Gondwana University Gadchiroli
Four Year Degree Course in Engineering and Technology
Course and Examination Scheme with Model AICTE Curriculum
Fifth Semester Electrical (Electronics & Power) Engineering

Course Category	Course Code	BoS	Course Title	Teaching Scheme				Examination Scheme									
				Hours per week			No. of credits	THEORY						PRACTICAL			
				L	T	P		Duration of paper (Hrs.)	Max. Marks ESE	Max. Marks Sessional		Total	Min. Passing Marks	Max Marks TW	Max Marks POE	Total	Min. Passing Marks
										MSE	IE						
PEC-1	TE101	Electrical	Program Elective-I	3	0	0	3	3	80	10	10	100	40	--	--	--	--
OEC-1	TE102	Electrical	OE-1	3	0	0	3	3	80	10	10	100	40	--	--	--	--
HSMC-1	TE103	S&H	Slot for HS	3	0	0	3	3	80	10	10	100	40	--	--	--	--
PCC	TE104	Electrical	Power Systems-I (Apparatus and Modelling)	3	0	0	3	3	80	10	10	100	40	--	--	--	--
PCC	TE105	Electrical	Control Systems	3	0	0	3	3	80	10	10	100	40	--	--	--	--
PCC	TE106	Electronics	Microprocessors	3	0	0	3	3	80	10	10	100	40	--	--	--	--
Laboratory																	
PCC	TE107	Electrical	Power Systems-I	0	0	2	1	--	--	--	--	--	--	25	25	50	25
PCC	TE108	Electrical	Control Systems	0	0	2	1	--	--	--	--	--	--	25	25	50	25
PCC	TE109	Electronics	Microprocessors	0	0	2	1	--	--	--	--	--	--	25	25	50	25
		Total		**18**	**0**	**6**	**21**					**600**				**150**	
		Semester Total		**24**			**21**	**750**									

HSMC-1: 1) Human Behavior and Social Science, 2) Effective Writing
PEC-1: 1) Electrical Machine Design, 2) High Voltage Engineering
OEC-1: 1) Power Plant Engineering, 2) Electrical Materials

Gondwana University Gadchiroli

Four Year Degree Course in Engineering and Technology

Course and Examination Scheme with Model AICTE Curriculum

Sixth Semester Electrical (Electronics & Power) Engineering

Course Category	Course Code	BoS	Course Title	Teaching Scheme				Examination Scheme									
				Hours per week			No. of credits	THEORY						PRACTICAL			
				L	T	P		Duration of paper (Hrs.)	Max. Marks ESE	Max. Marks Sessional		Total	Min. Passing Marks	Max Marks TW	Max Marks POE	Total	Min. Passing Marks
										MSE	IE						
PEC-2	TE201	Electrical, Mechanical	Program Elective-2	3	0	0	3	3	80	10	10	100	40	--	--	--	--
PEC-3	TE202	Electrical	Program Elective-3	3	0	0	3	3	80	10	10	100	40	--	--	--	--
OEC-2	TE203	Computer, Mechanical	OE-2	3	0	0	3	3	80	10	10	100	40	--	--	--	--
HSMC-2	TE204	S&H, Electrical	Slot for HS	3	0	0	3	3	80	10	10	100	40	--	--	--	--
PCC	TE205	Electrical	Power Systems-II (Operations and Control)	3	0	0	3	3	80	10	10	100	40	--	--	--	--
PCC	TE206	Electrical	Power Electronics	3	0	0	3	3	80	10	10	100	40	--	--	--	--
Laboratory																	
PCC	TE207	Electrical	Power Systems-II	0	0	2	1	--	--	--	--	--	--	25	25	50	25
PCC	TE208	Electrical	Power Electronics	0	0	2	1	--	--	--	--	--	--	25	25	50	25
PCC	TE209	Electronics	Electronics Design	1	0	4	3	--	--	--	--	--	--	25	25	50	25
		Total		**19**	**0**	**8**	**23**					**600**				**150**	
		Semester Total		**27**			**23**	**750**									

PEC-2: 1) Wind and Solar Energy System, 2) Digital Signal Processing
PEC-3: 1) Electrical Hybrid Vehicle, 2) Electrical Drive, 3) industrial Traction Systems
OEC-2: 1) Data Structures and Algorithms, 2) Thermal and Fluid Engineering
HSMC-2: 1) Industrial Economics and Management, 2) Energy Resources and Environment
PROJ-EE: Summer Internship during Summer Vacations (Non Credit)

Vth Semester B.E. Electrical (Electronics and Power Engineering)

Course Code : PEC-EE01

Title of the Course : Electrical Machine Design

Course Scheme					Evaluation Scheme (Theory)				
Lecture	Tutorial	Practical	Periods/week	Credits	Duration of paper, hrs	MSE	IE	ESE	Total
3	0	0	3	3	3	10	10	80	100

Course Outcome: Upon successful completion of course student will be able to,

1) Acquire knowledge to carry out the importance of design of machine based on their applications.

2) Acquire knowledge to carry out design of a transformer and provide the information required for the fabrication of the same along with an estimate of various performance indices.

3) Acquire knowledge to carry out a detailed design of induction machine and provide the information required for the fabrication of the same along with an estimate of various performance indices.

4) Acquire knowledge to carry out a detailed design of synchronous machine and provide the information required for the fabrication of the same along with an estimate of various performance indices.

5) Acquire knowledge to carry out the importance of materials used for the designs of machines.

Unit 1: General concept of Design of Electrical Machines

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 the Machines, Heating & Cooling characteristics, Calculation for losses

Unit 2: Transformer Design

Types of Transformers, Output equations of single phase & three phase transformers, Voltage per turn for winding, Need of stepped core, Necessity of tap changers, Optimum design, Specific loading, Window space factor & window dimension, Main dimension, core, yoke, windings

Unit 3: 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.

Unit 4: Induction Machine Design

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 of cage rotor and wound rotor design, current and other performance from characteristics for design data.

Unit 5: Synchronous Machine

Air gap length methods of obtaining sinusoidal o/p voltage, field coil design for salient pole machine and for turbo generator rotor, ventilation of synchronous generator, cooling air circuit, closed ventilation /quantity of cooling medium hydrogen and water as cooling media.

