SYLLABUS
FOR
B.TECH. PROGRAMME
IN
ELECTRICAL ENGINEERING
(3rd to 8th Semester)

UNIVERSITY OF KASHMIR
SRINAGAR

NOVEMBER – 2021
(Applicable to Batch 2020 & Onwards)

B.TECH IN ELECTRICAL ENGINEERING
UNDER THE CHOICE BASE CREDIT SYSTEM (CBCS)

Code	Nomenclature
ESC	Engineering Science Courses
BSC	Basic Science Courses
PCC	Professional Core Course
PEC	Professional Elective Course
OEC	Open Elective Course
ISE	Internal Semester Evaluation
MSE	Mid Semester Evaluation (35 Marks)
ESE	End Semester Evaluation (50Marks)

Code	Nomenclature
HSM	Humanities and Social Sciences including Management
PSI	Project work, Seminar and Internship
L	Lecture
T	Tutorial
P	Practical
IA	Internal Assessment (Assignment + Quiz/ Viva Voce (10 Marks) + Attendence (5 Marks)

COURSE STRUCTURE

Semester-3rd (Third)						**Examination Scheme (Distribution of Marks)**			
Course Code	**Course Title**	**L**	**T**	**P**	**Credits**	**ISE**		**ESE**	**Total**
						MSE	**IA**		
BSCEE301	Engineering Mathematics – III	3	1	0	4	35	15	50	100
PCCEE302	Engineering Electromagnetics	2	1	0	3	35	15	50	100
PCCEE303	Analog Electronic circuits	3	1	0	4	35	15	50	100
PCCEE304	Signals & Systems	3	1	0	4	35	15	50	100
PCCEE305	Circuit Analysis and Transients	3	1	0	4	35	15	50	100
PCCEE303L	Analog Electronics lab	0	0	2	1	50		50	100
PCCEE305L	Circuit Analysis and Transient Lab	0	0	2	1	50		50	100
PCCEE306L	MATLAB	0	0	2	1	50		50	100
Total		14	5	6	22				800

Semester-4th (Fourth)						Examination Scheme (Distribution of Marks)			
Course Code	Course Title	L	T	P	Credits	ISE		ESE	Total
						MSE	IA		
BSCEE401	Engineering Mathematics – IV	3	1	0	4	35	15	50	100
PCCEE402	Electrical Machines – I	3	1	0	4	35	15	50	100
PCCEE403	Control Systems	3	1	0	4	35	15	50	100
PCCEE404	Electrical Measurement	3	1	0	4	35	15	50	100
PCCEE405	Digital Electronics	3	1	0	4	35	15	50	100
PCCEE402L	Electrical Machines-I Lab	0	0	2	1	50		50	100
PCCEE403L	Control Systems Lab	0	0	2	1	50		50	100
PCCEE404L	Electrical Measurement Lab	0	0	2	1	50		50	100
PCCEE405L	Digital Electronics Lab	0	0	2	1	50		50	100
Total		15	5	8	24				900

Semester-5th (Fifth)						Examination Scheme (Distribution of Marks)			
Course Code	Course Title	L	T	P	Credits	ISE		ESE	Total
						MSE	IA		
PCCEE501	Power System –I	3	1	0	4	35	15	50	100
PCCEE502	Electrical Machines – II	3	1	0	4	35	15	50	100
PCCEE503	Microprocessors	3	1	0	4	35	15	50	100
OEC*EE504	Open Elective Courses-I	2	1	0	3	35	15	50	100
PCCEE505	Power Electronics	3	1	0	4	35	15	50	100
PCCEE502L	Electrical Machines-II Lab	0	0	2	1	50		50	100
PCCEE503L	Microprocessors Lab	0	0	2	1	50		50	100
PCCEE505L	Power Electronics Lab	0	0	2	1	50		50	100
Total		14	5	6	22				800

Semester-6th (Sixth)						Examination Scheme (Distribution of Marks)			
Course Code	Course Title	L	T	P	Credits	ISE		ESE	Total
						MSE	IA		
PCCEE601	Power System-II	3	1	0	4	35	15	50	100
ESCEE602	Non-Conventional Energy Sources	3	1	0	4	35	15	50	100
PEC*EE603	Professional Elective Courses-I	2	1	0	3	35	15	50	100
PEC*EE604	Professional Elective Courses-II	2	1	0	3	35	15	50	100
OEC*EE605	Open Elective Courses-II	2	1	0	3	35	15	50	100
PSIEE606	Seminar	0	0	4	2	50		50	100
PCCEE601L	Power System Lab	0	0	2	1	50		50	100
Total		12	5	6	20				700

Semester-7th (Seventh)						Examination Scheme (Distribution of Marks)			
Course Code	Course Title	L	T	P	Credits	ISE		ESE	Total
						MSE	IA		
PCCEE701L	Power System Protection & Switchgear	3	1	0	4	35	15	50	100
PCCEE702	Power System – III	3	1	0	4	35	15	50	100
OEC*EE703	Open Elective Courses – III	2	1	0	3	35	15	50	100
PEC*EE704	Professional Elective III	2	1	0	3	35	15	50	100
PEC*EE705	Professional Elective Course – IV	2	1	0	3	35	15	50	100
PSIEE706	Pre - Project	0	0	6	3	50		50	100
PCCEE701L	Power System Protection & Switchgear Lab	0	0	2	1	50		50	100
Total		12	5	8	21				700

Semester-8th (Eighth)						Examination Scheme (Distribution of Marks)			
Course Code	Course Title	L	T	P	Credits	ISE		ESE	Total
						MSE	IA		
HSMCEE801	Organisation of Engineering Systems and Human Resources and Management	3	0	0	3	35	15	50	100
PEC*EE802	Professional Elective Courses– V	2	1	0	3	35	15	50	100
PEC*EE803	Professional Elective Courses– VI	2	1	0	3	35	15	50	100
PCCEE804L	Advanced Power System Simulation and Scripting Lab	0	0	4	2	35	15	50	100
PSIEE805	Industrial Training & Viva**	0	0	0	1	35	15	50	100
PSIEE806	Major Project	0	0	16	8	50		50	100
Total		7	2	20	20				600

*** 1 to 4**

**** Industrial Training has to be covered up in winter vacations.**

Total Credits (Sem. 1st to 8th) = 172

Professional Elective Courses

Course Code	Course Title	Elective	Semester
PEC1EE603	Advanced Control Systems	I	6th
PEC2EE603	Utilisation and Traction		
PEC3EE603	Electrical Machine Design		
PEC1EE604	Advanced Power Electronics	II	
PEC2EE604	Power Station Practices		
PEC3EE604	Electrical Materials		
PEC1EE704	Power Quality	III	7th
PEC2EE704	FACTS		
PEC3EE704	Power Plant Engineering		
PEC1EE705	Electric Drives	IV	
PEC2EE705	Design of Photovoltaic Systems		
PEC3EE705	Special Electrical Machines		
PEC4EE705	Industrial Drives and Control		
PEC1EE802	HVDC	V	8th
PEC2EE802	Electric Vehicles		
PEC3EE802	Smart Grid		
PEC1EE803	High Voltage Engineering	VI	
PEC2EE803	Restructuring of Power Systems		
PEC3EE803	Power System Dynamics and Stability		
PEC4EE804	Advanced Power System Analysis		

Open Elective Courses

Course Code	Course Title	Elective	Semester	Department
OEC1EE504	Communication Systems	I	5th	Electrical Engineering
OEC2EE504	Thermal Engineering			
OEC3EE504	DSP			
OECME506	Automation in manufacturing			Mechanical Engineering
OEC1EE605	8085 Microcontroller	II	6th	Electrical Engineering
OEC2EE605	Energy Audit and Management			
OEC3EE605	Python Data Analytics			
OEC1EE703	SCADA Systems	III	7th	Electrical Engineering
OEC2EE703	Fuzzy Logic and Neural Networks			
OEC3EE703	Energy Management in Buildings			
OEC1ME705	Automatic Control			Mechanical Engineering
OEC2ME705	Engineering Statistics			

SYLLABUS

FOR

SEMESTER THIRD

Course Code	**BSCEE301**			**Semester**	**THIRD**
Category	**Basic Science Course**				
Course Title	**Engineering Mathematics - III**				
Scheme & Credits	**L**	**T**	**P**	**Credits**	**Max Marks: 100**
	3	**1**	**0**	**4**	
Prerequisites	**Nil**				

Course Objectives:

1. Familiarize the prospective engineers with different types of transform techniques.
2. To develop mathematical skills so that students are able to apply mathematical methods & principles in solving problems.

Unit	Topics	No. of Hours
I	Laplace Transforms: Laplace transform, shifting theorem, Laplace Transforms of different functions, Heaviside's unit function. Dirac Delta functions its Laplace Transforms. Heaviside's Expansion theorem.	13
II	Inverse Laplace Transforms: Initial and Final value theorems, Convolution theorem and applications,use of Laplace Transforms in the solution of linear Differential equations.	10
III	Fourier Transform: Fourier series, Harmonic analysis, Definition of Fourier transform. Fourier sine and cosine transform. Fourier integral formula, Applications to solutions of boundary value problems.	13
IV	Z- Transform: Definition, Linearity property, Z- transform of elementary functions, shifting theorems. Initial and Final value theorem. Convolution theorem.	12
V	Inverse Z-transform	8
Total Number of Hours		**56**

Textbooks:

S. No	Name of Book	Author	Publisher
1	Laplace Transforms	Murray R. Speigal	McGraw Hill
2	Advanced Engg. Mathematics	Erwin Kreyzing	Wiley Eastern. Pub.
3	The use of Integral Transform	Ian.N.Snedden	Tata McGraw Hill
4	Integral Transform	Loknath Debnath	New York, Press
5	Higher engineering mathematics	H. K. Dass, Rajnish Verma	S. Chand

Course Code	PCCEE302			Semester	THIRD
Category	Professional Core Course				
Course Title	Engineering Electromagnetics				
Scheme & Credits	L	T	P	Credits	Max Marks: 100
	2	1	0	3	
Prerequisites	Nil				

Course Objectives:

1. To understand the basic laws of electromagnetism.
2. To obtain the electric and magnetic fields for simple configurations under static conditions.
3. To analyse time varying electric and magnetic fields.

Unit	Topics	No. of Hours
I	Vector Analysis, coordinate systems, vector operator, curl, divergence theorem, Stoke's theorem, Coulomb's law, electric field intensity, field due to continuous volume charge distribution, field of a line charge, field of a sheet of charge.	8
II	Electric flux density, Gauss's law, symmetrical charge distributions, differential volume element, divergence, Maxwell's first equation, energy expended in moving a point charge in an electrostatic field, line integral, definition of potential; and potential difference, potential field of a charge, potential field of a system of charges, potential gradient, the dipole, energy density in electric field.	9
III	Current and current density, continuity of current, metallic conductors, conductor properties and boundary conditions, semiconductors, nature of dielectric materials, boundary conditions for perfect dielectric materials, capacitance, several capacitance examples, capacitance of two wire line, Poisson's and Laplace's equations, unique Theorem, examples of the solution of Laplace's and Poisson's equations, product solution of Laplace equation.	9
IV	Boit Savart law, Ampere's circuital law, magnetic flux and magnetic flux density, scalar and vector magnetic potentials, derivations of steady magnetic field laws, force on a moving charge, force on differential current element, force between differential current elements, force and torque on a closed circuit.	8
V	Faraday's law, displacement current, Maxwell's equations in point forms and in integral forms, Application of Maxwell's equations, EM waves and propagation of energy. Wave equation for free space. Plane and uniform plane wave. Poynting vector and power, Intrinsic impedance of media for uniform plane wave.	8
Total number of Hours		**42**

Textbooks:

S. No	Name of Book	Author	Publisher
1	Introduction to electro-dynamics	David J. Griffiths	Prentice hall India
2	Electrodynamics	J.D. Jacson	Pearson
3	Mathematical method for Physicists	Arfken Weber	Harcourt (INDIA)
4	Classical Theory & Fields	L.D. Landau, E.M. Lypshitz	Pergman

Course Code	PCCEE303			Semester	THIRD
Category	Professional Core Course				
Course Title	Analog Electronic Circuits				
Scheme & Credits	L	T	P	Credits	Max Marks: 100
	3	1	0	4	
Prerequisites	Nil				

Course Objectives:

1. Understand the characteristics of transistors. Design and analyse various rectifier and amplifier circuits.
2. Design sinusoidal and non-sinusoidal oscillators.
3. Understand the functioning of OP-AMP and design OP-AMP based circuits.

