UNIVERSITY OF ENGINEERING & MANAGEMENT

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Syllabus and Course Outline

M. TECH.

IN

POWER SYSTEM ENGINEERING

BATCH: 2016

DEPARTMENT OF ELECTRICAL ENGINEERING

UNIVERSITY OF ENGINEERING & MANAGEMENT

JAIPUR

Syllabus for M. Tech. EE in Power Systems

1st semester

Theory

Sl. No	Code	Paper	Contact periods per week			Total Contact hours	Credit
			L	T	P		
1.	EMM-101	Advanced Engineering Mathematics	3	1	0	4	4
2.	PSM-101	Advanced Power System Analysis	3	1	0	4	4
3.	PSM-102	High Voltage Transmission System	4	0	0	4	4
4.	PSM-103	Elective – I	4	0	0	4	4
5.	PSM-104	Elective - II	4	0	0	4	4

Practical/ Sessional

Sl. No.	Code	Paper	Contact periods per week			Total Contact hours	Credit
			L	T	P		
1.	PSM-191	Laboratory I	0	0	3	3	2
2.	PSM-192	Laboratory II	0	0	3	3	2
3.	PSM-193	Seminar I	0	0	3	3	2
		Total of Practical/ Sessional				9	6
Total of Semester			18	2	9	29	26

2nd Semester

Theory

Sl. No.	Code	Paper	Contact periods per week			Total Contact hours	Credit
			L	T	P		
1.	PSM-201	Power System Operation and Control	3	1	0	4	4
2.	PSM-202	Power System Instrumentation	3	1	0	4	4
4.	PSM-203	Advanced Power System Protection	4	0	0	4	4
4.	PSM-204	Elective – III	4	0	0	4	4
5.	PSM-205	Elective - IV	4	0	0	4	4

Practical/Sessional:

Sl. No.	Code	Paper	Contact periods per week			Total Contact hours	Credit
			L	T	P		
1.	PSM-291	Laboratory III	0	0	3	3	2
2.	PSM-292	Laboratory IV	0	0	3	3	2
3.	PSM-293	Seminar II	0	0	3	3	2
Total of Practical/ Sessional						9	6
Total of Semester			17	3	9	29	26

3rd Semester

Theory

Sl. No.	Code	Paper	Contact periods per week			Total Contact hours	Credit
			L	T	P		
1.	EMM-301	Introduction to Management	4	0	0	4	4
2.	PSM-301	Elective V	3	1	0	4	4

Practical/ Sessional

Sl. No.	Code	Paper	Contact periods per week			Total Contact hours	Credit
			L	T	P		
1.	PSM-391	Pre-submission Defense of Dissertation	0	0	0	0	4
2.	PSM-392	Dissertation (Part I)	0	0	0	20	10
		Total of Sessional				20	14
Total of Semester			17	3	9	28	22

4th Semester

Sl. No.	Code	Paper	Contact periods per week			Total Contact hours	Credit
			L	T	P		
1.	PSM-491	Dissertation (Completion)	0	0	0	24	14
2.	PSM-492	Post submission defense of Dissertation	0	0	0	0	8
3.	PSM-294	Comprehensive Viva-Voce	0	0	0	0	4
Total of Semester						24	26

Total Credits: 26 + 26 + 22 + 26 = 100

Elective I

i) Power System Planning and Reliability - PSM 103 (a)

ii) Power System Apparatus - PSM 103 (b)

iii) Power Quality - PSM 103 (c)

Elective II

i) Optimization Techniques - PSM 104 (a)

ii) Soft Computing Technique - PSM 104 (b)

iii) Digital Signal Processing - PSM 104 (c)

iv) Object Oriented Programming - PSM 104 (d)

Elective III

i) Power System Transient – PSM 204 (a)

ii) Flexible A.C. Transmission System - PSM 204 (b)

iii) Advanced Electrical Drives - PSM 204 (c)

Elective IV

i) Advanced Control System- PSM 205 (a)

ii) Modeling and Simulation of dynamic systems - PSM 205 (b)

iii) Advanced Microprocessor and Microcontroller – PSM 205 (c)

Elective V

i) Non-conventional Energy - PSM 301 (a)

ii) **Power System Harmonics - PSM 301 (b)**

iii) **Energy Management and Audit – PSM 301 (c)**

ADVANCED ENGINEERING MATHEMATICS

EMM 101

L-T-P=3-1-0

Course Outcomes (CO):

Upon successful completion of this course, students should be able to:

CO1: To introduce different functions of complex variables, review of complex variables.