TEXT BOOKS

1) A course in Electrical Machine Design By AK Sawhney, Dhanpatrai& Sons

2) Theory, performance & Design of AC Machines by MG Say, ELBS London

3) Principles of Electrical Machine Design with computer programs by SK Sen, Oxford & IBH Company, ND

4) Principles of Electrical Machine Design by RK Agrawal, SK Kataria&Sons

REFERENCE BOOKS

1) A textbook of Electrical Engineering Drawingby KL Narang, SatyaPrakashan, ND

2) Electrical Machine Design by A. Shanamugasundaram&Gangadharan, Wiley Eastern

3) Computer aided design for electrical machines by Vishnu Murti, BS Publications

Course Code : PEC-EE01

Title of the Course : High Voltage Engineering

Course Scheme					Evaluation Scheme (Theory)				
Lecture	Tutorial	Practical	Periods/week	Credits	Duration of paper, hrs	MSE	IE	ESE	Total
3	0	0	3	3	3	10	10	80	100

Course Outcome: Upon successful completion of course student will be able to,

1) Identify the breakdown mechanism in different types of dielectrics

2) Explain in detail about lightning and switching over-voltages, effects and its protection.

3) Illustrate the concepts of travelling waves and insulation coordination

4) Analyze different methods of generation of high voltage and high current in laboratory

5) Analyze different methods of measurement of high voltage and high current in laboratory

6) Describe the different methods of non-destructive & high voltage testing of electrical apparatus

Unit 1: 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, Stremer 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

Unit 2:- 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.

Unit 3:- Generation of High voltages & Current

Generation of High D.C. voltages by rectifiers, Voltage doubler Circuits and multiplier 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

Unit 4:- 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)

Unit 5:- 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.

Text Books –

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 Dekke

Course Code : OEC-EE01

Title of the Course : Power Plant Engineering

Course Scheme					Evaluation Scheme (Theory)				
Lecture	Tutorial	Practical	Periods/week	Credits	Duration of paper, hrs	MSE	IE	ESE	Total
3	0	0	3	3	3	10	10	80	100

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

1. Describe and analyze different types of sources and mathematical expressions related to thermodynamics and various terms and factors involved with power plant operation.

2. Analyze the working and layout of steam power plants and the different systems comprising the plant and discuss about its economic and safety impacts

3. Combine concepts of previously learnt courses to define the working principle of diesel power plant, its layout, safety principles and compare it with plants of other types.

4. Describe the working principle and basic components of the nuclear power plant and the economic and safety principles involved with it.

5. Discuss the working principle and basic components of the hydro electric plants and the economic principles and safety precautions involved with it.

6. Discuss and analyze the mathematical and working principles of different electrical equipments involved in the generation of power.

Syllabus:

UNIT I: Introduction: Power and energy, sources of energy, review of thermodynamic cycles related to power plants, fuels and combustion calculations. Load estimation, load curves, various terms and factors involved in power plant calculations. Effect of variable load on power plant operation, Selection of power plant. Power plant economics and selection: Effect of plant type on costs, rates, fixed elements, energy elements, customer elements and investor's profit; depreciation and replacement, theory of rates. Economics of plant selection, other considerations in plant selection.

UNIT II: Steam power plant: General layout of steam power plant, Power plant boilers including critical and super critical boilers. Fluidized bed boilers, boilers mountings and accessories, Different systems such as coal handling system, pulverizes and coal burners, combustion system, draft, ash handling system, Dust collection system, Feed water treatment and condenser and cooling towers and cooling ponds, Turbine auxiliary systems such as governing, feed heating, reheating, flange heating and gland leakage. Operation and maintenance of steam power plant, heat balance and efficiency, Site selection of a steam power

UNIT III: Diesel power plant: General layout, Components of Diesel power plant, Performance of diesel power plant, fuel system, lubrication system, air intake and admission system, supercharging system, exhaust system, diesel plant operation and efficiency, heat balance, Site selection of diesel power plant, Comparative study of diesel power plant with steam power plant.

Gas turbine power plant: Layout of gas turbine power plant, Elements of gas turbine power plants, Gas turbine fuels, cogeneration, auxiliary systems such as fuel, controls and lubrication, operation and maintenance, Combined cycle power plants, Site selection of gas turbine power plant .

UNIT IV: Nuclear power plant: Principles of nuclear energy, Lay out of nuclear power plant, Basic components of nuclear reactions, nuclear power station, Nuclear waste disposal, Site selection of nuclear power plants. Hydro electric station Hydrology, Principles of working, applications, site selection, classification and arrangements, hydro-electric plants, run off size of plant and choice of units, operation and maintenance, hydro systems, interconnected systems. Non Conventional Power Plants Introduction to non conventional power plants (Solar, wind, geothermal, tidal) etc.

UNIT V:

Electrical system: Generators and their cooling, transformers and their cooling.
Instrumentation Purpose, classification, selection and application, recorders and their use, listing

Recommended Books:

1. Power Plant Engineering, P.K. Nag, Tata McGraw Hill.

2. Power Plant Engineering, F.T. Morse, Affiliated East-West Press Pvt. Ltd, New Delhi/Madras

3. Power Plant Technology El-Vakil, McGraw Hill.

Course Code : OEC-EE01

Title of the Course : Electrical Materials

Course Scheme					Evaluation Scheme (Theory)				
Lecture	Tutorial	Practical	Periods/week	Credits	Duration of paper, hrs	MSE	IE	ESE	Total
3	0	0	3	3	3	10	10	80	100

Course Outcomes: After the completion of the course, the students will be able to:

1. Learn the basics of materials used in electrical engineering.
2. Realize the dielectric properties of insulators in static and alternating fields.
3. Explain the importance of magnetic properties and superconductivity.
4. Explain the behavior of conductivity of metals and classifications of semiconductor materials.
5. Discuss the various components and cables used in Electrical system .

Syllabus:

UNIT I: Elementary Materials Science Concepts: Bonding and types of solids, Crystalline state and their defects, Classical theory of electrical and thermal conduction in solids, temperature dependence of resistivity, skin effect, Hall effect.

UNIT II: Dielectric Properties of Insulators in Static and Alternating field: Dielectric constant of mono-atomic gases, poly-atomic molecules and solids, Internal field in solids and liquids, Properties of Ferro-Electric materials, Polarization, Piezoelectricity, Frequency dependence of Electronic and Ionic Polarizability, Complex dielectric constant of non-dipolar solids, dielectric losses.

UNIT III: Magnetic Properties and Superconductivity: Magnetization of matter, Magnetic Material Classification, Ferromagnetic Origin, Curie-Weiss Law, Soft and Hard Magnetic Materials, Superconductivity and its origin, Zero resistance and Meissner Effect, critical current density.

UNIT IV: Conductivity of metals: Ohm's law and relaxation time of electrons, collision time and mean free path, electron scattering and resistivity of metals.

Semiconductor Materials: Classification of semiconductors, semiconductor conductivity, temperature dependence, Carrier density and energy gap, Trends in materials used in Electrical Equipment.

UNIT V: Components- Resistors and Capacitors. Display units:-LED, LCD and Monitors. Effect of environment on components.