Unit	Topics	No. of Hours
I	BJTs: Brief review of BJTs, Analysis and Design of transistor amplifier circuits using h-parameters, Low frequency h- parameter model. High frequency hybrid – pi model, analysis and design of transistor amplifier circuits at high frequencies, Multistage amplifiers. Feedback Basics: Negative feedback, Effect of negative feedback on the performance of amplifiers e.g. on bandwidth. Types of feedback amplifiers, current shunt, current series, voltage shunt and voltage series feedback. Analysis of feedback amplifiers circuits	18
II	Sinusoidal Oscillators: Analysis of general oscillator circuits, Barkhausen's criteria, various types of oscillator circuits and their analysis, Design of practical oscillator circuits.	8
III	Power Amplifiers: Classification of power amplifiers, Class A, Class B, Class AB and Class C power amplifiers; analysis and design. Power supplies and IC regulators	9
IV	Operational Amplifiers: Operational amplifier stages, Differential amplifier, CMRR, Cascade amplifier, Ideal and practical operational amplifier characteristics and properties Op-amp applications, inverting and non-inverting amplifiers, difference amplifier, summer, differentiator and integrator, rectifiers etc. Op-amp in analog computation. Frequency response, Gain Bandwidth product, Signal to noise ratio.	13
V	Multivibrators and WaveForm Generators: Bistable multivibrators, Bistable circuit as a memory element, Generation of Square & Triangular waves using Astable multivibrators, Generation of the standard Pulse-The Monostable multivibrators, Integrated circuit Timers, Implementation of Astable, Monostable and Bistable multivibrators using 555 Timer, Various practical applications of 555 Timer.	8
Total Number of Hours		**56**

Textbooks:

S. No	Name of Book	Author	Publisher
1	Integrated circuits	Millman & Halkias	Tata Mc-Graw Hill
2	Microelectronic circuits	Sedra and Smith	Oxford univ. Press
3	Introduction to Electronic Circuit Design	Spencer and Ghausi	Pearson
4	Op-Amps and Linear Integrated Circuits	Ramakant Gaekwad	Pearson

Course Code	**PCCEE304**			**Semester**	**THIRD**
Category	**Professional Core Course**				
Course Title	**Signal & Systems**				
Scheme & Credits	**L**	**T**	**P**	**Credits**	**Max Marks: 100**
	3	**1**	**0**	**4**	
Prerequisites	**Nil**				

Course Objectives:

1. Understand the concepts of continuous time and discrete time systems.
2. Analyse systems in complex frequency domains.
3. Understand sampling theorem and its implications.

Unit	Topics	No. of Hours
I	Continuous-Time and Discrete-Time Signals, signal operations, Transformations. Independent Variable, Exponential and Sinusoidal Signals, Energy and power signals, Even and odd signals, Impulse and Unit Step Functions, Continuous and Discrete-Time Systems, Properties.	9
II	Discrete-Time & Continuous-Time LTI Systems: Properties of Linear Time-Invariant Systems. Causal LTI Systems described by Differential and Difference Equations, Singularity Functions.	7
III	Fourier Series Representation of Periodic Signals: Response of LTI Systems to Complex Exponentials, Fourier Series Representation of Continuous-Time Periodic Signals, Convergence of the Fourier Series, Properties of Continuous-Time Fourier Series, Fourier Series Representation of Discrete-Time Periodic Signals. Discrete-Time Fourier Transform.	15
IV	Time- and Frequency Characterization of Signals and Systems: The Magnitude-Phase Representation of the Fourier Transform,properties of Continuous-Time Fourier transform, Duality, Inverse Fourier Transform, The Magnitude-Phase Representation of the Frequency Response of LTI Systems. Sampling: Representation of a Continuous-Time Signal by Its Samples: The Sampling Theorem,The Effect of Undersampling: Aliasing, Sampling of Discrete-Time Signals.	17
V	The Laplace Transform: Region of Convergence for Laplace Transforms, properties, Analysis and Characterization of LTI Systems Using the Laplace Transform. Inverse Laplace Transform The Z-Transform: Region of Convergence for the z-Transform, properties, Analysis and Characterization of LTI Systems Using z-Transforms.	13
Total Number of Hours		**56**

Textbooks:

S. No	Name of Book	Author	Publisher
1	Signals and Systems	A.V. Oppenheim, A.S. Willsky and I.T. Young	Prentice hall
2	Signals and Systems - Continuous and Discrete	R.F. Ziemer, W.H. Tranter and D.R. Fannin	Prentice hall
3	Signal Processing and Linear Systems	B.P. Lathi	Oxford univ. press

Course Code	**PCCEE305**			**Semester**	**THIRD**
Category	**Professional Core Course**				
Course Title	**Circuit Analysis and Transients**				
Scheme & Credits	**L**	**T**	**P**	**Credits**	**Max Marks: 100**
	3	**1**	**0**	**4**	
Prerequisites	**Nil**				

Course Objectives:

1. Apply network theorems for the analysis of electrical circuits.
2. Analyze circuits in the sinusoidal steady-state (single-phase and three phase).
3. Obtain the transient and steady-state response of electrical circuits.
4. Analyse two port circuit behavior.

Unit	Topics	No. of Hours
I	DC Circuit Analysis:Introduction, Star -Delta Transformation, Loop and Nodal methods of circuit analysis, Superposition theorem, Thevenin's and Norton's theorems, Maximum Power theorem, Millmans Theorem, Tellegans Theorem, Reciprocity theorem, Substitution Theorem,	12
II	AC Circuit Analysis: Phasor and complex number representation, solutions of sinusoidally excited RLC circuits, Power and energy relations in A.C. circuits, Series and parallel AC circuits(RL,RC,RLC), Applications of network theorems to A.C. circuits, Power factor and its improvement, Concepts of active & reactive powers. Resonance in series and parallel circuits	14
III	Steady State A.C 3-phases Circuits: Concept of a 3-phase voltage, wye (Y) circuits. Delta (Δ) circuits, Current and voltage relations in Y and Δ Circuits, Characteristics of a 3 -phase system	8
IV	Capacitive, Inductive Transients & First Order Circuits: Capacitive Transients, Inductive Transients, Combination of Capacitance & Inductance, Initial and Final Conditions, Exponential Functions, Timing Intervals of First and 2nd Order Circuits. Laplace Transform application to solve differential equations and analysis of electric circuits.	12
V	Two port parameters: Z Parameter, Y parameter, h – parameter, ABCD parameter, Equivalent circuit using these parameters. Condition for reciprocity and symmetry of two port networks in different parameters. Interconnection of two port networks. Cascade connection of two port networks parallel connection of two port networks. Series and series parallel connections. Inter conversion of parameters.	10
Total Number of Hours		**56**

Textbooks:

S. No.	Name of Book	Author	Publisher
1	Fundamentals of Electric Circuits	Alexander Sadiku McGraw-Hill	McGraw-Hill
2	Engineering circuit Analysis	Hayt& Kimberly	McGraw-Hill
3	Electric Engineering Fundamentals	Vincent Del Toro	PHI
4	Network Analysis	Van Valkenberg	Prentice Hall of India
5	Network Analysis and Synthesis	F. F. Kuo	John Wiley & Sons

Course Code	**PCCEE303L**			**Semester**	**THIRD**
Category	**Professional Core Course**				
Course Title	**Analog Electronics Circuits Lab**				
Scheme & Credits	**L**	**T**	**P**	**Credits**	**Max Marks: 100**
	0	**0**	**2**	**1**	
Prerequisites	**Nil**				

S. No.	**Experiment**
1	Study V-I characteristics of transistors (PNP and NPN) and calculate the performance parameters of a transistor in CB, CE and CC Configurations.
2	To assemble a CE amplifier and observe its performance.
3	To obtain frequency response of a RC coupled CE amplifier.
4	To assemble an emitter follower circuit and observe its performance.
5	To assemble a differential amplifier and obtain its CMRR
6	To study different applications of OP AMPS.: inverting amplifier, non-inverting amplifier, integrator, differentiator
7	To assemble an RC phase shift oscillator.
8	Study performance of multivibrator circuits using 555 chip in following Modes: Bistable, Astable, Monostable, Use of 555 chip as a timer circuit
9	To assemble a Schmitt trigger circuit. And to obtain its characteristics and to use it as a Squaring circuit.
10	To assemble a Class A power amplifier and to determine its power gain.
11	To study different applications of OP-AMPS. i. OP- AMP as an inverting amplifier. ii. OP-AMP as a non-inverting amplifier. iii. OP-AMP as an integrator. iv. OP-AMP as a differentiator.
12	To study the performance of a voltage regulator IC chip.
13	To measure the following parameters of a typical OP-AMP. i. I/P Impedance ii. O/P Impedance iii. Slew rate iv. CMRR v. Freq. response.

Course Code	**PCCEE305L**			**Semester**	**THIRD**
Category	**Professional Core Course**				
Course Title	**Circuit Analysis and Transients Lab**				
Scheme & Credits	**L**	**T**	**P**	**Credits**	**Max Marks: 100**
	0	**0**	**2**	**1**	
Prerequisites	**Nil**				

S. No.	**Experiment**
1	To verify Thevenin's Theorem.
2	To verify Norton's Theorem.
3	To verify Maximum Power Transfer Theorem.
4	To verify Superposition Theorem
5	To plot the Resonance curve for Series & Parallel Resonance
6	Transformation of star & Delta Network
7	Analysis of Circuits using MATLAB
8	To measure power factor and ac power in single phase circuits with different linear loads.

Course Code	**PCCEE306L**			**Semester**	**THIRD**
Category	**Professional Core Course**				
Course Title	**MATLAB**				
Scheme & Credits	**L**	**T**	**P**	**Credits**	**Max Marks: 100**
	0	**0**	**2**	**1**	
Prerequisites	**Nil**				

S. No.	**Experiment**
1	Introduction to MATLAB: basic concepts, language, programming and simulation
2	Programs to study · Basic commands and programs · Loops, conditional statements etc. · Example of Fibonacci series · Solution of differential equations · Functions
3	Plotting in MATLAB
4	Use of MATLAB in electrical engineering as in · Transient and steady state analysis of A.C/D.C circuits. · Analysis of Electric Machines and Transformers. Using both programming and simulation knowledge.
5	Use of MATLAB and SIMULINK Tool boxes.

SYLLABUS

FOR

SEMESTER FOURTH

Course Code	**BSCEE401**			**Semester**	**FOURTH**
Category	**Basic Science Course**				
Course Title	**Engineering Mathematics - IV**				
Scheme & Credits	**L**	**T**	**P**	**Credits**	**Max Marks: 100**
	3	**1**	**0**	**4**	
Prerequisites	**Nil**				

Course Objectives:

1. Students will demonstrate basic knowledge of Functions of Complex Variable & Numerical Technique.
2. To make aware students about the importance and symbiosis between Mathematics and Engineering.

