

SYLLABUS
FOR
SEMESTER SIXTH

Course Code	PCCEE601			Semester	SIXTH
Category	Professional Core Course				
Course Title	Power Systems-II				
Scheme & Credits	L	T	P	Credits	Max Marks: 100
	3	1	0	4	
Prerequisites	Power System-I				

Course Objectives:

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

Unit	Topic	No. of Hours
I	Review of Per Unit Representation of Power Systems: Single line diagram, impedance and reactance diagram of a system, per unit calculations, per unit representation of a power system.	10
II	Fault Analysis (Balanced Faults): Faults, types of faults, symmetrical 3-phase balanced faults – calculation of fault currents, current limiting reactors. Fault Analysis (Unsymmetrical Faults): Symmetrical components, sequence impedances, sequence networks, unsymmetrical faults –single line to ground, line- to-line, double line to ground faults on unloaded alternators and on power systems.	14
III	Insulation Coordination: Generation of overvoltages in a power system, lightning phenomena, lightning surges, switching surges-interruption of short circuits and switching operations, switching surges – interruption of capacitive circuits, resonance over voltages, protection of power system components against over voltages – ground wires, lightning arrestors. Concept of insulation coordination, Basic impulse insulation level, standard impulse test wave, volt-time curve, location and rating of lightning arrestors.	14
IV	Surge Performance of Transmission Lines: Traveling waves on transmission lines, open-end line, short-circuited line, line terminated through a resistance, line connected to a cable, reflection and refraction at a T-junction, line terminated through a capacitance, line terminated through an inductance, Attenuation of traveling waves.	12
V	Interference of Power Lines with communication Circuit Electrostatic and Electromagnetic effects.	6
Total No. of Hours		56

Textbooks :

S. No	Name of Book	Author	Publisher
1	Power System Analysis	J.J. Grainger and W.D Stevenson	Tata McGraw Hill
2	Electrical Power Systems.	C.L. Wadhwa	New age Publication
3	Power Systems Engineering	Nagrath and Kothari	Tata McGraw hill

Course Code	ESCEE602			Semester	SIXTH
Category	Engineering Science Course				
Course Title	Non-Conventional Energy Sources				
Scheme & Credits	L	T	P	Credits	Max Marks: 100
	3	1	0	4	
Prerequisites	Nil				

Course Objectives:

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

Unit	Topic	No. of Hours
I	Classification of energy resources, Importance of non-conventional energy sources (NCES), present status and growth of energy sector, Various aspects of energy conservation. Energy Storage: Necessity and methods, Pumped storage, flywheel storage, Battery storage, Superconducting magnetic energy storages, super/ultra-capacitor storage, applications	11
II	Solar thermal systems: Introduction, Solar energy basics, classification, solar water heater, solar refrigeration and air-conditioning systems, solar cookers, solar pond electric-power plant, central receiver power plant	10
III	Solar Photovoltaic (PV) systems: introduction, solar cell characteristics and equivalent circuit, design of solar PV module and array in solar PV system, MPPT, standalone and grid connected solar PV system, Other Applications	12
IV	Wind Energy: Introduction, Applications of wind power, power extraction from wind, torque developed by the wind turbine, wind turbine classifications, wind generators, wind energy conversion systems, Hybrid standalone and grid connected systems	10
V	Other NCES (small hydro resources, biomass, ocean energy and geothermal energy): introduction, classification, essential components and principle.	13
Total No. of Hours		56

Textbooks:

Unit	Name of Book	Author	Publisher
1	Non-conventional energy resources	B. H. Khan	McGraw Hill
2	Renewable Energy Resources	J.Twidell and T.Weir	Taylor and Francis Group
3	Renewable Energy Resources Basic Principles and Application	G.N.Tiwari and MK Ghosal	Narosa Publishing House
4	Non-Conventional Energy Resources	R.K Singal	Dhanpat Rai publication
5	Energy Technology	S. Rao, B.B Parlekar	Khanna Publications
6	Wind & Solar Power System	M.Patel	CRC Press

Course Code	PEC1EE603			Semester	SIXTH
Category	Professional Elective Course				
Course Title	Advanced Control Systems				
Scheme & Credits	L	T	P	Credits	Max Marks: 100
	2	1	0	3	
Prerequisites	Control System				

Course Objectives:

1. Understanding State space Modelling
2. Design and analyse digital controllers.
3. Design state feedback and output feedback controllers.