Cables- Calculations of capacity of cables, charging current, stress, grading, heating of cables, Construction and characteristics of HV & EHV cable

Text book:

1. Electrical Engineering Materials Adrianus J Dekker, Phi Learning Publishers.
2. S.O. Kasap, „Principles of Electrical Engineering Materials," MGH.
3. Electrical Properties of Materials, 8th Edition by Solymar, L, Oxford University PressNew Delhi.

4. Electrical and Electronic Engineering Materials by SK Bhattacharya, Khanna Publishers, New Delhi.
5. Mahajan, „Principles of growth and processing of semiconductors,“ MGH.
6. Dhir, „Electronic components and Materials Principles manufacturing and Maintenance,“ TMH.
7. Allison, „Electronic Engineering Materials and Devices,“ TMH.

Course Code : HSMC-301

Title of the Course : Human Behavior and Social Science

Course Scheme					Evaluation Scheme (Theory)				
Lecture	Tutorial	Practical	Periods/week	Credits	Duration of paper, hrs	MSE	IE	ESE	Total
3	0	0	3	3	3	10	10	80	100

Course Outcomes:

- Describe the meaning and importance of human factors engineering
- Relate human sensory, cognitive, and physical capabilities and limitations to the design of human-machine systems.
- Select and correctly use appropriate human-machine system analysis and design tools.
- Apply sound human-machine system design principles to develop written and graphical design specifications.

Module 1: Human Factors Basics: (5 Hours)

Introduction to Human Factors. Visual Sensory System, Auditory, Tactile, Vestibular Systems, Decision Making

Module 2: Study of Social Science: (8 Hours)

Importance to Engineer, salient features of Indian constitution. Fundamental Rights and Duties. Directive Principles of State Policy.

Module 3: Indian Parliament: (3 Hours)

Composition and powers, President of India : Election and Powers. Council of Ministers and Prime Minister

Module 4: Production and Banking: (8 Hours)

Factors of production, Laws of return, Forms of Business Organisation.

Functions of Central and Commercial Banks. Introduction to GST, Market : Forms, perfect, imperfect competition and monopoly

Module 5: Nature and scope of Economics:(5Hours)

Special significance of Economics to Engineers. Economics of Development : Meaning, Characteristics of under development, obstacles to Economic growth and vicious circle of poverty.

Books Recommended :

1. Pylee M.V. : Constitutional Govt. in India, S.Chand and Co.

2. C N Shankar Rao: Sociology, S.Chand and Co.

3. Dewett and Varma J.D. : Elementary Economic Theory, S.Chand and Co.

4. A.N.Agrawal : Indian Economy, Problem of Development and Planning (Wiley Eastern Ltd), New Delhi.

5. S.K.Mishra : Indian Economy, Its Development Experience. Himalaya Pub.House, Bombay

Course Code : HSMC-301

Title of the Course : Effective Writing

Course Scheme					Evaluation Scheme (Theory)				
Lecture	Tutorial	Practical	Periods/week	Credits	Duration of paper, hrs	MSE	IE	ESE	Total
3	0	0	3	3	3	10	10	80	100

Course Outcomes:

- Effectively Learn the writing Skills
- How to write Essays
- How to write Technical Papers
- How to write Thesis for research

Module 1: Introduction to Effective Writing

Introduction to Effective Writing, Effective writing as an art. Principles Of Effective Writing, Types and Stages of Effective writing

Module 2: General Writing :

Essay Writing Types of Essays Essentials of Academic Writing

Module 3: Official Work Writing:

Business writing and its functions, Mechanics of business writings, Business letters and Memos, Format of business letters and memos, Types of business Letters

Module 4: Report Writings:

Sales, Complaints and Adjustment Letters, Report writing, Strategies and Structure of reports,Style of report writing

Module 5: Miscellaneous:

Creative Writing, Writing for Technical Papers, Thesis Writing.

Books Recommended :

1. Anne Lamott Bird by bird :Instructions on writing and life
2. Judith F. Olson : Writing Skills: Success in 20 Minutes a Day
3. Jean Withrow :Effective Writing Student's book: Writing Skills for Intermediate Students
4. Word Power Made Easy by Norman Lewis
5. Spoken English (English Improvement for Success) by Alison Reid

Course Code: PCC-EE15

Title of the Course: Power System-I (Apparatus and Modeling)

Course Scheme					Evaluation Scheme (Theory)				
Lecture	Tutorial	Practical	Periods/week	Credits	Duration of paper, hrs	MSE	IE	ESE	Total
3	0	0	3	3	3	10	10	80	100

Course Outcomes:

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

1. Understand the concepts of power systems.
2. Understand the various power system components.
3. Evaluate fault currents for different types of faults.
4. Understand the generation of over-voltages and insulation coordination.
5. Understand basic protection schemes.
6. Understand concepts of HVDC power transmission and renewable energy generation

Unit 1: Basic Concepts (4 hours)

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.

Unit 2: System Components (15 hours)

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, auto-transformers, Neutral Grounding transformers. Tap-Changing in transformers. Transformer Parameters. Single phase equivalent of three-phase transformers.

Synchronous Machines: Steady-state performance characteristics. Operation when connected to infinite bus. Real and Reactive Power Capability Curve of generators. Typical waveform under balanced terminal short circuit conditions – steady state, transient and sub-transient equivalent circuits. Loads: Types, Voltage and Frequency Dependence of Loads. Per-unit System and per-unit calculations.

Unit 3: Voltages and Insulation Requirements (4 hours)

Generation of Over-voltages: Lightning and Switching Surges. Protection against Over-voltages, Insulation Coordination. Propagation of Surges. Voltages produced by travelling surges. Bewley Diagrams.

Unit 4: Fault Analysis and Protection Systems (10 hours)

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.

Unit 5: Introduction to DC Transmission & Renewable Energy Systems (9 hours)

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.

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.