S. No	Topics	No. of Hours
I	Finite Difference: Difference Table and its usage. The difference operators Δ,▼ and the operator E. Interpolation: Interpolation with equal intervals, Newton's advancing difference formula. Newton's backward difference formula. Interpolation with unequal intervals. Newton's divided difference formula. Lagrange's interpolation formula	18
II	Central Differences: The central difference operator δ and the over-raging operator μ. Relations between the operators. Gauss forward and backward interpolation formula, Sterling's, Bessel's, Laplace and Everett's formulae	10
III	Numerical solution of algebraic and Transcendental Equations: Graphic Method, Regula- Fast method, Bolzano's Process of bisection of intervals, Newton-Raphson Method and its geometrical significance	10
IV	Numerical Integration: Numerical Integration, General Quadrature Formula, Simpson's one-third and three-eight rules, Weddle's' rule, Hardy's rule, Trapezoidal rule.	8
V	Numerical Solution of ordinary differential equations: Numerical solution of ordinary differential equations, Picard's method. Taylor's series method, Euler's method, Runge- Kutta Method	10
Total number of Hours		**56**

Textbooks:

S. No	Name of Book	Author	Publisher
1	Numerical Methods for Scientists and Engineering	M.K.Jain, S.R.Iyengar & R.K. Jain	New age publishers
2	Mathematical Numerical Analysis	S.C. Scarborough	CBS Publishers & distributors
3	Introductory methods in Numerical Analysis	S.S.Sastry	PHI learning Pvt Ltd
4	Numerical Methods for Mathematics, Sciences and Engg	J. H. Mathews	Prentice hall college division
5	Fundamentals of Mathematical Statistics	S.C.Gupta and V.K.Kapoor	S. Chand

Course Code	**PCCEE402**			**Semester**	**FOURTH**
Category	**Professional Core Course**				
Course Title	**Electrical Machines-1**				
Scheme & Credits	**L**	**T**	**P**	**Credits**	**Max Marks: 100**
	3	**1**	**0**	**4**	
Prerequisites	**Nil**				

Course Objectives:

1. Analyze single phase and three phase transformers circuits.
2. Understand the operation of dc machines.

Unit	Topics	No. of Hours
I	Transformers: Single Phase Transformers: Introduction, classification, construction, electromotive force (e. m. f.) equation, Equivalent circuit model, Phasor diagrams, Losses and efficiency, Voltage regulation,Transformer tests (polarity test, open circuit test and short circuit test), All day efficiency, Frequency response, Parallel operation, Auto-transformers, Excitation phenomenon in transformers	16
II	Three Phase Transformers: Construction, Connections, Open delta, Ratings, Phase Conversions. Special Purpose Transformers: Impedance matching transformers, Isolation transformers, constant current and constant voltage Transformers, Instrument Transformers	8
III	Principles of Electromechanical Energy Conversion: Energy conversion via electric and magnetic fields, Field energy and mechanical force, energy balance, co energy	4
IV	D.C. Generator: Construction, emf equation of D.C. generator, methods of excitation,losses condition for maximum efficiency, Commutation & armature reaction, interpoles and compensating winding, characteristics of D.C. generators	14
V	D.C. Motor: Working principle, voltage equation, torque developed, operating characteristics of D.C. motor, starting ,3 point and 4 point starter, speed control methods, Swinburne's and brake test, Application areas of D.C. Motors	14
Total Number of Hours		**56**

Textbooks:

S. No	Name of Book	Author	Publisher
1	Electric Machinery	Fitzgerald, Kingslay, Umans	Tata McGraw-Hill
2	Electric Machinery Fundamentals	Chapman	McGraw-Hill
3	Electric Machines	Nagrath and Kothari	Tata McGraw-Hill
4	Basic Electric Machines	Vincent Deltoro	Prentice Hall

Course Code	**PCCEE403**			**Semester**	**FOURTH**
Category	**Professional Core Course**				
Course Title	**Control Systems**				
Scheme & Credits	**L**	**T**	**P**	**Credits**	**Max Marks: 100**
	3	**1**	**0**	**4**	
Prerequisites	**Nil**				

Course Objectives:

1. **Understand the modelling of linear-time-invariant systems using transfer function**
2. **Understand The concept of stability and its assessment for linear-time invariant systems**
3. **Design simple feedback controllers.**

Unit	Topics	No. of Hours
I	Introduction to continuous control systems: Definition of a control system, open-loop, closed loop (automatic and manual) control. Mathematical modeling: Transfer functions, block diagrams, Mason's signal flow graph	13
II	First and second order system: Example of first and second order systems, responses of these systems to step, ramp, parabolic and sinusoidal inputs, transient, steady state and error analysis	12
III	Stability studies: Definition of stability, stability and pole locations, Routh Table	10
IV	Frequency response: Bode plot, polar plot, Nyquist's criterion, root locus.	11
V	Proportional, Integral, Derivative (P.I.D) control. Compensator design Lead – lag compensators. Modelling of dynamic systems in state space (Introduction).	10
Total number of Hours		**56**

Textbooks:

S. No	Name of Book	Author	Publisher
1	Control Systems Engineering	Norman S. Nise	John wiley
2	Control systems(Principles and Design)	M. Gopal	Tata McGraw-Hill
3	Control systems	A. Anand Kumar	PHI Learning Private limited
4	Feedback control of dynamic systems	Franklin and Powel.	Prentice Hall
5	Design of feedback control systems	Stefani	Oxford university press

Course Code	PCCEE404			Semester	FOURTH
Category	Professional Core Course				
Course Title	Electrical Measurement				
Scheme & Credits	L	T	P	Credits	Max Marks: 100
	3	1	0	4	
Prerequisites	Nil				

Course Objectives:

1. Learning the basic terminologies used in electrical measurements
2. Underlying principle of operation of measuring instruments
3. Instruments used for measurement of electrical quantities

Unit	Topics	No. of Hours
I	Definition of basic terms used in measurements. Electro-mechanical indicating instruments: Classification, effects utilized in measuring instruments, errors and their types, various forces in an electro-mechanical indicating instrument, various methods of damping,	12
II	Galvanometers, Ammeters and Voltmeters (PMMC, Induction, Electrostatic and Dynamometer type), mathematical theory of the D'Arsonval galvanometer	10
III	Measurement of Power and Energy: Power measurement in three phase a.c. circuits using single phase and 3-phase watt meter, measurement of reactive power a.c. circuits using single phase and 3-phase wattmeter, measurement of reactive power (Single phase and 3-phase), Energy measurement using induction type meter, Power factor meters, frequency meter and synchroscope.	12
IV	Measurement of Resistance: Resistance classification, Measurement of Low resistance, Measurement of medium resistance, Measurement of high resistance, Meggar, Ohmmeter. Measurement of Inductance, Capacitance and Frequency using A.C. bridges.	19
V	Introduction to cathode ray tube, block Diagram of CRO. Measurement of voltage, current, phase & frequency using CRO, Dual Beam Oscilloscope,Dual Trace Oscilloscope	3
Total Number of Hours		**56**

Textbooks:

S. No	Name of Book	Author	Publisher
1	Electrical Measurements and Measuring Instruments	Golding, Widdis	Pitman
2	Electrical Electronic Measurements	A.K.Sawhney.	Dhanpat Rai

Course Code	**PCCEE405**			**Semester**	**FOURTH**
Category	**Professional Core Course**				
Course Title	**Digital Electronics**				
Scheme & Credits	**L**	**T**	**P**	**Credits**	**Max Marks: 100**
	3	**1**	**0**	**4**	
Prerequisites	**Nil**				

Course Objectives:

1. Understand the working of logic families and logic gates.
2. Design and implement Combinational and Sequential logic circuits
3. Understand the process of Analog to Digital conversion and Digital to Analog conversion

Unit	Topics	No. of Hours
I	Review of Number systems, Radix conversion Complements 9's & 10's, Subtraction using 1's & 2's complements. Binary codes, Error detecting and Correcting codes, Theorems of Boolean algebra, Canonical forms,	8
II	Logic gates and implementation of Boolean functions with various types of logic gates. Circuit equivalence. Simplification techniques and minimization by map methods. Tabular method.	15
III	Combination logic and arithmetic circuits. Encoders and Decoders, multiplexers & de-multiplexers.	5
IV	Sequential circuits –state diagrams and state tables, design and analysis of flip-flops, registers, counters. Synchronous and asynchronous operation of sequential circuits,Analog to digital convertor, digital to analog convertor.	7
V	Latches and memory organisation. ROM's, EPROM's and RAM's –Dynamic and static. Digital Logic Families: Introduction to bipolar Logic families: RTL, DCTL, DTL, TTL, ECL and MOS Logic families (NMOS, PMOS, CMOS), Details of TTL logic family- Totem pole, Open collector outputs, TTL subfamilies, Comparison of different logic families.	7
Total Number of Hours		**42**

Textbooks:

S. No	Name of Book	Author	Publisher
1	Digital logic	M. Moris Mano	Pearson
2	Digital principles and applications	A.P. Malvino	Tata Mcgraw hill
3	Switching circuits	Marcus	Prentice hall
4	Digital Electronics	Anil K. Maini	Wiley

Course Code	**PCCEE402L**			**Semester**	**FOURTH**
Category	**Professional Core Course**				
Course Title	**Electrical Machines-1 Lab**				
Scheme & Credits	**L**	**T**	**P**	**Credits**	**Max Marks: 100**
	0	**0**	**2**	**1**	
Prerequisites	**Nil**				

S. No.	**Experiment**
1	To perform open circuit and short circuit tests on a single-phase transformer
2	To perform polarity test on a single phase transformer
3	To determine the efficiency and voltage regulation of a single phase transformer
4	To study three phase connections on a bank of three single phase transformers
5	To study various parts of a dc machine and draw sketches of the same
6	To plot the saturation curve of a dc machine
7	To plot the external characteristics of a separately excited dc generator.
8	To study the voltage build-up of a dc shunt generator
9	To plot the external characteristic of a dc shunt generator.
10	To plot the external characteristics of a dc series generator.
11	To plot the external characteristic of a dc compound generator.

Course Code	**PCCEE403L**			**Semester**	**FOURTH**
Category	**Professional Core Course**				
Course Title	**Control System Lab**				
Scheme & Credits	**L**	**T**	**P**	**Credits**	**Max Marks: 100**
	0	**0**	**2**	**1**	
Prerequisites	**Nil**				

S. No.	**Experiment**
1	Use of MATLAB / SIMULINK /Control System tool boxes, neural & fuzzy toolboxes.
2	Analysis of Control Systems in MATLAB.
3	To study the computer simulation of a number of systems
4	To study the torque-speed characteristics of an AC servo motor.
5	To study the time response of a variety of simulated linear systems.
6	To study the role of feedback in a DC speed control system.
7	To study the role of feedback in a DC position control system.
8	To study the role of a combination of P,I and D control actions in a variety of simulated linear systems
9	System identification using frequency domain techniques
10	Lead/ lag compensator design
11	Computer control of systems
12	Control of stepper motor
13	Control system (State Space) study

Course Code	**PCCEE404L**			**Semester**	**FOURTH**
Category	**Professional Core Course**				
Course Title	**Electrical Measurement Lab**				
Scheme & Credits	**L**	**T**	**P**	**Credits**	**Max Marks: 100**
	0	**0**	**2**	**1**	
Prerequisites	**Nil**				

S. No.	**Experiment**
1	Measurement of power in single phase and three phase circuits using single phase and three phase wattmeters.
2	Energy Measurement using watt-hour meter as well as using wattmeter and stopwatch.
3	To study the constructional details of an electromechanical indicating instrument with the help of demonstration type of instrument
4	Measurement of Inductance and capacitance using Bridge techniques.
5	Measurement of Resistance by different methods.
6	To Study RC and LC models of a transmission line and observe the variation of voltage magnitude and phase along the line.
7	Measurement of Electrical and Non Electrical quantities using virtual instrumentation. (Dasylab)
7	Measurement using MATLAB/Simulink.

Course Code	**PCCEE405L**			**Semester**	**FOURTH**
Category	**Professional Core Course**				
Course Title	**Digital Electronics Lab**				
Scheme & Credits	**L**	**T**	**P**	**Credits**	**Max Marks: 100**
	0	**0**	**2**	**1**	
Prerequisites	**Nil**				

S. No.	Experiment
1	To verify the truth table of following logic gates: AND, OR and NOT NAND, NOR, XOR and XNOR
2	To realize the above gates using discrete active and passive components
3	To implement XOR and XNOR using universal logic gates
4	To verify DE Morgan's law using logic gates
5	To implement certain Boolean expressions and check their equality
6	To design and realize a) Half adder and verify its truth table. b) Full adder and verify its truth table. c) Half subtractor and verify its truth table. d) Full subtractor and verify its truth table
7	To design a multiplexer/ demultiplexer using two input NAND gates
8	To design a 4-bit binary to decimal convertor
9	To design a modulo 10 counter
10	Given the frequency f obtain the waveforms with frequencies f/2, f/5 & f/10
11	Design and realize the following flip-flops using logic gates. a) RS flip flop b) JK flip flop. c) D flip flop d) T flip flop.
12	Use PLL as a) Frequency multiplier, b) Frequency demodulator

SYLLABUS

FOR

SEMESTER FIFTH

Course Code	**PCCEE501**			**Semester**	**FIFTH**
Category	**Professional Core Course**				
Course Title	**Power System-1**				
Scheme & Credits	**L**	**T**	**P**	**Credits**	**Max Marks: 100**
	3	**1**	**0**	**4**	
Prerequisites	**Nil**				

Course Objectives:

1. Understand the concepts of power systems.
2. Understand the various power system components.
3. Understand the generation of overvoltages and insulation coordination.