Unit	Topics	No. of Hours
I	State variable modeling: Block diagram, transfer function and signal flow graphs in state space	7
II	State variable Analysis and design solution of state vector equations, design using state – variable feedback.	10
III	Concepts of Controllability and Observability: state estimation, pole allocation, stability and reproducibility, Design of full State Observers, Design by separation principle.	9
IV	Digital control system: Hardware elements of a digital control system, Advantages of Digital control systems, Practical aspects of the choice of sampling rate and multirate sampling, Basic discrete time signals, Quantization & Sampling	7
V	Mathematical modeling, Data reconstruction and filtering of sampled signals, zero order hold. Pulse transfer function. Difference equations, Design of Discrete Data System, Digital P, PI, PID controller. Introduction to Advanced Controllers: Fuzzy logic control, Neural Network, Predictive Controller	9
Total number of Hours		42

Textbooks:

S. No	Name of Book	Author	Publisher
1	State variable methods and digital control	M. Gopal	Tata Mcgraw Hill
2	Control system engineering	Norman .S. Nise	John Wiley
3	Discrete Time Control Systems	K Ogata	Wesley longman
4	Control systems	A. Anand Kumar	PHI Learning Pvt. Ltd
5	Feedback control of dynamic systems	Franklin and Powell	Prentice hall

Course Code	PEC2EE603			Semester	SIXTH
Category	Professional Elective Course				
Course Title	Utilisation & Traction				
Scheme & Credits	L	T	P	Credits	Max Marks: 100
	2	1	0	3	
Prerequisites	Electrical Machines				

Course Objectives:

1. To understand the concepts of various electrical drives employed in industrial processes
2. To understand the models to describe hybrid vehicles and their performance.
3. Learning electric traction.

Unit	Topics	No. of Hours
I	Electric Drive: Factors governing selection of Electric drive. Control devices for industrial motors. Motors for particular services. Applications of Electric Drive.	8
II	ELECTRIC TRACTION: Introduction, requirements of an ideal traction, systems of traction, speed time curve, tractive effort, coefficient of adhesion, selection of traction motors, method of speed control, energy saving by series parallel control, ac traction equipment. Breaking methods used in Traction Motor, specific energy consumption and factors affecting it.	11
III	INTRODUCTION TO ELECTRIC AND HYBRID VEHICLES: Configuration and performance of electrical vehicles, traction motor characteristics, tractive effort, transmission requirement, vehicle performance and energy consumption.	9
IV	ILLUMINATION: Laws of illumination, lighting calculation, factory lighting, flood lighting, street lighting, different types of lamps-incandescent, fluorescent, CFL and LED lamps and their working, comparison, Glare and its remedy.	6
V	HEATING AND WELDING: Advantages and methods of electric heating, resistance ovens, induction heating, dielectric heating, the arc furnace, heating of buildings. Electric welding, resistance and arc welding, control devices and welding equipment.	8
Total No. of Hours		42

Textbooks

S. No	Name of Book	Author	Publisher
1	Utilization Of Electric Energy,	E Openshaw Taylor	12th Impression, 2009, Universities Press
2	Modern Electric, Hybrid Electric and Fuel Cell Vehicles,	E. Gay, Mehrdad, Ehsani, Yimin Gao, Sabastien.	Ali Emadi- CRC Press.
3	Art & utilization of Electric Energy	H. Partab	Bhandari Benevolent & Educational Society
4	Utilization of Electric Power & Electric Traction	J.B Gupta	S. K. Kataria & Sons

Course Code	PEC3EE603			Semester	SIXTH
Category	Professional Elective Course				
Course Title	Electrical Machine Design				
Scheme & Credits	L	T	P	Credits	Max Marks: 100
	2	1	0	3	
Prerequisites	Electrical Machines				

Course Objectives:

1. Understand the construction and performance characteristics of electrical machines.
2. Understand the various factors which influence the design: electrical, magnetic and thermal loading of Transformer.
3. Understand the various factors which influence the design: electrical and magnetic loading of Induction motor and synchronous machine.
4. Understand the principles of electrical machine design and carry out a basic design of synchronous machines.

Unit	Topics	No. of Hours
I	Introduction: Major considerations in electrical machine design, electrical engineering materials, space factor, choice of specific electrical and magnetic loadings, thermal considerations, heat flow, temperature rise, rating of machines	10
II	Transformers: Sizing of a transformer, main dimensions, kVA output for single- and three-phase transformers, window space factor, overall dimensions, operating characteristics, regulation, no load current, temperature rise in transformers, design of cooling tank, methods for cooling of transformers.	10program
III	Induction Motors: Sizing of an induction motor, main dimensions, length of air gap, rules for selecting rotor slots of squirrel cage machines, design of rotor bars & slots, design of end rings, design of wound rotor, magnetic leakage calculations, leakage reactance of poly-phase machines, magnetizing current, short circuit current, circle diagram, operating characteristics.	12
IV	Synchronous Machines: Sizing of a synchronous machine, main dimensions, design of salient pole machines, short circuit ratio, shape of pole face, armature design, armature parameters, estimation of air gap length, design of rotor, design of damper winding, determination of full load field mmf, design of field winding, design of turbo alternators, rotor design.	10
Total number of Hours		42