CO2: Analyze generalized Eigen vectors and factorization methods

CO3: Describe the basic concepts of functional dependent and independent variables

CO4: To Illustrate different Optimization Technique and Elements of calculus variation.

Mapping of Course Outcomes (CO) and Program Outcomes (PO):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓		✓	✓			✓			
CO2	✓	✓	✓		✓	✓						
CO3	✓	✓	✓						✓			
CO4	✓	✓	✓			✓						

Course Contents:

Unit I: Complex Variables

Review of complex variables, Conformal mapping & transformations, Function of complex variables, Pole and singularity, Integration with respect to complex argument, Residues and basic theorems on residues.

Unit II: Numerical Analysis

Introduction, Interpolation formulae, Difference equation, Roots of equations, Solution of simultaneous linear and non-linear equations, Solution techniques for ODE and PDE, Introduction to stability, Matrix eigen value and eigen vector problems.

Unit III: Optimization Technique

Calculus of several variables, Implicit function theorem, Nature of singular points, Necessary and sufficient conditions for optimization, Elements of calculus variation, Constrained Optimization, Lagrange multipliers, Gradient method, Dynamic programming.

Unit IV: Linear Algebra

Vector space, Linear dependence of vectors, basis, linear transformations, inner product space, rank and inverse of a matrix, solution of algebraic equations, consistency conditions, Eigen values and eigen vectors, Hermitian and Skew Hermitian matrices

Text Books:

1. John B. Conway, Functions of one complex variable, Springer International.
2. James Ward Brown & Ruel V. Churchill, Complex variable and application, Mc Graw Hill International edition .
3. Sen, M.K and Malik, D.F.-Fundamental of Abstract Algebra, Mc Graw Hill.
4. Khanna, V.K. and Ghamdri, S.K.- Course of Abstract Algebra, Vikash Pub.
5. Halmos, T.R. Naïve set theory,Van Nostrand.
6. Scarborough, J.B.- Numerical Mathematical Analysis, Oxford University Press

References

1. John H. Mathews, Numerical Methods for Mathematics , science and Engineering, PHI
2. D.C. Sanyal and K. Das, A text Book of Numeriacl analysis, U.N. Dhar & Sons Pvt. Ltd.
3. S.S.Rao,, Optimisation theory and application,
4. Wiely Eastern limited Hoffman & Kunze. R, Linear Algebra, PHI Control

ADVANCED POWER SYSTEM ANALYSIS

PSM 101

L-T-P=3-1-0

Course Outcomes (CO):

Upon successful completion of this course, students should be able to:

CO1: To introduce different techniques of dealing with sparse matrix for large scale power systems.

CO2: To impart in-depth knowledge on different methods of power flow solutions.

CO3: To apply energy function method for analysis of transient stability in power system.
CO4: To Illustrate different numeric al integration methods and factors influencing transient stability.

Mapping of Course Outcomes (CO) and Program Outcomes (PO):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓		✓		✓	✓					✓	
CO2	✓		✓		✓	✓			✓			
CO3	✓		✓					✓	✓	✓	✓	
CO4	✓		✓			✓	✓					✓

Course Contents:

Unit I : Network matrix:

Physical interpretation of bus admittance and impedance matrices, introduction to admittance matrix formulation, formation of admittance matrix due to inclusion of regulating transformer, development of admittance matrix using singular transformation, modification of admittance matrix for branch addition/ deletion.

Unit II: Complex power flow:

Analytical formulation of complex power flow solution, Gauss-Seidal method of power flow, Newton Raphson method of power flow, algorithm for solving power flow problem using N-R method in rectangular form, algorithm for solving power flow problem using N-R method in polar form fast decoupled load flow method.

Unit III: Power System Stability:

Definitions, classification of stability-rotor angle and voltage stability, synchronous machine representation for stability study.

Transient stability: Assumptions for transient stability, derivation of swing equation, swing equation for synchronous machine connected to infinite bus, swing equation for a two machine system, solution of swing equation by Euler and Runge Kutta method, equal area criterion, critical clearing angle, application of critical clearing angle to transient stability of synchronous machine. Methods of improving transient stability: reducing fault clearance time, automatic reclosing, single phase reclosing, electric braking, voltage regulators, fast governor action, high speed excitation system.