Unit	Topics	No. of Hours
I	Introduction to Power Systems generation, transmission & distribution. Per unit representation of power system variables, Single line diagram, impedance and reactance diagram of a system, per unit calculations. Overhead line insulator types; pin, suspension, strain, shackle, guy etc. String efficiency & methods of equalizing potential drop over string of suspension insulators.	14
II	Transmission line parameters and their evaluations, types of overhead conductors with calculations of inductance and capacitance.	10
III	Models of short, medium and long transmission lines. Lossless transmission lines; electrical length of a line and its importance, Equivalent circuits of a transmission line, Applications of ABCD representation of Power System components, Power transfer capability of a transmission line, Skin, proximity and Ferranti effect.	10
IV	Mechanical Design of transmission line: Sag, span and tension calculations. Electric Power Transmission Towers. Classification of cables, Cable conductors, insulating materials, insulation resistance, electrostatic stress, grading of cables, capacitance calculation of single & mult-core cable, losses and current carrying capacity,cross bonding of cables.. Location of faults, methods of laying of underground cables.	15
V	Corona, Visual & critical voltages, corona loss, effect of corona on line design practical considerations. Element of AC distribution. Single fed, double fed and ring main distributor.	7
Total number of Hours		**56**

Textbooks:

S. No	Name of Book	Author	Publisher
1	Power System Analysis	J.J. Grainger and W.D Stevenson	Mcgraw hill
2	Electric Power Systems	B.W. Weedy and B.J.Cory	John Wiley and sons
3	Electric Power Systems	C.L. Wadhwa	New age international
4	Power System Engineering	Nagrath and Kothari	Tata Mcgraw hill
5	Power System Analysis	Hadi Saadat	McGraw Hill

Course Code	**PCCEE502**			**Semester**	**FIFTH**
Category	**Professional Core Course**				
Course Title	**Electrical Machines-II**				
Scheme & Credits	**L**	**T**	**P**	**Credits**	**Max Marks: 100**
	3	**1**	**0**	**4**	
Prerequisites	**Electrical Machines-1**				

Course Objectives:

1. Understand the concepts of rotating magnetic fields.
2. Understand the operation of ac machines.
3. Analyse performance characteristics of ac machines.

Unit	Topics	No. of Hours
I	Basic Concepts in A.C. Rotating Electrical Machines: The rotating magnetic field, Magneto-motive force and flux distribution, Induced voltage, Production of torque, Leakage fluxes, losses and efficiency	5
II	Three Phase Induction Motors: Construction, Types, Principle of operation of an induction motor,Cogging and crawling, Equivalent circuit, Torque/speed characteristics, Induction motor tests, Speed control, Principle of operation of Induction generator.	15
III	Single-Phase Motors: Types of single phase induction motors, Starting of single phase induction motors, analysis and testing of single phase induction motors, universal motor, Schrage motor, Applications of single phase motors.	8
IV	Synchronous Machines: Construction & Types, working principle, field and armature windings, Equivalent circuit, voltage regulation and its determination, Synchronous reactance, saturation effect, parallel operation, Two-axis theory.	15
V	Salient type machines, steady-state power-angle characteristics, Excitation systems, V-curves, synchronous capacitors,Hunting, synchronous Machine Transients, Analysis of sudden 3-phase short circuit, Transient power-angle characteristics.	13
Total Number of Hours		**56**

Textbooks:

S. No	Name of Book	Author	Publisher
1	Electric Machinery by Fitzgerald	Kingslay, Umans	T.M.Hill
2	Electric Machines	Nagrath and Kothari	T.M.Hill
3	Electrical Machines and Transformers	Geroge Mc Pherson	John Wiley
4	Electric Machinery Fundamentals	Chapman	T.M.Hill
5	Electric machinery and Transformers	Irving Kosow	Pearson
6	Alternating current machinery	Langsdorf	T.M.Hill

Course Code	**PCCEE503**			**Semester**	**FIFTH**
Category	**Professional Core Course**				
Course Title	**Microprocessors**				
Scheme & Credits	**L**	**T**	**P**	**Credits**	**Max Marks: 100**
	3	**1**	**0**	**4**	
Prerequisites	**Nil**				

Course Objectives:

1. Do assembly language programming.
2. Do interfacing design of peripherals.
3. Develop systems using different microcontrollers.

Unit	Topics	No. of Hours
I	Detailed introduction & overview of Microprocessor. 8085 mp Architecture:Pin diagram, detailed internal architecture, Flag Register,data bus, address bus, multiplexing and demultiplexing of address/data lines, control bus, control and status signals	14
II	Instruction cycle,T-states (clock cycles), machine cycles,instruction formats,Instruction Set and Programming Techniques: Different addressing modes, complete description of all instructions , programming examples,Timing diagram of machine cycles and instructions, Stacks and subroutine,Delays & Delay routine	14
III	Interrupts: Concept of interrupts, priority of interrupts signals, software generated interrupts and hardware generated interrupts.	12
IV	Interfacing:Memory mapped I/O, I/O mapped I/O,Memory interfacing, Basic interfacing concepts, Interfacing peripheral devices, 8259A programmable interrupt controller and its interfacing ,Programmable peripheral interface (8255) and its interfacing,Multi-purpose programmable device (8155), The 8254 programmable interval timer,Direct memory access and DMA controller (8237),8155 Programmable I/O and Timer	10
V	Introduction to 8086 mp	6
Total number of Hours		**56**

Textbooks:

S. No	Name of Book	Author	Publisher
1	Microprocessor Architecture Programming and Applications with the 8085	Ramesh S. Gaonkar.	Prentice hall
2	Microprocessors and Programmed Logic	K.L. Short	Prentice hall
3	Microprocessors: Theory and Applications (Intel and Motorola)	M. Rafiquzzaman	Prentice hall

Course Code	**OEC1EE504**			**Semester**	**FIFTH**
Category	**Open Elective Course**				
Course Title	**Communication Systems**				
Scheme & Credits	**L**	**T**	**P**	**Credits**	**Max Marks: 100**
	2	**1**	**0**	**3**	
Prerequisites	**Nil**				

Course Objectives:

1. Analyze and compare different analog modulation schemes for their efficiency and bandwidth.
2. Analyze the behavior of a communication system in presence of noise.
3. Investigate pulsed modulation systems and analyze their system performance.
4. Analyze different digital modulation schemes and can compute the bit error performance.

Unit	Topic	No. of Hours
I	Introduction to Fourier series and Fourier transform, properties of Fourier Transform, Modulation theorem, amplitude spectrum of special signals viz. Pulse train and pulse waveform, etc. Introduction to Communication System, basic elements of Analog and digital Communication system, Importance/Application of Communication System in Electrical Engineering.	6
II	Modulation, Need of Modulation. AM, DSB/SC, SSB, VSB, etc : Introduction, waveforms, mathematical expressions, Generation, Detection and Application.	7
III	Angle modulation, types, NBFM, WBFM, PM: Introduction, waveforms, Mathematical expressions, Generation and Detection and Application. Comparison of Different Modulation Schemes.	7
IV	AM and FM transmitters, Radio Receivers – AM & FM, (Block diagram). Noise Analysis: Noise, types, Performance of AM & FM Systems in presence of noise, Threshold in AM & FM Demodulators, Pre- emphasis, and De-emphasis in FM Systems	10
V	Digital Communication: Sampling, Quantization, Quantization noise, Coding, Pulse code Modulation; Differential PCM, ADPCM, Relative advantages and dis- advantages.Delta modulation. PWM & PPM. Digital Modulation Techniques: ASK, FSK, PSK,QPSK, DPSK, GPSK etc. QAM, Constellation diagram	12
Total number of Hours		**42**

Textbooks:

S. No	Name of Book	Author	Publisher
1	Electronics communication System	G. Kennedy	Mcgraw hill education (India) Ltd
2	Principles of Communication system	Taub and Shelling	Mcgraw hill education Pvt Ltd
3	Communication system	S. Haykins	Willey India Pvt Ltd

Course Code	OEC2EE504			Semester	FIFTH
Category	Open Elective Course				
Course Title	Thermal Engineering				
Scheme & Credits	L	T	P	Credits	Max Marks: 100
	2	1	0	3	
Prerequisites	Nil				

Course Objectives:

1. After completing this course, the students will get a good understanding of various practical power cycles and heat pump cycles.
2. They will be able to analyze energy conversion in various thermal devices such as combustors, air coolers, nozzles, diffusers, steam turbines and reciprocating compressors
3. To analyze the performance of steam turbines

Unit	Topics	No. of Hours
I	THERMODYNAMICS: System and Surroundings, Zeroth Law, Temperature Scales, Equation of the state,First law, Steady flow, Isochoric, Isobaric, isothermal, adiabatic and polytropic processes. Properties of steam, Second law, Entropy change, Reversible Irreversible processes, Carnot's Cycle, Rankine Cycle, Modified Rankine Cycle, and Flow through nozzle.	14
II	STEAM TURBINE: Impulse turbine, velocity and pressure compounding , work output, Losses and efficiency, Reaction turbine, work output, losses and efficiency, degree of reaction, Modern steam power cycles, Regenerative and Reheat cycles, Governing of steam Turbines, Fields of Application.	10
III	I.C. ENGINES: Otto, Diesel and Dual cycles, Magneto and battery ignition, detonation and pre-ignition,Octane Number, Draught, Diesel knock, Cetane Number, various I.C engines fuels, Carburetion and Injection , Lubrication, Cooling, Governing of I.C Engines, Fields of Application.	10
IV	GAS TURBINES: Present status and future trends, Basic types and Cycles, Thermal refinements, jet propulsion, fields of Application.	8
Total number of Hours		**42**

Textbooks:

S. No	Name of Book	Author	Publisher
1	Steam Turbine Performance and Economics	Bartlett	McGraw Hill
2	Steam Turbine Theory and Practice	Kearton Pitman	CBS Publishers
3	Theory and Design of steam and Gas turbine	Loe	McGraw Hill
4	Gas Turbines Theory and Practice	Cohn and Rogers	Pearson
5	Turbo machines	Yahya	McGraw Hill

Course Code	OEC3EE504			Semester	FIFTH
Category	Open Elective Course				
Course Title	Digital Signal Processing				
Scheme & Credits	L	T	P	Credits	Max Marks: 100
	2	1	0	3	
Prerequisites	Nil				

Course Objectives:

1. To make students familiar with the most important methods in DSP, including digital filter design, transform-domain processing
2. To make students familiar with the importance of Signal Processing.
3. To make students aware about the meaning and implications of the properties of systems and signals.

Unit	Topics	No. of Hours
I	Discrete Time Signals & Systems: Sequences, & sequence operations, Discrete-time systems. Linear Time – Invariant systems, impulse response, causality, stability. Frequency-Domain Representation of Discrete-Time signals and systems, Fourier Transforms, properties, theorems.	7
II	Sampling of Continuous – Time Signals: Periodic sampling, frequency- domain representation of sampling, reconstruction of signals, discrete-time processing of continuous –time signals, continuous –time processing of Discrete-time signals, changing the sampling rate.	10
III	Transform Analysis of Linear time Invariant Systems: Z- Transform, Region of Convergence, properties, Inverse Z-Transform, Frequency Response of LTI systems, system functions, linear constant coefficient, difference equations FIR and IIR systems, Frequency Response.	10
IV	Structure of Discrete-Time Systems: Block Diagram Representation of linear constant-coefficient Difference equations, signal flow graph representation. Basic structures for IIR systems, Transposed forms, Basic network structures for FIR systems.	8
V	Filter Design Techniques: Design of Discrete-Time IIR filters from continuous – Time filters. Impulse invariance, bilinear transformation. Butterworth Chebyshev, Eliptic Approximation, low pass, high pass, band-pass and Band-stop filters, design of FIR filters by windowing. Kaiser, Hamming, Hamming windows.	7
Total number of Hours		**42**

Textbooks:

S. No	Name of Book	Author	Publisher
1	Discrete Time Signal Processing.	A.V Oppenheim and R. W Schafer	Prentice hall
2	Digital Signal Processing Principles, Algorithms and Applications.	John G. Proakis & D.G Manolavis	Prentice hall
3	Introduction To Digital Signal Processing.	J.R Johnson	Prentice hall
4	Theory and Application of Digital Signal Processing.	L.R Rabinder and B. Gold	Prentice hall

Course Code	**PCCEE505**			**Semester**	**FIFTH**
Category	**Professional Core Course**				
Course Title	**Power Electronics**				
Scheme & Credits	**L**	**T**	**P**	**Credits**	**Max Marks: 100**
	3	**1**	**0**	**4**	
Prerequisites	**Solid State devices, Circuit Analysis and Electrical Machines**				

Course Objectives:

1. Understand the differences between signal level and power level devices.
2. Analyse the operation of controlled rectifier circuits, DC-DC choppers & voltage source inverters for different types of Loads.