Textbooks:

S. No	Name of Book	Author	Publisher
1	A Course in Electrical Machine Design	A. K. Sawhney	Dhanpat Rai Publication.
2	Design of Electrical Machines	V. N. Mittle	Standard Publishers Distributors.
3	Principles of Electrical Machine Designs.	R. K. Agarwal,	K. Kataria & Sons
4	Principles of Electrical machine Design	S. K. Sen	Oxford & Ibh Publishing Co. Pvt Ltd

Course Code	PEC1EE604			Semester	SIXTH
Category	professional Elective Course				
Course Title	Advanced Power Electronics				
Scheme & Credits	L	T	P	Credits	Max Marks: 100
	2	1	0	3	
Prerequisites	Power Electronics				

Course Objectives:

1. Analyse the operation of multilevel inverters.
2. Analyse the operation of DC-DC Converters.
3. Analyse the operation of UPS.

Unit	Topic	No. of Hours
I	DC-DC switched mode converters: introduction, control of dc-dc converters, Continuous and discontinuous conditions of buck, boost and buck-boost converters, Cuk dc-dc converter, full bridge dc-dc converter	8
II	Switched dc power supplies: Flyback converter, forward and push- pull converter	8
III	Uninterruptible Power Supply (UPS): Off Line UPS, On- Line UPS, Rating of Battery Bank, Calculation of Back-up-time.	8
IV	Cascaded H-Bridge Multilevel Inverters: Introduction, Bipolar and unipolar for H- Bridge Inverter, Multilevel Inverter Topologies, Carrier-Based PWM Schemes, Staircase Modulation, Applications	9
v	Diode-Clamped and Flying-Capacitor Multilevel Inverter: Introduction, Three-Level Inverter, Neutral- Point Voltage Control, Carrier-Based PWM Scheme, other modulation schemes, Applications	9
Total		42

Textbooks:

S. No	Name of Book	Author	Publisher
1	High-Power Converters and AC Drives	Bin Wu	Wiley
2	Power Electronics - converters, Applications, and Design	Ned Mohan, T. M. Undeland, W.P. Robbins	Wiley

Course Code	PEC2EE604			Semester	SIXTH
Category	Professional Elective Course				
Course Title	Power Station Practice				
Scheme & Credits	L	T	P	Credits	Max Marks: 100
	2	1	0	3	
Prerequisites	Power System				

Course Objectives:

1. To introduce students to different aspects of power plant engineering.
2. To familiarize the students to the working of power plants based on different fuels.
3. Expose the students to the principles of safety and environmental issues.

Unit	Topic	No. of Hours
I	Economic Aspects and power factor improvement: Economics of generation, factors affecting the cost of generation, reduction of costs by interconnection of stations, curves useful in system operation, choice of size and number of generating units. Power factor, disadvantages of low power factor, methods of improving power factor, location of power factor improvement apparatus, and economics of power factor improvement.	10
II	Power Tariff: Cost of generating station, fixed capital, running capital, annual cost, running charges, fixed charges, factors influencing the rate of tariff, designing tariff, different types of tariff, flat rate tariff, block rate tariff, two part tariff, maximum demand tariff, power factor tariff.	10
III	Neutral Grounding: Neutral grounding, solid grounding, resistance grounding, reactance grounding, arc suppression coil grounding, earthing transformers, choice of methods of neutral grounding equipment, grounding for safety.	8
IV	Overview of different types of power stations and their auxiliaries: Thermal power plants, hydroelectric stations, nuclear power stations, diesel power stations, gas turbine plants	8
V	Overview of substations and substation equipment	6
Total		42

Textbooks:

S. No	Name of Book	Author	Publisher
1	Elements of Electrical Power Station Design	Deshpande	PHI learning
2	The Art and Science of Utilisation of Electric Energy	H. Pratab	Dhanpat Rai & Co
3	Substation Design and Equipment	Satnam	Dhanpat Rai
4	A Course in Electrical Power	Soni, Gupta and Batnagar	Dhanpat Rai & Co

Course Code	PEC3EE604			Semester	SIXTH
Category	Professional Elective Course				
Course Title	Electrical Materials				
Scheme & Credits	L	T	P	Credits	Max Marks: 100
	2	1	0	3	
Prerequisites	Nil				