Voltage stability: Definition and classification of voltage stability, mechanism of voltage collapse, analytical concept of voltage stability for a two bus system, expression for critical receiving end voltage and critical power angle at voltage stability limit for a two bus power system, PV and QV curves, L index for the assessment of voltage stability.

Text Book:

1. A. Chakrabarti,M.L. Soni, P.V. Gupta, U. S. Bhatnagar "A text book on Power System Engineering", Dhanpat Rai and Co.

Reference Book:

1. Power system Analysis by John J. Grainger & William D. Stevenson, JR: Tata McGraw-Hill Edition.

2. P.Kundur, "Power System Stability and Control", McGraw Hill, 1994

HIGH VOLTAGE TRANSMISSION SYSTEM

PSM 102

L-T-P=4-0-0

Course Outcomes (CO):

Upon successful completion of this course, students should be able to:

CO1: Distinguish HVDC Transmission and EHVAC transmission system.

CO2: Analyze HVDC transmission with Current Source Converters and Voltage Source Converters

CO3: To analyze system dynamic performance and reactive power requirements.

CO4: To know about corona and radio & TV interference and design filters for reduction of harmonics **.**

Mapping of Course Outcomes (CO) and Program Outcomes (PO):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓		✓		✓	✓					✓	
CO2	✓		✓			✓			✓		✓	
CO3	✓		✓		✓			✓	✓	✓	✓	
CO4	✓		✓			✓	✓	✓				✓

Course Contents:

Unit I

High voltage transmission line trends and preliminary aspects of standard transmission voltages. Comparison between HVAC and HVDC transmission, planning for HVDC transmission, links, properties of HVDC thyristor valves, components of HVDC transmission system.

Unit II

HVDC converters: 6 pulse converter circuits and working principle, converter bridge characteristics, working principle and characteristics of a twelve pulse converter with two & three valve conduction mode, three valve conduction mode and three and four valve conduction mode

Unit III

Calculation of line resistance and inductances: resistance of conductors, temperature rise of conductor and current carrying capacity. Properties of bundled conductors and geometric mean radius of bundle, inductance of two conductors lines and multi-conductor lines coefficient matrix.

Unit IV

Line capacitance calculation: capacitance of two conductor line, and capacitance of multi conductor lines, potential coefficient for bundled conductor lines, sequence inductance and capacitances.

Unit V

Corona: Corona in EHV lines- corona loss formulates- Audio noise due to corona, its generation, characteristics and limits measurement of audio noise.

Unit VI

Introduction of Electric Field calculation, Uniqueness theorem, Field calculation by finite difference method with equal and unequal nodal distance in 2-D and 3D system.

Text Book:

1. Rakosh Das Begamudre, 'Extra high voltage ac transmission engineering' New Age International Publisher

Reference Book:

1. Padiyar K. R. 'HVDC transmission systems' Wiley.
2. Begamudre, R..D., EHVAC Transmission Engineering, New Age International (P) Limited, Publishers (2006).

POWER SYSTEM PLANNING AND RELIABILITY

PSM 103(A)

L-T-P=4-0-0

Course Outcomes (CO):

Upon successful completion of this course, students should be able to:

CO1: Students will develop the ability to learn about load forecasting.

CO2: To study the fundamentals of Generation system, transmission system and Distribution system reliability analysis

CO3: Learners will understand the significance ancillary services and pricing of transmission network

CO4: Students will understand the concepts of Contingency analysis and Probabilistic Load flow Analysis

Mapping of Course Outcomes (CO) and Program Outcomes (PO):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓		✓	✓					✓	
CO2	✓	✓	✓			✓			✓		✓	
CO3	✓	✓	✓		✓	✓		✓	✓	✓	✓	✓
CO4	✓	✓		✓		✓	✓	✓				✓

Course Contents:

Unit I

Load Forecasting: Load Forecasting Categories-Long term, Medium term, short term, very short term Applications of Load Forecasting, Factors Affecting Load Patterns Medium and long term load forecasting methods- end use models, econometric models, statistical model based learning.

Short Term Load Forecasting (STLF): Applications of Load Forecasting, methods- similar day approach, regression methods, time series, ANN, Expert systems, Fuzzy logic based method, support vector machines ANN architecture for STLF, Seasonal ANN, Adaptive Weight, Multiple-Day Forecast, STLF Using MATLAB'S ANN Toolbox, Training and Test Data, Stopping Criteria for Training Process, sensitivity analysis

Unit II

Power System Reliability: Basic Notions of Power System Reliability- sub systems, reliability indices, outage classification, value of reliability tools, Concepts and methodologies, power system structure, Reliability based planning in power systems, Effect of failures on power system, Planning criteria, Risk analysis in power system planning, multi-state systems.