Course Code: PCC-EE17

Title of Course: Control System

Course Scheme					Evaluation Scheme (Theory)				
Lecture	Tutorial	Practical	Periods/week	Credits	Duration of paper, hrs	MSE	IE	ESE	Total
3	0	0	3	3	3	10	10	80	100

Course Outcomes:

Upon successful completion of course student will be able to,

1) Apply various conventional techniques for Block diagram reduction technique, Signal flow graph, Parameter reduction and sensitivity analysis
2) Understand Transfer function and Block diagram reduction technique, Students is able to find the transfer function of any electrical systems and mechanical system
3) Expose the general issues concerning the design, principle of operation and characteristics of control system and electrical system.
4) Understand the modeling and analysis of different types of Control system hence Students will able to use the knowledge of mathematics and engineering. to find the stability of system
5) Develop skills for drawing time response and frequency response plot of different types of systems for various conditions
6) Study steady state and transient behavior of various systems. using conventional and state space technique It will encourage the students to work in core electrical engineering field like testing, maintenance, installations etc

Unit	Contents
UNIT I	**Mathematical Modelling:** Mathematical modelling of electrical systems, mechanical systems, electro-mechanical systems. Laplace transforms, transfer functions, electrical analogues of other dynamical systems. Block diagrams, block diagram reductions. Signal flow graph, Mason's gain formula. Linearity, time-invariance versus nonlinearity and time-variance., Effect of feedback on sensitivity to parameter variation and reduction of the noise.
UNIT II	**Time Response Analysis of Dynamical System:** Time response, Time domain specification, Types of test inputs, First and Second order system response, Error coefficient, Generalized error series , Steady State Error, P,PI,PID modes of feedback control .
UNIT III	**Stability Analysis of Control System:** Stability of control system, location of roots in S plane for stability, characteristics equation, Routh- Hurwitz criterion, Special cases for determining relative stability, Root locus construction, Root location and its effect on time response, Effect of pole-zero addition on proximity of imaginary axis.
UNIT IV	**Frequency response analysis:** Frequency response of linear system, Logarithmic frequency response (Bode) plots from transfer function for various systems, Polar plots for various systems, Estimation of approximate transfer function from the frequency response, Stability analysis from Bode plots, Nyquist criterion, Nyquist Plots and stability analysis

UNIT V	**State Space Analysis:** State variable method of analysis, Characteristics of system state, Choice of state variables, representation of vector matrix differential equation, Standard form, relation between transfer function and state variable.

Text Books -

1) Automatic Control Systems (with MATLAB Programs) by S.Hasan Saeed, S.K.Kataria & Sons.
2) Control System Engineering by Nagrath I.J.Gopal M, Wiley Eastern.
3) Modern Control Systems by Ogata K,Prentice Hall of India.
4) Linear Control Systems by B.S.Manke, Khanna Publication.

Reference Books -

1) Analysis and Design of Control Systems using MATLAB by Rao.V.Dukkipati,New Age.
2) Modern Control System by Richard Dorf,Robert Bishop, IIth edition 2008.

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Course Code: PCC-EE19

Title of the Course: Microprocessor

Course Scheme					Evaluation Scheme (Theory)				
Lecture	Tutorial	Practical	Periods/ week	Credits	Duration of paper, hrs	MSE	IE	ESE	Total
3	0	0	3	3	3	10	10	80	100

Course Outcomes:

Upon successful completion of course student will be able to,

1. Assess and solve basic binary math operations using the microprocessor and explain the microprocessor's internal architecture and its operation within the area of manufacturing and performance.
2. Identify a detailed s/w & h/w structure of the Microprocessor.
3. illuustrate how the different peripherals (8255, 8253 etc.) are interfaced with Microprocessor.
4. Analyze the data transfer information through serial & parallel ports.
5. Design electrical circuitry to the Microprocessor I/O ports in order to interface the processor to external devices.
6. Apply knowledge and demonstrate programming proficiency using the various addressing modes and data transfer instructions of the target microprocessor.
7. Analyze assembly language programs; select appropriate assemble into machine a crossassembler utility of a microprocessor.
8. Evaluate assembly language programs and download the machine code that will provide solutions real world control problems.

Unit 1: 8 Bit Microprocessor (10 Hours)
8085 Microprocessor: Architecture and its operations, Register structure, Pin configuration, Addr/Data bus, Timing, control & status signals. Addressing Modes Instruction Cycle: Fetch Operation, Execute operation, Machine cycle & state, Instruction & Data flow. Timing Diagram

Unit 2: Instruction Set & Programming Of 8085 (08 Hours)
Classification, Instruction & Data format, Assembly Language Programming of 8085, Counters & time delays, Stack & subroutines.

Unit 3: Memory Mapping & Interrupts Of 8085 (08 Hours)
Memory mapped I/O and I/O mapped I/O, Address decoding techniques. Interrupt system of 8085 (Software & Hardware Interrupts), Data transfer schemes, Serial data transfer through SOD & SID line.

Unit 4: Interfacing Devices & Applications (10 Hours)
Internal architecture & programming of PPI 8255, A/D & D/A (0800/0808) convertors.
Applications: 7 segment LED display, Measurement of Electrical Quantities – Frequency, Phase angle, Power factor, Voltage, Current, Resistance, Reactance, KW, KVA, KVAR.

Unit 5: Programmable Interval Timer (07 Hours)
Intel 8255, pin configuration, intel block diagram of counter and modes of operation, counter read methods, programming, READ-BACK command of Intel 8254.

Text Books

1. Microprocessor Architecture Programming and Applications with the 8085 by R. S. Gaonkar
2. Fundamentals of Microprocessor and Microcontrollers by B.Ram
3. Introduction to Microprocessors by Aditya P. Mathur
4. Introduction to Microprocessor for Engineers and Scientist by P. K. Ghosh and P. R. Sridhar

Reference Books

1. Microprocessors Principals and Applications by Gilmore
2. Microprocessors – Theory ad Applications by M. Rafiquzzaman
3. Microprocessors and Microcontrollers by Krishna Kant
4. Microprocessor and Interfacing and applications by Renu Singh & B. P. Singh

Course Code: PCC-EE16

Title of the Course: Power System-I Laboratory

Course Scheme			Evaluation Scheme (Practical)		
Practical	Periods/week	Credits	TW	POE	Total
2	2	1	25	25	50

Course Outcomes:

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

1. Understand the concepts measurement of power and power factor of system.
2. Analyze the performance of transmission lines.
3. Analyze the various faults of transmission lines.
4. Get apprehensive to various types of circuit breaker and protection scheme.

List of Laboratory Experiments/ Demonstrations: (Any Eight)

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
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 breaker.
12) Study of types of circuit breaker as per arc extinguishing media.
13) To perform over current protection scheme for transmission line.
14) To perform distance protection scheme for transmission line.