Unit	Topic	No. of Hours
I	Review of power semiconductor switching devices, Diode, Thyristors, MOSFET, IGBT and modern devices, characteristics and applications, Introduction to Turn-ON/Turn-OFF mechanism of switching devices, Gate-drive circuits, Switching-aid circuits, protection, Heat sink design.	14
II	Single phase half wave and full wave rectifiers (uncontrolled, semi controlled, controlled) with passive loads, performance analysis. Three-phase half wave and full wave rectifiers (uncontrolled, semi controlled, controlled) with passive loads, performance analysis. effect of source inductances	16
III	Single -phase inverter : single phase half and full bridge inverter with passive loads, performance analysis. Three-phase inverters: 180 degree conduction and 120 degree conduction, introduction to voltage control and harmonic reduction methods in inverters.	14
IV	AC Voltage Controllers Introduction-Principle of AC voltage control (On-Off control, Phase control) Single-Phase controllers (Analysis for different types of load)-evaluation of performance parameters . Introduction to Cycloconverters	6
V	DC-DC converters; buck, boost and buck-boost converters	6
Total No. of Hours		**56**

Textbooks:

S. No	Name of Book	Author	Publisher
1	Fundamental of Power Electronics	Robert Erickson, D. Maksimovic	Springer
2	Power Electronics, Circuits, Devices and Applications	Muhammad H. Rashid	PEI
3	Power Electronics	P. S. Bhimra	Khanna
4	Power Electronics - converters, Applications and Design	Ned Mohan, T. M.Undeland,W.P. Robbins	Wiley

Course Code	**PCCEE502L**			**Semester**	**FIFTH**
Category	**Professional Core Course**				
Course Title	**Electrical Machines-II Lab**				
Scheme & Credits	**L**	**T**	**P**	**Credits**	**Max Marks: 100**
	0	**0**	**2**	**1**	
Prerequisites	**Nil**				

S. No.	Experiment
1	To study the different parts of an Induction motor.
2	To determine the equivalent–circuit parameters of a 3 -f Induction motor by (i) No load test (ii) Blocked rotor test
3	To determine the Torque / speed characteristics of a 3-f Induction motor
4	To study the speed control of an Induction motor by pole-changing method
5	To study the speed control of an Induction motor by varying voltage
6	To study the speed control of an Induction motor by changing rotor resistance
7	To Study of the construction of a synchronous machine
8	To obtain the OCC and SCC of a synchronous machine by Synchronous impedance method
9	To find voltage regulation of an alternator by actual loading
10	To obtain the V-curves and inverted V-curves of a synchronous motor
11	To conduct slip-test on a salient-pole synchronous machine and hence determine its direct and quadrature – axis reactances

Course Code	**PCCEE503L**			**Semester**	**FIFTH**
Category	**Professional Core Course**				
Course Title	**Microprocessors Lab**				
Scheme & Credits	**L**	**T**	**P**	**Credits**	**Max Marks: 100**
	0	**0**	**2**	**1**	
Prerequisites	**Nil**				

S. No.	Experiment
1	Microprocessors (8085) training kit and its working.
2	Programs related to data transfer between registers, between registers and memory.
3	Programs related to logic instructions.
4	Programming techniques with additional instructions, looping, counting and indexing.
5	i) To develop a program to add two double byte numbers. ii) To develop a subroutine to add two floating point quantities.
6	i) To develop program to multiply two single byte unsigned numbers, giving a 16 bit product ii) To develop subroutine which will multiply two positive floating point numbers
7	To write program to evaluate P* Q*+R* & S are 8 bit binary numbers.
8	To write a program to divide a 4 byte number by another 4 byte number.
9	To write a program to divide an 8 bit number by another 8 bit number upto a fractional quotient of 16 bit.
10	Write a program for adding first N natural numbers and store the results in memory location X.
11	Write a program which decrements a hex number stored in register C. The Program should half when the program register reads zero.
12	Write a program to introduce a time delay of 100 ms using this program as a subroutine display numbers from 01H to OAH with the above calculated time delay between every two numbers.
13	N hex numbers are stored at consecutive memory locations starting from X. Find the largest number and store it at location Y.
14	Interfacing concepts. Switch and LED interfacing. Square wave generation.
15	ADC interfacing.
16	Interface a display circuit with the microprocessor either directly with the bus or by using I/O ports. Write a programme by which the data stored in a RAM table is displayed.

Course Code	**PCCEE505L**			**Semester**	**FIFTH**
Category	**Professional Core Course**				
Course Title	**Power Electronics Lab**				
Scheme & Credits	**L**	**T**	**P**	**Credits**	**Max Marks: 100**
	0	**0**	**2**	**1**	
Prerequisites	**Nil**				

S. No.	Experiment
1	To obtain the VI characteristics of an i. SCR ii. Triac
2	To study various triggering circuits
3	To obtain the UJT characteristics
4	To study the operation of a Line Synchronised UJT Relaxation Oscillator.
5	To study illumination control using SCR.
6	To study a half wave gate controlled rectifier using one SCR.
7	To study single phase half controlled, full wave rectifiers.
8	To study various techniques of forced commutation of an SCR.
9	To study the speed control of a DC shunt motor using a single phase bridge converter.
10	To study generation of SPWM modulation
11	To study following choppers i. Buck converter ii. Boost converter iii. Buck-Boost converter
12	To simulate power electronic converters using MATLAB

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 Brullioun 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 estimationHypothesis 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**				
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.					

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

SYLLABUS

FOR

SEMESTER SEVENTH

Course Code	PCCEE701			Semester	SEVENTH
Category	Professional Core Course				
Course Title	Power System Protection & Switchgear				
Scheme & Credits	L	T	P	Credits	Max Marks: 100
	3	1	0	4	
Prerequisites	Power System				

Course Objectives:

1. Understand the different components of a protection system.
2. Evaluate fault current due to different types of fault in a network.
3. Understand the protection schemes for different power system components.

Unit	Topic	No. of Hours
I	PROTECTIVE RELAYING: Function, fundamental principle, primary and backup relaying, characteristics. CLASSIFICATION OF RELAYS: Operating principles and characteristics of the following electromechanical relays: Current, voltage, directional, current balance, voltage balance, differential relays, and distance relays.	13
II	PROTECTION OF GENERATORS: Short- circuit protection of stator windings, protection against turn-to-turn fault, stator ground-fault protection, stator open circuit protection.	10
III	TRANSFORMER PROTECTION: Short circuit protection, over current and earth-fault protection differential protection. Use of biased relay for differential protection, Buchholz relay, protection of parallel transformer banks	8
IV	PROTECTION OF FEEDERS, BUSBARS AND TRANSMISSION LINES: Protection of feeders, time limit fuse, overcurrent protection for radial feeders, protection of parallel feeders, differential protection for parallel feeders, protection of ring mains, differential pilot wire protection, Circulating current protection, protection for bus-bars, frame leakage protection, differential protection, for bus bars, protection for double bus-bar system, transmission line protection, using over- current relays, using distance relays. Setting of overcurrent and distance relays, coordination of relays. Phase fault and earth fault protection.	10
V	FUSES: Fusing element, classification of fuses, current carrying capacity of fuses, high rupturing capacity, characteristics of H.R.C. fuses, selection of HRC fuses. CIRCUIT BREAKERS: Types of circuit breakers , basic principle of operation, phenomena of arc, initiation,maintenance & arc extinction, d. c. circuit breaking,a.c. circuit breaking, arc voltage and current waveforms in a.c. circuit breaking, restriking and recovery voltages, deionization and current chopping, ratings of circuit breakers, oil circuit breakers, air blast circuit breakers, SF6 Circuit breakers ,Vacuum breakers.	15
Total		**56**

Textbooks:

S. No	Name of Book	Author	Publisher
1	Art and Science of Protective Relaying	Mason	John Wiley & Sons
2	Protective relaying, Principles and Applications	J. L Black Burn	CRC Press

Course Code	**PCCEE702**			**Semester**	**SEVENTH**
Category	**Professional Core Course**				
Course Title	**Power Systems-III**				
Scheme & Credits	**L**	**T**	**P**	**Credits**	**Max Marks: 100**
	3	**1**	**0**	**4**	
Prerequisites	**Power System**				

Course Objectives:

1. Use numerical methods to analyse a power system in steady state
2. Understand the problem of power system stability and its impact on the system.
3. Model different power system components for the study of stability.
4. Understand the methods to improve stability.

Unit	Topic	No. of Hours
I	Load Flows: Nature and importance of the problem, Network model formulation, algorithm for the formulation of Y-bus matrix, formulation of Y-bus by singular transformation, primitive network, Bus incidence matrix; sparsity fundamentals. Flow problem, load flow equations, bus classification – List of variables in load flow equations, Load Flow Solution Techniques:-Gauss - Seidel & Newton-Raphson method for solving load flow problem, comparison of performance load flow methods: De-coupled, Fast decoupled , DC power flow; programming issues and scripting fundamentals.	20
II	Optimal operation of power systems: Introduction to nonlinear optimization. Constrained and unconstrained optimal thermal dispatch; effect of losses. Basic idea of unit-commitment	8
III	Power System Stability: The stability problem, steady state, dynamic and transient stability, rotor dynamics and swing equation, power- angle curve, equal-area criterion of stability, Numerical solution of swing equation, Factors affecting transient stability. Multi-machine transient stability (programming and models).	12
IV	Power system control: Generator control loops; Load frequency control: generator, load, prime-mover, and governor models. Automatic Generation Control: single-area and multi-area systems; tie-line bias control; AGC with optimal dispatch. Reactive power and voltage control: models of amplifiers, exciters, generators, sensors; excitation system stabilizers. AGC includes an excitation system. Basic idea of modern control applications: pole-placement and optimal control design.	16
Total		**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	B.M. Weedy and Cory	John Wiley & sons.
3	Power Systems Engineering	Nagrath and Kothari	McGraw-Hill Education
4	Electric Power Systems	C.L. Wadlhwa	New Age Publications

Course Code	OEC1EE703			Semester	SEVENTH
Category	Open Elective Course				
Course Title	SCADA				
Scheme & Credits	L	T	P	Credits	Max Marks: 100
	2	1	0	3	
Prerequisites	Basic Programming & Automation				

Course Objectives:

1. To understand what is meant by SCADA and its functions
2. To know SCADA communication
3. To get an insight into its application.

Unit	Topic	No. of Hours
I	Introduction to SCADA:-SCADA in power systems, advantages, general structure, Architecture,Classification of SCADA systems..	6
II	Components of SCADA Systems. Remote terminal unit (RTU), Communication subsystem, Protocols, Logic subsystem, termination subsystem, test and power supply subsystem, Master Station(MTU), Human machine interface, data concentrators,IED.	10
III	Supervisory and Control Functions: Overview of the methods of data acquisition systems, commonly acquired data, status indications, majored values, energy values, monitoring alarm and event application processing. Functions of SCADA:-Human-machine interface (HMI) , Electrical communication ,Data acquisition (DAQ) and Transmission , Monitoring , Control , Data collection, storage and retrieval , Calculation and Report generation, Set points and feedback loops, time tagged data. etc	8
IV	SCADA Software, Communication and Protocols:ISO's OSI 7 layers Reference Model, TCP/IP Model, SCADA communication requirements,SCADA communication systems topologies, data communication techniques-Master-Slave,peer-to-peer, broadcast and multicast, Introduction to SCADA and Smart Grid communication protocols- Modbus, IEC61850-5-101/103/194, DNP. Various types of Communication Media (Guided and Unguided)	10
V	Energy Management System: Introduction to EMS, Architecture and working of EMS Operation states of a power system,Power system security, production control and load management, economic dispatch	8
Total		**42**

Textbooks:

S. No	Name of Book	Author	Publisher
1	Electric Power Substation Engineering	John D Mc Donald	CRC Press
2	Power Generation Operation and Control	Wood, A. J and Wollenberg, B. F	John Wiley and Sons
3	SCADA-Supervisory Control And Data Acquisition	Stuart A. Boyer	ISA
4	Practical SCADA for industry	David Bailey and Edwin Wright-	Elsevier

Course Code	OEC2EE703			Semester	SEVENTH
Category	Open Elective Course				
Course Title	Fuzzy Logic and Neural Networks				
Scheme & Credits	L	T	P	Credits	Max Marks: 100
	2	1	0	3	
Prerequisites	Digital Logic				

Course Objectives:

1. Introduction to Neural networks and various neural network models
2. Various important concepts related with neural networks
3. Various learning paradigms in artificial neural networks
4. How fuzzy systems are used to solve problems of uncertainties.
5. How various artificial intelligence methods are clubbed to introduce hybrid systems.