Unit III

Basic Tools and Techniques- random processes methods & Markov models, Computation of power system reliability measures by using Markov reward models, Evaluation of reliability indices, Universal Generating Function (UGF) Method, Monte Carlo simulation

Unit IV

Reliability of Generation Systems- capacity outage calculations, reliability indices using the loss of load probability method, unit commitment and operating constraints, optimal reserve management, single and multi-stage expansion.

Unit V

Reliability Assessment for Elements of Transmission and Transformation Systems- reliability indices of substations based on the overload capability of the transformers, evaluation and analysis of substation configurations, Reliability analysis of protection systems for high voltage transmission lines.

Text Book:

1. Markey operations in electric power systems Forecasting, Scheduling, and Risk Management, Shahidehpour M, Yamin H, Li z, John Wlley & sons

Reference Book:

1. Reliability evaluation of power systems, Billinton R, Allan R (1996) Plenum Press New York.
2. B.R. Gupta, “Generation of Electrical Energy”,S.Chand Publications 1983.

POWER SYSTEM APPARATUS

PSM 103(B)

L-T-P=4-0-0

Course Outcomes (CO):

Upon successful completion of this course, students should be able to:

CO1: Students will develop the ability to learn about VCB and SF6 Circuit breaker, Ratings, Selection.

CO2: To know the reactive power control in electrical power transmission lines and the importance of FACTS devices.

CO3: Learners will understand to Analyze the operation, performance and applications of SVC.
CO4: Students will develop the ability to learn about TCR and TSR, FC-TCR (Fixed Capacitor, Thyristor Controlled Reactor), Hybrid VAR Generators. Static VAR Compensator (SVC & STATCOM).

Mapping of Course Outcomes (CO) and Program Outcomes (PO):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓			✓	✓					✓	
CO2	✓	✓			✓	✓			✓		✓	✓
CO3	✓	✓			✓	✓		✓	✓	✓	✓	✓
CO4	✓	✓		✓	✓	✓	✓	✓				✓

Course Contents:

Unit I

Circuit Breaker: Introduction, Operating Principle, Detail study on VCB and SF6 Circuit breaker, Ratings, Selection. Surge Arrester & Surge Absorber. Insulation Co-ordination, BIL.

Unit II

FACTS: Concepts and general system consideration: Opportunities for FACTS. Basic types of FACTS controllers. Brief description and definition of FACTS controllers. Shunt connected controllers. Series Connected controllers. Combined Shunt and Series connected controllers.

Unit III

Static Shunt Compensators: Objectives of Shunt Compensations. Midpoints voltage regulation for line segmentation. Improvements of transient stability, Methods of controllable VAR generation. Variable impedance type static VAR generation, TCR and TSR, FC-TCR (Fixed Capacitor, Thyristor Controlled Reactor), Hybrid VAR Generators. Static VAR Compensator (SVC & STATCOM). Transfer Function and Dynamic Performance. Power Oscillation, Damping. Transient Stability.

Unit IV

Static Series Compensators: GCSC, TSSC, TCSC and SSSC: Basic Operating Control Schemes for GCSC, TSSC and TCSC.

Unit V

Static Voltage and Phase Angle Regulators: TCVR and TCPAR.

Unified power flow controllers

Text Book:

1. Understanding FACTS by Narain G. Hingorani & Laszlo Gyugyi: IEEE Press

Reference Book:

1. Power System Switchgear & Protection by Sunil S. Rao
2. B.R. Gupta, “Generation of Electrical Energy”,S.Chand Publications 1983

POWER QUALITY

PSM 103(C)

L-T-P=4-0-0

Course Outcomes (CO):

Upon successful completion of this course, students should be able to:

CO1: Discuss the various types of power quality problem.

CO2: Analyze the sources, types and mitigation of over voltage issues and model of over voltage problem with computer software tools.

CO3: Evaluate the effects of harmonics on power system equipments and analyze the methods of controlling of harmonics.

CO4: Explain the principle of operation of various types of power quality monitoring devices.