Course Code: PCC-EE18
Title of the Course: Control System Laboratory

Course Scheme			Evaluation Scheme (Practical)		
Practical	Periods/week	Credits	TW	POE	Total
2	2	1	25	25	50

Minimum Eight experiments based on above syllabus are to be performed from the list given below

1) Determination of Step & Impulse Response for a First Order Unity Feedback System.
2) Determination of Step & Impulse Response for a Second Order Unity Feedback System.
3) Determination of Step & Impulse Response for a Type '0', Type '1', Type '2' Systems.
4) Determination of Nyquist Plot Using MATLAB Control System Toolbox.
5) Determination of Bode Plot Using MATLAB Control System Toolbox.
6) Determination of Root Locus Plot Using MATLAB Control System Toolbox.
7) Study The Effect of P, PI & PID Controller On System Performance.
8) Study The Effect of Addition Of Zeros 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

Course Code: PCC-EE20
Title of the Course: Microprocessor Laboratory

Course Scheme			Evaluation Scheme (Practical)		
Practical	Periods/week	Credits	TW	POE	Total
2	2	1	25	25	50

Course Outcomes:

After the successful completion of this laboratory, students will be able to:

1. Explain architecture and pin diagram of 8085.
2. Compute addition and subtraction of two 8 bit and 16 bit number.
3. Build Assembly language program of multiplication using successive addition method.
4. Design and develop assembly language code to solve problems.
5. Choose processor for various kind of applications.
6. Demonstrate design of interrupt routines for interfacing devices.

List of Laboratory Experiments/Demonstrations: (Any Eight)
It includes at least 8 experiments based on the theory syllabus of Microprocessor.

List of suggested experiments

1. Write an ALP for microprocessor 8085 to add 10 data bytes
2. Write an ALP for microprocessor 8085 to find occurrence of 0's in lower nibble of data byte
3. Write an ALP for microprocessor 8085 to reverse an array stored from memory location.
4. Write an ALP for microprocessor 8085 to arrange an array in descending order.
5. Write an ALP for microprocessor 8085 using subroutine to calculate factorial of number.
6. Write an ALP for microprocessor 8085 to multiply two 8 bit number using add & shift method.
7. Write an ALP to interface ADC/DAC to microprocessor 8085.
8. Write an ALP to interface 8255 to microprocessor 8085.
9. Write an ALP to interface 8253/8254 to microprocessor 8085.
10. To study architecture of 8085 microprocessor
11. To perform addition and subtraction of two 8-bit numbers.
12. To perform 1's and 2's complement of 8-bit number.
13. To perform 16 bit subtraction.
14. To perform multiplication of two 8-bit numbers
15. To perform the division X/Y where X and Y are two 8 bit numbers.
16. To add 5 bytes of data present from memory location 3000H.
17. To find total number of odd data from a block of 10 bytes data.
18. To transfer 10 bytes from starting source address 3000H to destination address 3500H.
19. To find largest number from a block of 5 bytes present from 3000H.
20. To arrange a block of 5 bytes of data in ascending order from the same location.

VIth Semester B.E. Electrical (Electronics and Power Engineering)

Course Code: PEC-EE02

Title of the Course: Wind and Solar Energy Systems

Course Scheme					Evaluation Scheme (Theory)				
Lecture	Tutorial	Practical	Periods/week	Credits	Duration of paper, hrs	MSE	IE	ESE	Total
3	0	0	3	3	3	10	10	80	100

Course Outcomes:

At the end of this course, students will demonstrate the ability to

1. Understand the energy scenario and the consequent growth of the power generation from renewable energy sources.
2. Describe the basic physics of wind and solar power generation.
3. Discuss the power electronic interfaces for wind and solar generation.
4. Understand the issues related to the grid-integration of solar and wind energy systems.

Module 1: Physics of Wind Power: History of wind power, Indian and Global statistics, Wind physics, Betz limit, Tip speed ratio, stall and pitch control, Wind speed statistics-probability distributions, Wind speed and power-cumulative distribution functions.

Module 2: Wind generator topologies: Review of modern wind turbine technologies, Fixed and Variable speed wind turbines, Induction Generators, Doubly-Fed Induction Generators and their characteristics, Permanent Magnet Synchronous Generators, Power electronics converters. Generator-Converter configurations, Converter Control.

Module 3: The Solar Resource: Introduction, solar radiation spectra, solar geometry, Earth Sun angles, observer Sun angles, solar day length, Estimation of solar energy availability.

Solar photovoltaic: Technologies-Amorphous, monocrystalline, polycrystalline; V-I characteristics of a PV cell, PV module, array, Power Electronic Converters for Solar Systems, Maximum Power Point Tracking (MPPT) algorithms. Converter Control.

Module 4: Network Integration Issues: Overview of grid code technical requirements. Fault ride-through for wind farms - real and reactive power regulation, voltage and frequency operating limits, solar PV and wind farm behavior during grid disturbances. Power quality issues. Power system interconnection experiences in the world. Hybrid and isolated operations of solar PV and wind systems.

Module 5: Solar thermal power generation: Technologies, Parabolic trough, central receivers, parabolic dish, Fresnel, solar pond, elementary analysis.

References:

1. T. Ackermann, "Wind Power in Power Systems", John Wiley and Sons Ltd., 2005.

2. G. M. Masters, "Renewable and Efficient Electric Power Systems", John Wiley and Sons, 2004.

3. S. P. Sukhatme, "Solar Energy: Principles of Thermal Collection and Storage", McGraw Hill, 1984.

Course Code: PEC-EE02

Title of Course: DIGITAL SIGNAL PROCESSING

Course Scheme					Evaluation Scheme (Theory)				
Lecture	Tutorial	Practical	Periods/week	Credits	Duration of paper, hrs	MSE	IE	ESE	Total
3	0	0	3	3	3	10	10	80	100

Course Outcomes:

Upon successful completion of course student will be able to,

1) Formulate engineering problems in terms of DSP tasks
2) Analyze digital and analog signals and systems
3) Analyze discrete time signals in frequency domain
4) Design digital filters
5) Change sampling rate of the signal
6) Conceptualize the need of adaptive filters in communication applications.
7) Apply digital signal processing algorithms to various areas

UNIT	CONTENTS

I	**Discrete-Fourier Transform & Fast Fourier Transform:** Representation of Periodic sequences: The discrete Fourier Series and its Properties Fourier Transform of Periodic Signals, Sampling the Fourier Transform, **Z transform & properties,** The Discrete-Fourier Transform, Properties of DFT, Linear Convolution using DFT. FFT-Efficient Computation of DFT, Goertzel Algorithm, radix2 Decimation-in-Time and Decimation in-Frequency FFT Algorithms.
II	**Structure of FIR filters:** Structures for realization of discrete time systems, basic structures for fir systems: Direct form, cascade form, lattice structure, frequency sampling structure. Basic structure for IIR systems direct forms I, II, cascade, parallel forms, lattice and lattice-ladder structures, transposed forms.
III	**FIR Filter Design Techniques:** Introduction of FIR filters, linear phase filters symmetric and anti symmetric filters, Window method, frequency sampling method. Design FIR filters using Kaiser Window. Comparison of design methods for linear phase FIR filters.
	IIR Filter Design Techniques: Introduction to IIR filters, Butterworth approximation, Chebyshev approximation, Design of IIR filter: impulse invariance method, bilinear transformation, approximation derivative method, Frequency transformations: low pass to high pass, band pass, band reject. Comparison between FIR and IIR filters
V	**Advance DSP Techniques:** **Multirate Digital Signal Processing** : Introduction, Decimation by a factor D, Interpolation by a factor I, Sampling rate conversion by a rational factor I/D, Implementation of sampling rate conversion, Applications of multi rate signal processing, Introduction to digital filter banks. **Adaptive filters:** Introduction**,** Basic principles of Forward Linear Predictive filter and applications such as system identification, echo cancellation, equalization of channels, and beam forming using block diagram representation study only.