Unit	Topics	No. of Hours
I	Introduction to neural networks: Introduction, Humans and Computers, Organization of the Brain, Biological Neuron, Biological and Artificial Neuron Models, Characteristics of ANN, McCulloch- Pitts Model, Historical Developments, Potential Applications of ANN.	9
II	Essentials of artificial neural networks: Operations of Artificial Neuron, Types of Neuron Activation Function, ANN Architectures, Classification Taxonomy of ANN – Connectivity, Neural Dynamics (Activation and Synaptic), Learning Strategy (Supervised, Unsupervised, Reinforcement), Learning Rules.	9
III	Learning Paradigms: Introduction to various learning algorithms, back propagation algorithm, pattern classification, clustering, Kohonen self-organizing feature map, radial basis function network, support vector machines, Hopfield network, Associative memory and BAM, Applications of ANN models to engineering problems.	9
IV	Fuzzy systems: Fuzzy sets, Membership, Uncertainty, Operations, properties, fuzzy relations, cardinalities, membership functions and its types. Fuzzification, defuzzification. Methods of defuzzification. Fuzzy inference systems.	9
V	Hybrid Intelligent Systems: Genetic algorithms, neuro-fuzzy systems, adaptive neuro-fuzzy inference system, evolutionary neural networks, fuzzy evolutionary systems. Illustration of these systems with examples from power systems etc.	6
Total number of Hours		**42**

Textbooks:

S. No	Name of Book	Author	Publisher
1	Introduction to Artificial Neural Systems	Jacek M. Zurada	PWS Publishing Company
2	Neural Networks: A Comprehensive Foundation,	S. S Haykin,	Pearson Education.
3	C++ Neural Networks and Fuzzy Logic,	ValluruRao,	Honary Holt & Co (1998)
4	Neural Networks,	Freeman	Pearson Publication (2003).
5	Genetic Algorithms; Synthesis and applications,	Rajasekaran & Pai	Prentice Hall of India (2004).

Course Code	**OEC3EE703**			**Semester**	**SEVENTH**
Category	**Open Elective Course**				
Course Title	**Energy Management in Buildings**				
Scheme & Credits	**L**	**T**	**P**	**Credits**	**Max Marks: 100**
	2	**1**	**0**	**3**	
Prerequisites	**Risk management, Energy sustainability**				

Course Objectives:

1. To understand the energy use and conservation options in buildings.
2. To understand the concepts of heat transmission in building
3. To learn the lightning fundamentals and day lightning use and estimation.
4. To understand the ASHRAE Methods and standards for estimates of Heating, cooling and Ventilation.

Unit	Topics	No. of Hours
I	Energy use in Buildings: Factors affecting Energy use, Energy Conservation options. External Factors – Climate, Climatic Zone, Building Orientation, Shading, Sizing of Shading Devices. Thermal Comfort: Criteria and various Parameters, Psychrometric Chart, Indoor air quality; Requirements in residential, Commercial, Hospital Buildings.	14
II	Heat Transmission in Buildings: Heat Transmission in Buildings: Surface Coefficient, Air cavity, Internal and External Surface, Overall Thermal Transmittance Walls and Windows, and Packed Roof, Heat Transfer due to ventilation/ infiltration, Internal Heat gains, Solar Temperature, Steady State Method (for Trombe Wall, Water wall and Solarium),	10
III	Lighting Fundamentals & Day Lighting use: Lighting Fundamentals, Visual Performance, Calculations of Lighting Levels, Energy Efficient Lighting. Day Lighting Use: Estimation of available Daylight, Day lighting Systems, Advantages and Limitations of Daylight Use.	8
IV	ASHRAE Methods and standards for estimates of Heating and cooling and Ventilation, Requirements of Different use Buildings, Air Quality control Equipments, Distribution Systems for Conditioned Air, Typical Designs of Selected Buildings in various Climatic Zones, Thumb Rules for Design of Building systems; Building Codes.	10
Total number of Hours		42

Textbooks:

S. No	Name of Book	Author	Publisher
1	Solar Passive: Building Science and Design	M S Sodha, N.K. Banaal, P.K.Bansal, A.Rumaar and M.A.S. Malik	Pergamon Press (1986).
2	Building, Climate and Energy	T.A. Markus and R.N. Morris,	Spottiswoode Ballantyne Ltd-, London U.K. (1980)
3	Energy storage technologies", a reading material prepared by Dr. D. Buddhi, School Of Energy And Environmental Studies, DAVV, Indore.		
4	Thermal Environment Engineering,	Jamee; L. Threlked	Prentice Hall, INC-, Raglevood Cliffs, New Jersey

Course Code	**PEC1EE704**			**Semester**	**SEVENTH**
Category	**Professional Elective Course**				
Course Title	**Power Quality**				
Scheme & Credits	**L**	**T**	**P**	**Credits**	**Max Marks: 100**
	2	**1**	**0**	**3**	
Prerequisites	**Basic Electrical Circuits, Power Electronics, Control System**				

Course Objectives:

1. Understand the different power quality issues to be addressed
2. Understand the recommended practices by various standard bodies on voltage & frequency, harmonics
3. Understand about compensation and compensators

Unit	Topic	No. of Hours
I	Introduction to Power Quality- Definition, Power Quality Problems, Causes and Consequences,voltage sags, swells, interruptions, flicker, reactive power and harmonics. Load Current Compensation, Reactive power compensation and zero voltage regulation.	10
II	Passive Compensation, Active load compensation- D-STATCOM- Design, Control and Phasor Analysis.	12
III	Source Voltage Compensation, Dynamics of sags and swells, Passive Series Compensation, Active Series Compensation- Dynamic Voltage Restorer (DVR) with and without energy support- Design, Control and Phasor Analysis.	10
IV	Combined Compensation- Unified Power Quality Conditioner (UPQC) , Right Shunt and Left Shunt Topologies	10
Total		**42**

Textbooks:

S. No	Name of Book	Author	Publisher
1	Power Quality Problems and Mitigation Techniques	B. Singh and A. Chandra	Wiley
2	Understanding Power Quality Problems: Voltage Sags and Interruptions .	Math H. Bollen	Wiley
3	Power Quality Enhancement using Custom Power Devices, Springer.	A. Ghosh, G. Ledwich	Springer

Course Code	PEC2EE704			Semester	SEVENTH
Category	Professional Elective Course				
Course Title	FACTS				
Scheme & Credits	L	T	P	Credits	Max Marks: 100
	2	1	0	3	
Prerequisites	Power Electronics, Power System				

Course Objectives:

Students will be able to

1. Understand the characteristics of ac transmission and the effect of shunt and series reactive compensation.
2. Understand the working principles of FACTS devices and their operating characteristics.

Unit	Topic	No. of Hours
I	Introduction to FACTS Technology, Types of FACTS controllers, FACTS vs. HVDC, Benefits of FACTS Technology, Performance Equations and Parameters of Transmission Lines, Transfer of Active and Reactive Power over a Transmission Line, Uncompensated Transmission, Need for Compensation, Definition and Functions of compensation.	10
II	Compensation Techniques: Ideal Shunt compensation, Ideal Series compensation, Phase-Angle control (Regulator), Advantages of Series compensation (voltage support, Transient stability improvement, Power oscillation damping), Advantages of shunt compensation, Thyristor Controlled Reactor (TCR), Thyristor-Switched Capacitor (TSC).	10
III	Analysis of various types of Static Var compensators (SVC), Static Synchronous Compensator (STATCOM): Analysis and comparison with SVC, Series compensators: GTO-Controlled Series Capacitor (GCSC),Thyristor-Switched Series Capacitor (TSSC), Thyristor-Controlled Series Capacitor (TCSC),Static Synchronous Series Compensator (SSSC).	10
IV	Voltage & Phase-Angle Regulation, Thyristor-Controlled Voltage Regulator (TCVR), Thyristor Controlled Phase-Angle Regulator (TCPAR), Introduction to Series-Shunt compensator & Series-Series compensator,Thyristor Controlled Braking Resistor (TCBR)	12
Total		**42**

Textbooks:

S. No	Name of Book	Author	Publisher
1	Understanding FACTS	N. G. Hingorani, Laszlo Gyugyi,	Wiley
2	FACTS Controllers In Power Transmission and Distribution	K R Padiyar	New Age International

Course Code	PEC3EE704			Semester	SEVENTH
Category	Professional Elective Course				
Course Title	Power Plant Engineering				
Scheme & Credits	L	T	P	Credits	Max Marks: 100
	2	1	0	3	
Prerequisites	Nil				

Objectives:

1. Understand the layout, construction and working of the components inside a thermal power plant.
2. Understand the layout, construction and working of the components Diesel, Gas and Combined cycle power plants.
3. Understand the layout, construction and working of the components inside nuclear power plants.
4. Understand the layout, construction and working of the components inside Renewable energy power plants.

Unit	Topic	No. of Hours
I	COAL BASED THERMAL POWER PLANTS: Rankine cycle – improvisations, Layout of modern coal power plant, Super Critical Boilers, FBC Boilers, Turbines, Condensers, Steam & Heat rate, Subsystems of thermal power plants – Fuel and ash handling, Draught system, Feed water treatment. Binary Cycles and Cogeneration systems.	15
II	DIESEL, GAS TURBINE AND COMBINED CYCLE POWER PLANTS: Otto, Diesel, Dual & Brayton Cycle – Analysis & Optimisation. Components of Diesel and Gas Turbine power plants. Combined Cycle Power Plants. Integrated Gasifier based Combined Cycle systems.	10
III	Basics of Nuclear Engineering, Layout and subsystems of Nuclear Power Plants, Working of Nuclear Reactors : Boiling Water Reactor (BWR), Pressurized Water Reactor (PWR), CANada Deuterium- Uranium reactor (CANDU), Breeder, Gas Cooled and Liquid Metal Cooled Reactors. Safety measures for Nuclear Power plants.	10
IV	HydroElectric Power Plants – Classification, Typical Layout and associated components including Turbines and Principle of operation	7
Total		42

Textbooks:

S. No	Name of Book	Author	Publisher
1	Power Plant Engineering, Third edition	Nag.P.K	Tata McGraw Hill Publishing Company Ltd., 2008.

Course Code	PEC1EE705			Semester	SEVENTH
Category	**Professional Elective Course**				
Course Title	**Electric Drives**				
Scheme & Credits	L	T	P	Credits	Max Marks: 100
	2	1	0	3	
Prerequisites	Machines and Power Electronics				

Course Objectives:

1. Understand the characteristics of dc motors and induction motors.
2. Understand the principles of speed-control of dc motors and induction motors.
3. Understand the power electronic converters used for dc motor and induction motor speed control.