Course Objectives:

1. Given a type of material, the students will be able to qualitatively describe the bonding scheme and its general physical properties, as well as possible applications in electrical engineering.
2. Students will be able to do comparative analysis of magnetic materials based upon their properties.
3. Students will be able to differentiate among various materials such as conductor and semiconductor based upon the internal composition and

Unit	Topic	No. of Hours
I	Crystal Structure of Solids: Atomic packing, crystal lattice, Different type of crystal Bands, structure of silicon & Germanium, Energy Bands in solids, one dimensional lattice, Electron in periodic potential, concept of hole, Three dimensional Lattice and Brillouin Zones Elastic Wave and Photons (Elementary Ideas).	12
II	Insulating Materials: Introduction to Insulators, dielectric behavior, Properties of Insulating Materials, Insulators in Static & Alternating fields, classification as per temperature rise, Practical Dielectrics, Liquid: Solid and Gaseous and their applications.	10
III	Dielectric Materials: Polarization, Quantitative and qualitative discussion of dielectric constants of polyatomic molecules, Internal fields in solids and Liquids. Ferroelectrics & Piezoelectric Materials, spontaneous polarization, Frequency dependence of polarizabilities, complex dielectric constant of non-dipolar solids, Dipolar relaxation, dielectric losses, Dielectric Break downs.	10
IV	Magnetic Materials: Review of magnetic field concepts, Orbital dipole, and angular momentum of simple atomic models, classification of magnetic materials, spontaneous magnetism, Curie- Weiss Law, coercive forces; antiferromagnetic materials, ferromagnetic materials, Properties & applications of ferrites.	10
Total		42

Textbooks:

S. No	Name of Book	Author	Publisher
1	Electrical Engineering Materials.	Dekker	
2	Materials & Electronics Engineering & Devices.	Allison	
3	Electrical Engineering Materials.	Raghvan	
4	Electrical Engineering Materials.	S.P. Seth and P. V. Gupta,	

Course Code	OEC1EE605			Semester	SIXTH
Category	Open Elective Course				
Course Title	Microcontroller 8051 & interfacing				
Scheme & Credits	L	T	P	Credits	Max Marks: 100
	2	1	0	3	
Prerequisites	Nil				

Course Objectives:

1. To develop background knowledge of Computers and its memory System.
2. To understand the architecture of 8051.
3. To write programs for 8051 microcontrollers.
4. To understand the design of Microcontroller Applications.

Unit	Topic	No. of Hours
I	Overview of microcomputer systems and their building blocks, Memory Interfacing, Steps taken by the microprocessor to fetch and executes an instruction from the memory, Concepts of Program counter register, Reset, Stack and stack pointer ,Subroutine, Interrupts and Direct Memory Access	10
II	Concept of RISC & CISC Architecture, Harvard & Von Neumann Architecture, Addressing modes, Instruction set, Need of Assembler & Cross Assemble, Assembler Directives	10
III	Programs related to: arithmetic, logical, delay subroutine , input, output, timer, counters, port, serial communication, and interrupts	12
IV	8051 interfacing with 4x4 Matrix keyboard, Interfacing 4 digit 7 segment Multiplexed LED Display, Interfacing with ADC,interfacing LCD	10
Total No. of Hours		42

Textbooks:

S. No	Name of Book	Author	Publisher
1	Microprocessors & Interfacing	Douglas V Hall, SSSP Rao	McGraw Hill
2	The 8051 Microcontroller & Embedded systems	M. A. Mazidi, J. G. Mazidi and R. D. Mckinlay	Pearson Publications, Second Edition 2006
3	The 8051 Microcontroller & Embedded system using assembly & 'C	C. Kenneth J. Ayala and D. V. Gadre	Cengage Learning, Edition 2010

Course Code	OEC2EE605			Semester	SIXTH
Category	Open Elective Course				
Course Title	Energy Audit and Management				
Scheme & Credits	L	T	P	Credits	Max Marks: 100
	2	1	0	3	
Prerequisites	Nil				

Course Objectives:

1. Understand the current energy scenario and importance of energy conservation.
2. Understand the concepts of energy management.
3. Understand the methods of improving energy efficiency in different electrical systems.
4. Understand the concepts of different energy efficient devices.

