**Site Selection and Foundation Preparation**	8

			
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	Selection of installation location, Transformer foundation design, Safety clearances and statutory requirements, Earthing requirements, Transportation and handling of transformers	
III	**Transformer Installation Procedures** Pre-installation inspection and testing, Assembly of accessories (bushings, conservator, radiators), Oil filling and filtration, Cable termination and connections, Installation of protection devices	**8**
IV	**Testing, Commissioning and Protection** Insulation resistance test, Ratio test and polarity test, Vector group verification, Commissioning procedures, Transformer protection systems	**8**
V	**Operation, Maintenance and Troubleshooting** Preventive and predictive maintenance, Oil testing and analysis, Fault diagnosis and troubleshooting Safety practices during maintenance Maintenance records and documentation	**8**

Textbooks

1 J. Winders Jr., *Power Transformer Engineering*, CRC Press.

Reference Books

1. Electric Power Distribution Engineering, CRC Press.
2. Electrical Power Systems, New Age International.
3. Principles of Power Systems, S. Chand Publications.
4. Power System Engineering, McGraw Hill.
5. Electrical Power, Khanna Publishers.
6. Testing, Commissioning, Operation and Maintenance of Electrical Equipment, Khanna Publishers.
7. Handbook of Transformer Design and Applications, McGraw Hill.

			
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Two-year UG Diploma in Engineering/Technology

Exit Course after Third Year of B.Tech. Electrical Engineering

Course Code: STEXELE622

Title of Course: Autonomous, Connected, Electric Vehicles (ACE)

Teaching Scheme					Examination Scheme (Practical)			
Lecture	Tutorial	Practical	Periods/week	Credits	Duration in Hours	CA	UA	Total
-	2	12	14	8	--	100	100	200

Course Description

This course covers the fundamentals of Electric Vehicle, including all electronic circuit, EV Charging Technologies, Regulations and Certification for Electric Vehicles, Electric Machines and Drives in HEVs case studies and practical exercises.

Course outcomes:

After completing the course, the students will be able to;

CO1 To explain electric, hybrid electric and plug-in hybrid electric vehicle (PHEV), their architecture, technologies and fundamentals
CO2 To explain the design, component sizing of the power electronics converters and various electric drives suitable for hybrid electric vehicles
CO3 To demonstrate different configurations of electric vehicles and charging techniques
CO4 Ability to understand the regulations of EV.
CO5 Able to analyze the use of different electrical machines in hybrid electric vehicles

Unit	Content	Hours
I	**History of Electric Vehicles** Development towards 21st Century, Need of Electric vehicle, Types of Electric Vehicles in use today- Battery Electric Vehicle, Hybrid (ICE & others), Fuel Cell EV, Solar Powered Vehicles. Trends and developments in electric vehicle markets Basics of the EV, Basics of the HEV, Basics of Plug-In Hybrid Electric Vehicle (PHEV) and	8

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	vehicle architectures: Series Hybrid Vehicle, Parallel Hybrid Vehicle	
II	**Power Electronics in HEVs:** Power electronics circuits used for control and distribution of electric power in DC-DC, AC-DC, DC-AC converters used for HEV.	**8**
III	**EV Charging Technologies:** Classification of different charging technology for EV charging station, introduction to Grid-to-Vehicle, Vehicle to Grid (V2G) or Vehicle to Buildings (V2B) or Vehicle to Home (V2H) operations, bi-directional EV charging systems	**8**
IV	**Regulations and Certification for Electric Vehicles:** Need for Certifications and Standards, Overview of the Main International Standards Related to Electric Mobility: Safety and security, charging connectors, charging topology, EV charging related communications.	**8**
V	**Electric Machines and Drives in HEVs:** Fundamental of Drives and Control of EV Using DC motor, Induction Motor, Permanent Magnet Motor, Switched Reluctance Motor, BLDC motor, Design and Sizing of Traction Motors	**8**

Reference Books

1. M. Ehsani, Y. Gao, and A. Emadi, “Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design”, 2nd edition, CRC Press, 2009.
2. Hussein, “Electric and Hybrid Vehicles: Design Fundamentals”, CRC Press, 3rd edition, 2021.
3. J. Larminie and J. Lowry, “Electric Vehicle Technology Explained”, Wiley, 2nd edition, 2012.
4. C. Mi and M. A. Masrur, “Hybrid Electric Vehicles: Principles and Applications with Practical Perspectives”, Wiley, 2nd edition, 2017

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BoS Member	**BoS Member**	**BoS Member**	**BoS Chairman**

Two-year UG Diploma in Engineering/Technology

Exit Course after Third Year of B.Tech. Electrical Engineering

Course Code: STEXELE631

Title of Course: Internship / Technical Project

Teaching Scheme					Examination Scheme (Practical)			
Lecture	Tutorial	Practical	Periods/week	Credits	Duration in Hours	CA	UA	Total
-	-	16	16	8	--	100	100	200

Course Objectives

- To provide experiential learning through industrial training or technical project work.
- To enable students to apply engineering knowledge to real-world industrial problems.
- To develop professional skills including communication, teamwork, leadership, ethics, and technical documentation.
- To promote innovation, creativity, self-learning, and lifelong learning.

Course outcomes:

After completing the course, the students will be able to;

CO1	Apply engineering knowledge and technical skills to solve practical industrial or engineering problems.
CO2	Demonstrate professional competence through successful completion of internship or technical project activities
CO3	Prepare professional technical reports and effectively communicate technical outcomes through presentations.
CO4	Demonstrate professional ethics, teamwork, leadership, project management, and lifelong learning abilities.

Course Guidelines

			
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Each student shall undertake either an Internship or a Technical Project approved by the Head of the Department. Internship may be carried out in Industry, MSME, Government Organization, PSU, R&D Laboratory, Start-up, Academic Institution or any University-approved organization.

The Technical Project shall be undertaken individually in the field of Mechanical Engineering and shall demonstrate application of theoretical knowledge to practical problem-solving. The project work shall include problem identification, literature review, planning and design, technical execution, experimentation/analysis (as applicable), documentation, and preparation of a detailed technical report.

General Guidelines

1. Each student shall be assigned a Faculty Mentor by the Department.
2. The student shall maintain regular contact with the Faculty Mentor throughout the course.
3. Periodic progress reviews shall be conducted by the Faculty Mentor. Satisfactory progress is mandatory.
4. The Faculty Mentor shall guide, monitor, verify progress, evaluate submissions and recommend eligibility for final assessment.
5. Where applicable, an Industry Mentor/Training Supervisor may guide the student during internship.
6. There shall be no theory examination.
7. Evaluation shall be based on technical work, report, seminar presentation and viva-voce.
8. Originality and professional ethics shall be maintained.
9. Reports shall be certified by the Faculty Mentor (and Industry Mentor, wherever applicable) before submission

Course Requirements

Each student shall complete and submit the following:

- Logbook/Work Diary, duly verified by the Faculty Mentor and, wherever applicable, the Industry Mentor.
- Internship Completion Certificate (for Internship, where applicable).
- Approved Project Synopsis (for Technical Project).

			
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- Comprehensive Internship/Project Report.
- Seminar Presentation.
- Appearance in the Final Viva-Voce Examination.

Assessment & Evaluation

Component	**Internal (Faculty Mentor / Department)**	**External (University Examiner)**
Continuous progress Assessment	20	-
Technical Work / Performance	30	-
Evaluation of Report	20	30
Seminar / Presentation	15	30
Viva-voce/Professional and Technical Competency	15	40
Total	**100**	**100**

			
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