Units	Topic	No. of Hours
I	Types of Drives and Load:Introduction, advantages of electric drives, components of electric drives, modes of operation, characteristic of different types of mechanical load, steady state stability of motor load system, fluctuating loads and load equalization, thermal loading of motor,estimation of motor rating for continuous, intermittent and short time duty loads.	8
II	DC Drives I: Characteristics of DC motors. Conventional methods of speed control: rheostatic, field and armature control. Electric braking of DC drives: Regenerative braking, Plugging and dynamic braking. Phase control of fully controlled DC drives, continuous and discontinuous conduction modes of operation	9
III	DC Drives II: Chopper controlled drives. Comparison of phase and chopper controlled drives. Review of feedback control, closed loop configurations in electric drives: current limit control, torque control, speed control of multi-motor drives and position control. Closed loop control of phase and chopper controlled dc drives.	9
IV	AC Drives I: Review of three phase induction motor characteristics. Electric braking of induction motor drives: Regenerative, Plugging, AC and DC dynamic braking. Methods of speed control of induction motors: stator voltage control, variable frequency control, and pole changing and pole amplitude modulation.	8
V	Speed control of wound rotor induction motor: Rotor resistance control (conventional and static), slip power recovery schemes. Closed loop control of induction motor drives: VSI control, static rotor resistance control, static Scherbius and Kramer drives, current regulated VSI drives. Introduction to vector control.	8
Total		**42**

Textbooks:

S. No	Name of Book	Author	Publisher
1	Fundamentals of Electric Drives	G. K. Dubey	Narosa Publications
2	Modern Power Electronics and AC Drives	Bimal. K. Bose	Prentice Hall PTR
3	Electric Motor Drives: Modeling, Analysis and Control	R. Krishnan	Pearson
4	High Performance AC Drives: Modelling, Analysis and Control	M. Ahmad	Springer.

Course Code	PEC2EE705			Semester	SEVENTH
Category	Professional Elective Course				
Course Title	Design of Photovoltaic Systems				
Scheme & Credits	L	T	P	Credits	Max Marks: 100
	2	1	0	3	
Prerequisites	Power Electronics				

Course Objectives:

1. Understand the basics of Solar PV System
2. Understand the working principles of standalone and grid connected PV systems.

Units	Topic	No. of Hours
I	A historical perspective, PV cell characteristics and equivalent circuit, Model of PV cell, Short Circuit, Open Circuit and peak power parameters, Datasheet study, Cell efficiency, Effect of temperature, Fill factor, PV cell simulation	3
II	Series & Parallel interconnection: Identical cells in series, Load line, Non-identical cells in series, Protecting cells in series, Interconnecting modules in series, Simulation of cells in series, Identical cells in parallel, Non-Identical cells in parallel, Protecting cells in parallel, Interconnecting modules, Simulation of cells in parallel, Practicals - Measuring i-v characteristics	9
III	Energy from Sun: Introduction, insolation & irradiance,Insolation variation with time of day,Earth centric viewpoint and declination, Solar geometry, Insolation on a horizontal flat plate, Energy on a horizontal flat plate, Sunrise and sunset hour angles Incident energy estimation: Energy on a tilted flat plate, Energy plots in octave, Atmospheric effect, Energy with atmospheric effects, Clearness index and energy scripts in Octave	7
IV	Sizing PV: Sizing PV for applications without batteries, Battery capacity, C-rate, efficiency,energy & power density,comparison,battery selection, Sizing PV for applications without batteries, Other energy storage methods, PV system design- Load profile, Days of autonomy and recharge, Battery size, PV array size. MPPT concept, Input impedance of DC-DC converters - Boost converter,Buck Converter & Buck Boost converter	8
V	MPPT Algorithms,PV battery interface,Peltier cooling, Pv & water pumping, Pv & Grid Interface and life cycle costing	15
Total		**42**

Textbooks:

S. No	Name of Book	Author	Publisher
1	Solar Photovoltaic Technology and Systems	Chetan Singh Solanki	Prentice Hall India
2	Solar Photovoltaics - Fundamentals, Technologies and Applications	Chetan Singh Solanki	Prentice Hall India
3	Design of Photovoltaic Systems	L Umanand	NPTEL

Course Code	**PEC3EE705**			**Semester**	**SEVENTH**
Category	**Professional Elective Course**				
Course Title	**Special Electric Machines**				
Scheme & Credits	**L**	**T**	**P**	**Credits**	**Max Marks: 100**
	2	**1**	**0**	**3**	
Prerequisites	**Electrical Machines**				

Course Objectives:

1. Familiarize with Construction features of various special electric machines, their mode of excitation and characteristics
2. Familiarize with control of special electric machines

Units	Topic	No. of Hours
I	SYNCHRONOUS RELUCTANCE MOTORS: Constructional features – Types – Axial and Radial flux motors – Operating principles – Variable Reluctance Motors– Voltage and Torque Equations - Phasor diagram - performance characteristics – Applications	10
II	STEPPER MOTORS: Constructional features – Principle of operation – Variable reluctance motor– Hybrid motor – Single and multi-stack configurations – Torque equations – Modes of excitation – Characteristics – Drive circuits – Microprocessor control of stepper motors – Closed loop control-Concept of lead angle – Applications	10
III	PERMANENT MAGNET BRUSHLESS D.C. MOTORS: Permanent Magnet materials – Minor hysteresis loop and recoil line-Magnetic Characteristics – Permeance coefficient -Principle of operation – Types – Magnetic circuit analysis – EMF and torque equations –Commutation - Power Converter Circuits and their controllers – Motor characteristics and control– Applications.	11
IV	PERMANENT MAGNET SYNCHRONOUS MOTORS (PMSM): Principle of operation – Ideal PMSM – EMF and Torque equations – Armature MMF – Synchronous Reactance – Sine wave motor with practical windings - Phasor diagram – Torque/speed characteristics - Power controllers - Converter Volt-ampere requirements– Applications.	11
Total		42

Textbooks:

S. No	Name of Book	Author	Publisher
1	Electric Machinery	Fitzgerald, Kingslay, Umans	Tata McGraw-Hill
2	Electric Machinery Fundamentals	Chapman	McGraw-Hill Higher Education
3	Electric Machines	Nagrath and Kothari	Tata McGraw-Hill

Course Code	PEC4EE705			Semester	SEVENTH
Category	Professional Elective Course				
Course Title	Industrial Drives & Control				
Scheme & Credits	L	T	P	Credits	Max Marks: 100
	2	1	0	3	
Prerequisites	Electrical Machines, Control and Power Electronics				

Course Objectives:

1. Understand the principles of open loop & closed loop speed control of dc motors and Ac motors.
2. Simplification of Analysis by use of transformations from one reference frame to another in AC drives
3. Understand vector control & sensorless control.

Units	Topic	No. of Hours
I	Electrical Drives: Introduction, AC & DC Drives, Advantages, components, General applications, Modelling of DC Machines: Theory of operation, Torque-speed characteristics revision,State-Space Modelling, Block Diagram & Transfer Function	11
II	Control of DC Drives: Revision of speed control methods of DC motors, Controlled rectifier based drives,Modes of operation, Speed control & Drive classification,Closed Loop speed control of Drives	7
III	Chopper Controlled DC Motor Drive: Introduction,Principle of operation of the Chopper, Four-quadrant Chopper Circuit, and Closed Loop Operation.	6
IV	Modelling of Induction Motor: Introduction,Park's transformation, stator, rotor and synchronously rotating reference frame models, State Space Equations	9
V	Induction motor drive control: Introduction to scalar and vector control, direct and indirect vector control ,principle of operation and control strategy (VSI, VSI fed drive, block diagram, controllers, etc.), Direct torque control, Sensorless control of AC drives	9
Total		**42**

Textbooks:

S. No	Name of Book	Author	Publisher
1	Fundamentals of Electric Drives	G. K. Dubey	Narosa publications
2	Modern Power Electronics and AC Drives	Bimal. K. Bose	Prentice Hall PTR
3	Electric Motor Drives: Modeling, Analysis and Control	R. Krishnan	Pearson
4	Sensorless Vector and Direct Torque Control	Peter Vas	Oxford science publications

Course Code	PSIEE706			Semester	SEVENTH
Category	Project, Seminar and Internship				
Course Title	Pre-project				
Scheme & Credits	L	T	P	Credits	Max Marks: 100
	0	0	6	3	
Prerequisites	All core courses				
The pre-project work is carried out by students in a group. The group comprises a minimum of three and a maximum of five students. The number of students in a group depends on the type and scale of the project being undertaken. In the pre project work students shall choose a specific topic/area for the project. The selected areas shall encompass recent and emerging trends in technologies that prove beneficial for society in general and humanity in particular. Supervisors will be assigned to each group in the beginning of the 7th semester of their course. Each student at the end of the course will submit a Project report and a working prototype or simulation regarding the project and the same will be evaluated for final award of the course. The pre-project can be a full-fledged project or a part of a major project.					

Course Code	PCCEE701L			Semester	Seventh
Category	Professional Core Course				
Course Title	Pre-project				
Scheme & Credits	L	T	P	Credits	Max Marks: 100
	0	0	2	1	
Prerequisites	Nil				

S. No.	Experiment
1	Study of various types of relays.
2	Characteristics of fuses.
3	Characteristics of inverse time over current relays
4	Time graded protection using inverse time O/C relay
5	Study of circuit breakers.
6	Study of differential protection schemes.
7	Study of an oil circuit breaker.

SYLLABUS

FOR

SEMESTER EIGHTH

Course Code	HSMC-EE801			Semester	EIGHTH
Category	Humanities and Social Sciences including Management Course				
Course Title	Organisation of Engineering Systems and Human Resources and Management				
Scheme & Credits	L	T	P	Credits	Max Marks: 100
	3	0	0	3	
Prerequisites	Nil				

Course Objectives:

1. An understanding of the principles of Organisation of engineering systems & HR Management
2. The ability to perceive issues from an overall management perspective.
3. The means to analyse developments in an organisation's systems, functioning and capabilities
4. The means to effectively understand organizational functioning and its human elements
5. The ability to become a performance-oriented manager of systems

Unit	Topic	No. of Hours
I	Introduction to Organisation of Engineering Systems and Human Resources(HR) Management	3
II	Basics of organizations and HR management: Understanding organizations: nature and functions, Concerns of organising engineering business and systems, Concerns of organising engineering business and systems, Structure and process issues in running organisations, Design issues in running organisations Operating organizations	12
III	Effectiveness and performance: Cybernetics and systems framework,Socio-technical systems, Dealing with efficiency and excellence, Man-machine relationship, Longitudinal Thinking.	13
IV	Human elements of functioning organizations:Concerns of recruitment, selection, skill formation and redeployment, Developing teams and leadership, Understanding motivation, Elements of HR planning, Indian Industrial Law and managing industrial relations	14
Total		**42**

Textbooks:

S. No	Name of Book	Author	Publisher
1	The Heart of Enterprise	Beer,Stafford(1975)	Preguin Press, London
2	The Future of Organisation:Achieving Excellence through Business Transformation	Coulson-Thomas Colin	Kogen Page
3	Cybernetics and Applied Systems	Constantin Virgil Negoita	CRS Press,USA
4	Business, Marketing, and Management Principles for IT and Engineering	Dimitris N. Chorafas	Taylor and Francis,USA
5	Comparative Manpower Planning Practices-Select Indian Experiences	Gautam Vinayshil	National Publishing House, New Delhi
6	Organisation Development Systems	G. Vinayshil and S. K Batra	Concept Publishing
7	Engineering a High Tech Business: Entrepreneurial Experiences and Insights	Jose Miguel Lopez-Higuera and Brian Culshaw	SPIE,Washington
8	Managing Human Resource and Industrial Relations	Tapomoy Deb (2009).	Excel Books,India

Course Code	PEC1EE802			Semester	EIGHTH
Category	Professional Elective Course				
Course Title	HVDC				
Scheme & Credits	L	T	P	Credits	Max Marks: 100
	2	1	0	3	
Prerequisites	Nil				

Course Objectives:

1. Understand the advantages of dc transmission over ac transmission.
2. Understand the operation of Line Commutated Converters and Voltage Source Converters.
3. Understand the control strategies used in HVDC transmission systems.
4. Understand the improvement of power system stability using an HVDC system.