Text Books

1. "Digital Signal Processing, Principles, Algorithms and Applications", by Proakis J. G and D. G. Manolakis Pearson Education, PHI.
2. "Introduction to Digital Signal Processing" by Johnson J. R, , PHI publications .
3. "Digital Signal Processing" by P. Ramesh Babu , Sci- Tech Publications.
4. Digital Signal Processing by S Salivahanan, C Gnanapriya, TMH ,Publications

Reference Books

1. "Digital Signal Processing: A Computer based Approach", by S. K. Mitra, TMH, 2001.

2. "Discrete Time Signal Processing" by Oppenheim A. V and R. W. Schafer, Person Education, India
3. "Theory and Applications of Digital Signal Processing", by Rabnier, Gold , TMH. Publications

Course Code: PEC-EE03

Title of Course: Electrical Hybrid Vehicles

Course Scheme					Evaluation Scheme (Theory)				
Lecture	Tutorial	Practical	Periods/week	Credits	Duration of paper,hrs	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:

1. Review history, Social and environmental importance of Hybrid and Electric vehicles.
2. Describe the performance and selection of energy storage systems and Analyze battery management system.
3. Distinguish between the performance and architecture of various drive trains.
4. Describe the different Instrumentation and Control used for electric vehicles.

UNIT 1: Introduction(8 Hours)

Conventional Vehicle: Basic of Vehicle performance, vehicle power source characterization, transmission characterization. Need and importance of transportation development. History of Electric Vehicle, Hybrid Electric Vehicle and Fuel cell Vehicle. Social and environmental importance of Hybrid and Electric vehicles. Impact of modern drive-trains on energy supplies.

UNIT 2: Energy Storage Systems (8 Hours)

Introduction to energy storage requirements in Hybrid and Electric vehicles, battery-based energy storage and its analysis, Fuel cell based energy storage and its analysis, Ultra capacitor based energy storage and its analysis, flywheel based energy storage and its analysis.
Hybridization of energy sources for Hybrid and Electric vehicle: - Hybridization of drive trains in HEVs, Hybridization of energy storage in EVs. Selection of energy storage technology

UNIT 3: Battery charging and Management systems (8 Hours)

Introduction, charging algorithm, balancing method for battery pack charging.
Battery management system representation: - battery module, measurement unit block, battery equalization balancing unit, MCU estimation unit, display unit, fault warning block.
SoC and SoH, estimation of SoC, battery balancing, Thermal monitoring of Battery unit.

UNIT 4: Hybrid and Electric vehicles (8 Hours)

Electric vehicles: - Components, configuration, performance, tractive efforts in normal driving, Advantages and challenges in EV design.

Hybrid Electric vehicles: - Concept and architecture of HEV drive train (Series, parallel and series-parallel).Energy consumption of EV and HEV

UNIT 5: Drives and control systems (8 Hours)

Drives: - Application of BLDC drives and Switched reluctance motor drive for HEV and EV, performance characteristics of drives.

Instrumentation and control system related to Hybrid and Electric vehicles, speed control, acceleration characteristics, Electric steering, motion control, braking mechanism, Vehicle tracking through GPS, over speed indicating systems, Auto-parking systems

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Text/Reference Books:

1. James Larminie and John Lowry, "Electrical Vehicle", John Wiley and Sons, 2012.
2. Ronald K. Jurgen, "Electric and Hybrid-Electric Vehicles", SAE InternationalPublisher**.**
3. K T Chau, "Energy Systems for Electric and Hybrid Vehicles", The institution of Engineering and Technology Publication
4. D.A.J Rand, R Woods, R M Dell, "Batteries for Electric Vehicles", Research studies press Ltd, New York, John Willey and Sons
5. Electric and Hybrid Vehicles-Design Fundamentals, CRC press
6. Mehrdad Ehsani, Yimin Gao and Ali Emadi, "Modern Electrical Hybrid Electric and Fuel Cell Vehicles: Fundamental, Theory and design", CRC Press, 2009.
7. Junwei Lu, Jahangir Hossain,"Vehicle-to-Grid: Linking Electric Vehicles to the Smart Grid", IET Digital Library.
8. "Automobile Electrical and Electronic systems", Tom Denton, SAE International publications.
9. "Automotive handbook 5th edition", Robert Bosch, SAE international publication.

Course Code: PEC-EE03

Title of the Course: Electrical Drives

Course Scheme					Evaluation Scheme(Theory)				
Lecture	Tutorial	Practical	Periods /week	Credits	Duration of paper, hrs	MSE	IE	ESE	Total
3	1	0	4	4	3	10	10	80	100

Course Outcomes:

Upon successful completion of course student will be able to,

1. Conceptualize the basic drive system and analyse it for different types of loads.
2. To provide solid foundation in controlling method of different electrical Drives using semiconductor devices.
3. Articulate power electronics applications in control of speed, torque and other components.
4. Understand & to apply control techniques for DC motor by Single phase & Three Phase converters & Choppers.
5. Understand & to apply control techniques for Induction motor drives through Stator Side as well as rotor side control.
6. Estimate the motor rating for different condition of load.

Unit 1: Electric Drives (10 Hours)
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.

Unit 2: DC Motor Drives (09 Hours)
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.

Unit 3: Induction Motor Drives (09 Hours)

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.

Unit 4: Estimation of Motors Rating (07 Hours)

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

Unit 5: Synchronous Motor Drives (10 Hours)

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.

Text Books :

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

Course Code: PEC-EE03

Title of the Course: Industrial Traction System

CourseScheme					EvaluationScheme(Theory)				
Lecture	Tutorial	Practical	Periods/week	Credits	Duration ofpaper, hrs	MSE	IE	ESE	Total
3	0	0	3	3	3	10	10	80	100

Course Outcomes:

Upon successful completion of course student will be able to,

1. Distinguish different traction systems and latest trends in traction systems.
2. Differentiate services of traction system based on speed time curve.
3. Control different types of traction motors.
4. Use various traction system auxiliaries.
5. Explain the distribution system of a traction system.