Unit	Topic	No. of Hours
I	ENERGY SCENARIO - Energy needs of growing economy, Long term energy scenario, Energy pricing, Energy sector reforms, Energy and environment: Air pollution, Climate change, Energy security, Energy conservation and its importance, Energy strategy for the future, Energy conservation Act-2001 and its features.	11
II	ENERGY MANAGEMENT AND AUDIT - Definition, Energy audit- need, Types of energy audit, Energy management (audit) approach-understanding energy costs, Benchmarking, Energy performance, Matching energy use to requirement, Maximizing system efficiencies, Optimizing the input energy requirements, Fuel and energy substitution, Energy audit instruments, Facility as an energy system, Methods for preparing process flow,	11
III	FINANCIAL MANAGEMENT - Investment-need, Appraisal and criteria, Financial analysis techniques- Simple payback period, Return on investment, Net present value, Internal rate of return, Cash flows, Risk and sensitivity analysis, Financing options, Energy performance contracts and role of ESCOs.	10
IV	ELECTRICAL SYSTEM - Electricity tariff, Load management and maximum demand control, Power factor improvement, Distribution and transformer losses. Losses in induction motors, Motor efficiency, Factors affecting motor performance, Rewinding and motor replacement issues, energy efficient motors. Light source, Choice of lighting, Luminance requirements, and Energy conservation avenues.	10
Total		42

Textbooks:

S. No	Name of Book	Author	Publisher
1	Utilization of Electrical Energy and Conservation	S. C. Tripathy	McGraw Hill, 1991
2	Success stories of Energy Conservation by BEE, New Delhi (www.bee-india.org)		
3	Guide books for National Certification Examination for Energy Manager / Energy Auditors Book-1, General Aspects (available online)		
4	Guide books for National Certification Examination for Energy Manager / Energy Auditors Book-3, Electrical Utilities (available online)		

Course Code	OEC3EE605			Semester	SIXTH
Category	Open Elective Course				
Course Title	Python Data Analytics				
Scheme & Credits	L	T	P	Credits	Max Marks: 100
	2	1	0	3	
Prerequisites	Nil				

Course Objectives:

1. To understand the importance of data science
2. To experience and apply Python's diverse array of packages

Unit	Topics	No. of Hours
I	Introduction to data analytics, Python Fundamentals, Central Tendency and Dispersion, Probability and Probability Distributions, Sampling and Sampling Distribution, Confidence interval estimation Hypothesis Testing; Errors in Hypothesis Testing, ANOVA, Post Hoc Analysis, Randomized block design (RBD), Two Way ANOVA	10
II	Linear Regression, Estimation, Prediction of Regression Model Residual Analysis, MULTIPLE REGRESSION MODEL; Categorical variable regression	8
III	Maximum Likelihood Estimation , LOGISTIC REGRESSION , Linear Regression Model Vs Logistic Regression Model	8
IV	Confusion matrix and ROC, Performance of Logistic Model. Regression Analysis Model Building	6
V	Chi - Square Test of Independence, Chi-Square Goodness of Fit Test, Cluster analysis, Energy banking, Industrial Cogeneration, K- Means Clustering, Hierarchical method of clustering, Classification and Regression Trees, Measures of attribute selection	10
Total number of Hours		42

Textbooks:

S. No	Name of Book	Author	Publisher
1	Data Science from Scratch: First Principles with Python	Grus, Joel	O'Reilly Media, 2019
2	Python for Data Analysis.	Wes Kinney	O'Reilly Media, 2018
3	The Elements of Statistical Learning: Data Mining, Inference, and Prediction	Trevor Hastie, Robert Tibshirani, Jerome Friedman	Springer, 2013

Course Code	PSIEE606			Semester	SIXTH
Category	Project, Seminar and Internship				
Course Title	Seminar				
Scheme & Credits	L	T	P	Credits	Max Marks: 100
	0	0	4	2	
Prerequisites	Nil				
<p>The students are required to prepare a seminar report and presentation based on the latest trends and technologies in their respective fields of study. The work is to be carried out in the 6th semester of their course individually. Each student will have to select a topic of study duly approved by the faculty incharge of conducting the seminar. The student will have to prepare a seminar report and deliver a presentation before a panel of experts based on the seminar work carried by him/her.</p>					

Course Code	PCC-EE601L			Semester	Six
Category	Professional Core Course				
Course Title	Seminar				
Scheme & Credits	L	T	P	Credits	Max Marks: 100
	0	0	2	1	
Prerequisites	Nil				

S. No.	Experiment
1	A.C distribution
2	D.C. distribution
3	Efficiency, Regulation & ABCD parameters of Transmission line
4	Study of cables & find charging current
5	Study of different types of insulators
6	Per unit representation of a power system.
7	Measurement of positive, negative and zero sequence impedance and currents.
8	Measurement of earth resistance.
9	Measurement of insulation resistance of insulators
10	Transmission line fault analysis
11	Computer Simulation of Power System