Unit	Topic	No. of Hours
I	Introduction to HVDC and comparison with AC transmission, HVDC Operation-Converters and Inverters	7
II	Motor drive technologies,Energy Source Technologies, Battery Charging Technologies, Vehicle to Grid, Electric Vehicle Subsystems & configurations, Hybrid Electric Vehicle Subsystems, Hybrid Subsystems & modes of operations	10
III	Introduction to vehicle dynamics and Tractive effort,Vehicle dynamics & dynamic equation, dynamic equation variable Fte	9
IV	Storage for EVs,Fundamentals of EV Battery Pack design and battery management system,	8
V	EV Motors and Controllers: Fundamentals and Design,Vehicle Accessories	8
Total No. of Hours		**42**

Textbooks :

S. No	Name of Book	Author	Publisher
1	HVDC Power Transmission Systems,	K.R. Padiyar	New Age International
2	Power System Stability and control	Prabha Kundur	Tata McGraw-Hill

Course Code	**PEC2EE802**			**Semester**	**EIGHTH**
Category	**Professional Elective Course**				
Course Title	**Electric Vehicles**				
Scheme & Credits	**L**	**T**	**P**	**Credits**	**Max Marks: 100**
	2	**1**	**0**	**3**	
Prerequisites	**Nil**				

Course Objectives:

1. To understand upcoming technology of hybrid system
2. To understand different aspects of drives application
3. Learning the electric Traction

Unit	Topic	No. of Hours
I	Introduction to Electrical Vehicles, Historical background, benefits of using Electric Vehicles, overview of types of Electric vehicles & its challenges,	7
II	Motor drive technologies,Energy Source Technologies, Battery Charging Technologies, Vehicle to Grid, Electric Vehicle Subsystems & configurations, Hybrid Electric Vehicle Subsystems, Hybrid Subsystems & modes of operations	10
III	Introduction to vehicle dynamics and Tractive effort,Vehicle dynamics & dynamic equation, dynamic equation variable Fte	9
IV	Storage for EVs, Fundamentals of EV Battery Pack design and battery management system,	8
V	EV Motors and Controllers: Fundamentals and Design, Vehicle Accessories	8
Total No. of Hours		**42**

Textbooks :

S. No	Name of Book	Author	Publisher
1	Modern Electric, Hybrid Electric, and Fuel Cell Vehicles	Ehsani Mehrdad, Yimin Gao, Ali Emadi	CRC press
2	Electric Powertrain: Energy Systems, Power Electronics and Drives for Hybrid,Electric and fuel cell vehicles	John G. Hayes and A. Goodarzi	Wiley Publication

Course Code	PEC3EE802			Semester	EIGHTH
Category	Professional Elective Course				
Course Title	Smart Grids				
Scheme & Credits	L	T	P	Credits	Max Marks: 100
	2	1	0	3	
Prerequisites	Power System				

Course Objectives:

1. Understand concept of smart grid and its advantages over conventional grid
2. Know smart metering techniques
3. Learn wide area measurement techniques
4. Understand the problems associated with integration of distributed generation & its solution through smart grid.

Unit	Topic	No. of Hours
I	Introduction to Smart Grid, Architecture of Smart Grid System,Standards for Smart Grid System, Elements and Technologies of Smart Grid System	9
II	Distributed generation resources, wide area monitoring system,Phasor estimation,Digital relays for smart grid protection	9
III	Islanding Detection Techniques, Smart Grid Protection,Modelling of Storage Devices, Modelling of DC Smart Grid components	7
IV	Operation and control of AC Microgrid,Operation and control of DC Microgrid,Operation and control of AC-DC hybrid Microgrid	8
V	Demand side management. of Smart Grid, Demand response analysis of Smart Grid,Energy Management, Design of Smart grid,System Analysis of AC/DC Smart Grid	9
Total No. of Hours		**42**

Textbooks :

S. No	Name of Book	Author	Publisher
1	Smart power grids	A Keyhani, M Marwali	
2	Computer Relaying for Power Systems	ArunPhadke	
3	Microgrids Architecture and control	Nikos Hatziargyriou	
4	Renewable Energy Systems	Fang Lin Luo, Hong Ye	

Course Code	PEC1EE803			Semester	EIGHTH
Category	Professional Elective Course				
Course Title	High Voltage Engineering				
Scheme & Credits	L	T	P	Credits	Max Marks: 100
	2	1	0	3	
Prerequisites	Nil				

Course Objectives:

1. To get introduced to high voltage engineering
2. To understand different high voltage measurements and the necessary instruments

Unit	Topic	No. of Hours
I	CONDUCTION AND BREAKDOWN IN GASES: Gases as insulators, ionization, current growth,Townsend's criterion for breakdown, electro-negative gases, Paschen's Law, Streamer breakdown mechanism, corona discharges, post breakdown phenomena, practical considerations in using gases for insulating materials.	8
II	CONDUCTION AND BREAKDOWN IN LIQUID DIELECTRICS: Classification of liquid dielectrics, conduction and breakdown in pure liquids and in commercial liquids.	4
III	BREAKDOWN IN SOLID DIELECTRICS: Intrinsic breakdown, electromechanical breakdown, thermal breakdown, breakdown of solid dielectrics in practice, breakdown of composite insulation, solid dielectric used in practice.	5
IV	APPLICATIONS OF INSULATING MATERIALS IN DIFFERENT ELECTRICAL APPARATUS: Applications in power transformers, rotating machines, circuit breakers, cables, power capacitors, electronic equipment.	3
V	GENERATION OF HIGH VOLTAGES AND CURRENTS: Generation of high d.c. and a.c. voltages, generation of impulse voltages and currents.	7
VI	MEASUREMENT OF HIGH VOLTAGES AND CURRENTS: Measurement of high d.c., a c. and impulse voltages, Measurement of high d.c., a.c and impulse currents.	5
VII	NON DESTRUCTIVE TESTING: Measurement of d.c. resistivity, dielectric constant and loss factor, partial discharge measurement.	4
VIII	TESTING OF ELECTRICAL APPARATUS: Testing of insulators, bushings, isolators, circuit breakers, cables, transformers and surge diverters.	3
Total No. of Hours		**39**

Textbooks :

S. No	Name of Book	Author	Publisher
1	High Voltage Engineering Fundamentals	E. Kuffel, W.S Zaengl	Newnes
2	High Voltage Engineering	M.S. Naidu, V. Karamraju	Tata McGraw-Hill
3	High voltage test techniques	Dieter kind, Kurt Feser.	Newnes
4	An Introduction to High Voltage Engineering	Subir Ray	Prentice Hall of India

Course Code	**PEC2EE803**			**Semester**	**EIGHTH**
Category	**Professional Elective Course**				
Course Title	**Restructuring of Power Systems**				
Scheme & Credits	**L**	**T**	**P**	**Credits**	**Max Marks: 100**
	2	**1**	**0**	**3**	
Prerequisites	**Nil**				

Course Objectives:

1. Understand what is meant by restructuring of the electricity market
2. Understand the need behind requirement for deregulation of the electricity market
3. Understand the money, power & information flow in a deregulated power system

Unit	Topic	No. of Hours
I	Introduction to restructuring of the power industry.Fundamentals of Economics.	7
II	The Philosophy of Market Models.Transmission Congestion Management.	10
III	Locational Marginal Prices (LMP) and Financial Transmission Rights (FTR). Ancillary Service Management.	11
IV	Pricing of transmission network usage and loss allocation.Market power and generators bidding.	10
V	Reforms in the Indian power sector.	9
Total No. of Hours		**42**

Textbooks :

S. No	Name of Book	Author	Publisher
1	Fundamentals of Power System economics	Daniel Kirschen and Goran Strbac	John Wiley & Sons
2	Operation of restructured power systems	Kankar Bhattacharya, Jaap E. Daadler, Math H.J Bollen, Kluwer	Academic Pub.

Course Code	**PEC3EE803**			**Semester**	**EIGHTH**
Category	**Professional Elective Course**				
Course Title	**Power System Dynamics & Stability**				
Scheme & Credits	**L**	**T**	**P**	**Credits**	**Max Marks: 100**
	2	**1**	**0**	**3**	
Prerequisites	**Power System**				

Course Objectives:

1. Understand the problem of power system stability and its impact on the system.
2. Analyse linear dynamical systems and use of numerical integration methods.
3. Model different power system components for the study of stability.
4. Understand the methods to improve stability.

Unit	Topic	No. of Hours
I	Introduction to Power System Stability, Analysis of Dynamical Systems	10
II	Modeling of a Synchronous Machine, Modeling of Excitation and Prime Mover Systems	12
III	Modeling of Transmission Lines and Loads	8
IV	Stability Issues in Interconnected Power Systems, Power System Stability Analysis Tools	12
V	Enhancing System Stability	4
Total No. of Hours		**42**

Textbooks :

S. No	Name of Book	Author	Publisher
1	Power System Stability and Control,	P.Kundur	McGraw Hill Inc
2	Power System Dynamics & Stability	P.Sauer & M.A.Pai	Prentice Hall
3	Power System Dynamics, Stability & Control	K.R.Padiyar	B.S. Publications,

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Course Code	**PEC4EE803**			**Semester**	**EIGHTH**
Category	**Professional Elective Course**				
Course Title	**Advanced Power System Analysis**				
Scheme & Credits	**L**	**T**	**P**	**Credits**	**Max Marks: 100**
	2	**1**	**0**	**3**	
Prerequisites	**Nil**				

Course Objectives:

1. Study various methods of load flow and their advantages and disadvantages
2. Understand how to analyze various types of faults in power system
3. Understand power system security concepts and study the methods to rank the contingencies

Unit	Topic	No. of Hours
I	Revision of Newton Raphson, Gauss Siedel method, Fast decoupled load flow.	6
II	DC power flow : Single phase and three phase, AC-DC load flow, DC system model, Sequential Solution Techniques,Extension to Multiple and Multi-terminal DC systems, DC convergence tolerance, Test System and results.	10
III	Fault Studies, Analysis of balanced and unbalanced three phase faults, fault calculations.	8
IV	System optimization, strategy for two generator systems, generalized strategies,effect of transmission losses, Sensitivity of the objective function, Formulation of optimal power flow, solution by Gradient method-Newton's method.	9
V	State Estimation, method of least squares, statistics, errors, estimates, test for bad data, structure and formation of Hessian matrix, power system state estimation.	9
Total No. of Hours		**42**

Textbooks :

S. No	Name of Book	Author	Publisher
1	Power System Analysis	Grainger, J.J. and Stevenson, W.D.	Tata McGraw hill
2	Computer analysis of power systems	Arrillaga, J and Arnold, C.P.	John Wiley and Sons
3	Computer Techniques in Power System Analysis	Pai, M.A.	Tata McGraw hill

Course Code	**PCC-EE804L**			**Semester**	**EIGHTH**
Category	**Professional Core Course**				
Course Title	**Advanced Power System Simulation and Scripting Lab**				
Scheme & Credits	**L**	**T**	**P**	**Credits**	**Max Marks: 100**
	0	**0**	**4**	**2**	
Prerequisites	**Nil**				

S.No.	**Experiment**
1	Power Simulation and Scripting; SimPowerSystems™Models
2	Models of Power Circuit Devices in SimPowerSystems™; Measuring and Control Blocks
3	SimPowerSystems™ Simulation of Power Electronics Devices
4	SimPowerSystems™ Simulation of Electric Machine and Electric Drive Simulation
5	SimPowerSystems™ Simulation of Electric Power Production and Transmission Simulation
6	SimPowerSystems™ Simulation of the Renewable Electrical Sources and Wind Generators
7	Power System Scripting in Python/MATLAB
8	Power Flow Analysis
9	Optimal Power Flow Analysis
10	Time Domain Analysis: Numerical Integration and Transient Computation
11	Challenges of Scripting for Power System Education

Course Code	PSIEE805			Semester	EIGHTH
Category	Project work, Seminar and Internship				
Course Title	Industrial Training & Viva				
Scheme & Credits	L	T	P	Credits	Max Marks: 100
	0	0	0	1	

S.No.	Practical /Industrial Training/Internship
1	The students have to undergo a minimum four week practical training/internship /industrial training in any relevant industrial organization during winter vacations. The students will be asked to submit a practical training report (one copy per student) in a group. These reports will be evaluated in partial fulfilment for the award of the degree of Bachelors of Technology in their respective branches of study.

Course Code	PSIEE806			Semester	EIGHTH
Category	Project, Seminar and Internship				
Course Title	Major Project				
Scheme & Credits	L	T	P	Credits	Max Marks: 100
	0	0	16	8	
Prerequisites	Nil				

S.No.	PROJECT DESCRIPTION
1	In the final project, the students are required to extend the pre-project work for the final submission of the course. The final project work is to be carried out in the last semester of their respective fields of study. The supervisors will guide the students from the beginning of the pre-project in 7th semester to its accomplishment as a final project in the 8th semester. The students will be asked to submit a project report in a group. These reports will be evaluated in partial fulfilment for the award of the degree of bachelors of Technology in their respective branches of study.