Unit 1: Traction Systems and Latest Trends (07 Hours)

Latest trends in traction system, General arrangement of D.C. ,A.C. single phase, 3 phase, Composite systems, Choice of traction system -Diesel- Electric or Electric.

Unit 2: Mechanics of Train Movement (09 Hours)

Analysis of speed time curves for main line, suburban and urban services, Simplified speed time curves. Relationship between principal quantities in speed time curves, Requirement of tractive effort, Specific energy consumption and Factors affecting it.

Unit 3: Traction Motors and Their Control (12 Hours)

Features of traction motors, Significance of D.C. series motor as traction motor, A. C. Traction motors-single phase, Three phase, Linear Induction Motor, Comparison between different traction motors, Series-parallel control, Open circuit, Shunt and bridge transition, Pulse Width Modulation control of induction motors, Types of electric braking system.

Unit 4: Electric Locomotives and Auxiliary Equipment (11 Hours)

Important features of electric locomotives, Different types of locomotives, Current collecting equipment Coach wiring and lighting devices, Power conversion and transmission systems, Control and auxiliary equipment.

Unit 5: Feeding and Distribution System (06 Hours)

Distribution systems pertaining to traction (distributions and feeders),Traction sub station requirements and selection, Method of feeding the traction sub-station.

Text Books :

1. “Modern Electric Traction by H. Partab, Dhanpat Rai and Sons, New Delhi

2. Electric Traction by J. Upadhyay and S. N. Mahendra, Allied Publishers Ltd., Dhanpat Rai and Sons, New Delhi

3. Electric Traction by A.T. Dover Mac millan, Dhanpat Rai and Sons, New Delhi

4. Electric Traction Hand Book by R. B. Brooks., Sir Isaac Pitman and sons ltd. London

Course Code : HSMC-302

Title of the Course : Industrial Economics & Management

Course Scheme					Evaluation Scheme (Theory)				
Lecture	Tutorial	Practical	Periods/week	Credits	Duration of paper, hrs	MSE	IE	ESE	Total
3	0	0	3	3	3	10	10	80	100

Course Outcomes (The Student would be able to)

1 Understand the law of demand and factors of production

2 Students will be familiar with market competition and price determination

3 Understand the functions of banks and taxes.

4 Students will be aware of management skills at professional level

5 Students will get acquainted with knowledge of marketing strategies

6 Students will understand balance sheet and ratio analysis.

Unit 1: Demand, Utility and Indifference curves, Approaches to analysis of demand, Elasticity of demand and its measures, Factors of production, Advertising elasticity, Marginalism

Unit 2: Functions of Central and commercial banks, direct and indirect taxes, monetory and fiscal policy of goernment, liberalization, globalization and privatization;

Unit 3: Concept of Industrial management and its scope, Development of scientific management, Principles of Frederick Taylor and Henry Fayol, Functions of management such as planning, organizing, directing, controlling, motivating etc.

Unit 4: Introduction to marketing manaqgement, Concepts of marketing, marketing mix, channels of distribution, advertising, sales promotion, pricing of the product

Unit 5: Meaning, nature and scope of finanacial management, brief outline of profit and loss account, balance sheet, budgets and their importance, ratio analysis, principles of costing.

Recommended Books

1. Modern Economics – By H.L.Ahuja

2. Modern Economic Theory – By K.K.Dewett

3. Industrial management – By I. K. Chopde

4. Industrial Engg. and Organization Management – By S.K.Sharma

Course Code : HSMC-302

Title of the Course : Energy Resources and Environment

Course Scheme					Evaluation Scheme (Theory)				
Lecture	Tutorial	Practical	Periods/week	Credits	Duration of paper, hrs	MSE	IE	ESE	Total
3	0	0	3	3	3	10	10	80	100

Course outcome:

1.understand in brief the various energy resources

2.To know about the energy security and impact of environment

3. understand the utililisation of energy resources

4.describe energy conservation act

5 illustrate the energy policy and enery vision

Unit-01: Global Energy Scenario. Discovery of various energy sources: Energy Sources and Overall Energy demand and availability, Energy Consumption in various sectors and its changing pattern, Exponential increase in energy consumption and Projected future demands. Energy Resources: Coal, Oil, Natural Gas, Nuclear Power and Hydroelectricity, Solar and Other Renewable etc.

Unit-02: Energy Security, Energy Consumption and its impact on environmental climatic change. International Energy Policies,Energy Crisis.

Unit-03: Energy resources & Consumption,Commercial and noncommercial forms of energy, Fossil fuels, Renewable sources including Bio-fuels in India, their utilization pattern in the past, present and future projections of consumption pattern.Development and Environment, Energy for Sustainable Development, Energy and Environmental policies, Need for use of new and renewable energy sources.

Unit-04 Energy Conservation Act-2001 & its features, Electricity Act-2003 & its features. Framework of Central Electricity Authority ,Central & States Electricity Regulatory Commissions

Unit-05: Energy Policy (C-1.0, L-10) Global Energy Issues, National & State Level Energy Issues, National & State Energy Policy, Industrial Energy Policy, Energy Security, Energy Vision.)

Reference Books:

1. Energy for a sustainable world: Jose Goldenberg, Thomas Johansson, A.K.N.Reddy, Robert Williams (Wiley Eastern).

2. Energy policy for : B.V.Desai (Weiley Eastern),

3. Energy Policy and Planning : B.Bukhootsow.

4. G.D. Rai, „Non-conventional energy sources“, Khanna Publishers

5. B.H.Khan, „Non Conventional Energy Resources“ TMH.

Course Code: PCC-EE21

Title of the Course: Power System-II (Operations and Control)

Course Scheme					Evaluation Scheme (Theory)				
Lecture	Tutorial	Practical	Periods/week	Credits	Duration of paper, hrs	MSE	IE	ESE	Total
3	0	0	3	3	3	10	10	80	100

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

1. Use numerical methods to analyse a power system in steady state.
2. Understand stability constraints in a synchronous grid.
3. Understand methods to control the voltage, frequency and power flow.
4. Understand the monitoring and control of a power system.
5. Understand the basics of power system economics.

Unit 1: Power Flow Analysis (7 hours)

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.

Unit 2: Stability Constraints in synchronous grids (8 hours)

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 4^{th} 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.

Unit 3: Control of Frequency and Voltage (7 hours)

Turbines and Speed-Governors, Frequency dependence of loads, Droop Control and 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

Unit 4: Monitoring and Control (6 hours)

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.

Unit 5: Power System Economics and Management (7 hours)

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.

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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.

Course Code: PCC-EE24

Title of the Course: Power Electronics

Course Scheme					Evaluation Scheme (Theory)				
Lecture	Tutorial	Practical	Periods/week	Credits	Duration of paper, hrs	MSE	IE	ESE	Total
3	0	0	3	3	3	10	10	80	100

Course Outcomes

- Apply various conventional and advanced techniques for Controller design.
- Understand various power electronics device and their use in the industrial application.
- Expose the general issues concerning the design, principle of operation and characteristics of power electronics device.
- Understand the modeling ,analysis andThyristor devices.
- Develop skills for analysis of different types of converter topology,invertertopology,chopper.
- Different, protection scheme and design of firing circuit for different scheme. It will encourage the students to work in core electrical engineering field like testing, maintenance, installations etc

Module 1: Basics in Power Electronics Engineering (10 hours)

Development of Power Controllers, Working Principle & Characteristics of different Power Controllers, Thyristor Family, Two Transistor model of SCR, Gate Characteristic, Turn On , Turn Off Mechanisms & other ratings of SCRs , Relaxation Oscillators using UJT, Basic Firing Circuits for SCR, Application of SCR in obtaining Logic Gates, Flip Flop and Circuit Breaker, AC Power control using TRIAC- DIAC, Basic Firing Circuits for SCR. Power Transistor, Power MOSFET & IGBT (Basic properties, characteristics, comparison & applications

Module 2: Phase Controlled Rectifiers (10 Hours)

Principle of Phase Control, Line Commutation, Single phase half wave, Full wave mid – point, Fully controlled with & without freewheeling diode with different types of Loads, Effect of Source inductance, Half Controlled Bridge configurations, Development of expressions for mean current & voltage for different loads, Dual Converter. Three Phase fully controlled & half controlled bridge circuits , Development of expressions for mean

Module 3: Inverters (10 hours)

Principle of Inversion, Various Techniques of Forced Commutation & their designs, Single phase & Three phase series Inverter, Single Phase Parallel Inverter, Single phase bridge Inverter (All with commutation

Circuits), Design of Filter. Three phase fully controlled bridge inverters in different modes (without commutation Circuit), Design of complete firing circuit for Three phase Power Control Circuits.

Module 4: Choppers and its Classification (08 Hours)

Principle of Working ,Types of Choppers, Oscillating Chopper, Jones & Morgan's Chopper, Multi Phase Chopper, Step Up Chopper, AC Chopper, Need & Principle of Working of Cycloconverter using single phase bridge circuits

Module 5: Multiple Connection &Protection(07 hours)

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, Converter Faults.

Reference Books

1)Philip T. Krein, "Elements of Power Electronics", Oxford University Press
2)VedamSubrahmanyam, "Power Electronics", New Age International
3) MS JamilAsghar, "Power Electronics", Prentice Hall of India
4) PC Sen, 'Modern Power Electronics", S. Chand Publishers 5) PS Bhimra, "Power Electronics",Khanna Publishers

Remark: Syllabus of following subject not received from other BoS

1. **Data structure and algorithm BoS- Computer science and Engineering**
2. **Thermal And Fluid Engineering BoS- Mechanical Engineering**

Course Code: PCC-EE22

Title of the Course: Power System-II Laboratory

Course Scheme			Evaluation Scheme (Practical)		
Practical	Periods/week	Credits	TW	POE	Total
2	2	1	25	25	50

Course Outcomes:

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

1. Use numerical methods to analyze a power system in steady state.
2. Use numerical methods to analyze power system stability.
3. Use phasor measurement to analyze a power system in steady state.
4. Understand the effect of shunt and series compensation on power system.

List of Laboratory Experiments/ Demonstrations: (Any Eight)

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 4^{th} order method.
7) To study the application of equal area criteria to check stability for sudden change method.
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.

Course Code: PCC-EE12

Title of the Course: Power Electronics Laboratory

Course Scheme			Evaluation Scheme (Practical)		
Practical	Periods/week	Credits	TW	POE	Total
2	2	1	25	25	50

Course Outcomes

On completion of this course, the student will be able to

1) Demonstrate the learning's of various power semiconductor devices with their protection and apply them for various applications.
2) Analyse different Power Electronics Converter circuits and choose them for suitable applications.
3) Demonstrate the knowledge of chopper circuits, analyse and utilise them for different applications.
4) Analyse inverter circuits with different modulation techniques and identify their applications.

List of Laboratory Experiments/ Demonstrations: (Any Eight)

1. To show V-I characteristics of SCR and measure holding and latching current of SCR.
2. To estimate sensitivity of four modes operation of TRIAC
3. To evaluate average dc voltage of single phase half wave rectifier with Resistive load.
4. To show transfer and output characteristics of Power MOSFET.
5. To show speed control of DC Shunt Motor with Semi Converter.
6. To demonstrate single phase step down Cycloconverter with Resistive load.
7. To demonstrate Forced Commutation methods of SCR.
8. To evaluate RMS AC Voltage of single phase MOSFET based full Bridge inverter.
9. Study of Gate Pulse Generation using R, RC and UJT.
10. Study of AC to DC half controlled converter.
11. Study of AC to DC fully controlled Converter.
12. Study of Step down and step up MOSFET based choppers.
13. Study of IGBT based single phase PWM inverter 8. IGBT based three phase PWM inverter.
14. Study of Switched mode power converter.
15. Simulation of PE circuits (1Φ&3Φsemiconverter, 1Φ&3Φfullconverter, dc-dc converters, ac voltage controllers).
16. Study of Characteristics of GTO & IGCT.

Course Code: PCC-EE25

Title of the Course: Electronics Design

Course Scheme			Evaluation Scheme (Practical)		
Practical	Periods/week	Credits	TW	POE	Total
2	2	1	25	25	50

Course Outcomes

1) Analyze circuits in different biasing modes
2) Identify the suitable devices based on characteristics and operating conditions
3) Design circuits based on specifications
4) Distinguish various devices and operate safely within the limit of operation
5) Understand the functioning of various electronic circuits.

List of Laboratory Experiments/ Demonstrations: (Any Eight)

To design the following circuits, assemble these on bread board and test them. Simulation of these circuits with the help of appropriate software.

1. Op-Amp characteristics and get data for input bias current, measure the output-offset voltage and reduce it to zero and calculate slew rate.
2. Op-Amp in inverting and non-inverting modes.
3. Op-Amp as scalar, summer and voltage follower.
4. Op-Amp as differentiator and integrator.
5. Design LPF and HPF using Op-Amp 741
6. Design Band Pass and Band reject Active filters using Op-Amp 741.
7. Design Oscillators using Op-Amp (i) RC phase shift (ii) Hartley (iii) Colpitts
8. Design (i) Astable (ii) Monostable multivibrators using IC-555 timer
9. Design Triangular & square wave generator using 555 timer.
10. Design Amplifier (for given gain) using Bipolar Junction Transistor