Mapping of Course Outcomes (CO) and Program Outcomes (PO):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓		✓	✓					✓	
CO2	✓	✓	✓			✓			✓	✓	✓	✓
CO3	✓	✓	✓		✓	✓		✓	✓	✓	✓	✓
CO4	✓	✓				✓		✓				✓

Course Contents:

Unit I

Electric power quality phenomena: Impacts of power quality problems on end users, Power quality standards, power quality monitoring.

Unit II

Power quality disturbances:- transients, short duration voltage variations ,long duration voltage variations, voltage imbalance, wave-form distortions, voltage fluctuations, power frequency variations, power acceptability curves.

Unit III

Power quality problems: poor load power factor, loads containing harmonics, notching in load voltage, dc offset in loads, unbalanced loads, disturbances in supply voltage.

Unit IV

Transients: Origin and classification- capacitor switching transient-lighting-load switching-impact on users-protection- mitigation

Unit V

Harmonics: harmonic distortion standards, power system quantities under non sinusoidal conditions-harmonic indices-source of harmonics-system response characteristics-effects of harmonic distortion on power system apparatus –principles for controlling harmonics, reducing harmonic currents in loads, filtering, modifying the system frequency response- Devices for controlling harmonic distortion, inline reactors or chokes, zigzag transformers, passive filters, active filters.

Unit VI

Power quality conditioners: Shunt and series compensators, Dstatcom-dynamic voltage restorer, unified power quality conditioners

Text Book:

1. Arindam and Ledwich Gerard, 'Power quality enhancement using custom power devices' Springer
2. Arrillaga J., Watson N. R. and Chen S., 'Power System Quality Assessment' Wiley.

Reference Book:

1. Angelo Baggini 'Handbook of Power Quality' – Wiley
2.

OPTIMIZATION TECHNIQUES

PSM 104 (A)

L-T-P=4-0-0

Course Outcomes (CO):

Upon successful completion of this course, students should be able to:

CO1: Able to formulate mathematical models of real world problems

CO2: Understand the major limitations and capabilities of deterministic operations

CO3: Handle, Solve and analyze problems using linear programming and other mathematical programming algorithms

CO4: Solve various multivariable optimization problem

Mapping of Course Outcomes (CO) and Program Outcomes (PO):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓									✓	
CO2	✓	✓									✓	✓
CO3	✓	✓									✓	✓
CO4	✓	✓										✓

Course Contents:

Unit I

Fundamentals of optimization techniques: Definition-Classification of optimization problems-Unconstrained and Constrained optimization-Optimality conditions-Classical Optimization techniques (Lamda Iteration method, Linear programming, Quadratic programming).

Unit II

Lamda iteration method: Brief introduction to lamda iteration method, formulate the Lagrange function, Lamda iteration method to solve Optimal dispatch problem.

Unit III

Quadratic programming: Introduction to quadratic programming, Working principle, sequential programming, Linear constrained optimization problem, Karush-Kuhn-Tucker conditions and its application to solve various problems, Interior point method, lagrangian duality

Unit IV

Linear programming: Examples of linear programming problem, The Simplex Method I, Fundamental theorem of linear programming, Weak and strong duality theorems, Integer programming, Network flow, develop a linear programming model from problem description.

Unit V

Genetic Algorithm: Introduction to genetic Algorithm, working principle, Principles of Genetic Algorithm- Evolutionary Strategy and Evolutionary Programming-Genetic Operators-Selection, Crossover and Mutation fitness function. GA operators; Similarities and differences between GA and traditional methods; Unconstrained and constrained optimization using Genetic Algorithm.

Unit VI

Particle Swarm Optimization: Fundamental principle-Velocity Updating-Advanced operators-Parameter selection- Hybrid approaches (Hybrid of GA and PSO, Hybrid of EP and PSO) -Binary, discrete and combinatorial

Unit VII

Differential Evolution: Fundamental principle, developing DE based solution techniques for OPF problems with single and multiple objectives and comparing the performance and computational effectiveness of DE with other evolutionary and conventional techniques

Unit VIII

Application of population based optimization techniques in power systems: Algorithms and flow chart of various optimization techniques for solving economic load dispatch and hydro-thermal scheduling problem

Text Book:

1. S.S.Rao, Engineering Optimization, 3rd Edition, New Age International (P) Ltd
2. Genetic Algorithm – D.E.Goldberg
3. Principle of soft computing by S.N.Sivanandam & S.N. Deepa
4. Soft computing Technique and its application in electrical Engineering by Chaturvedi

Reference Book:

1. Optimization on Power system Operation by Jizhong Zhu Wiley-IEEE Press.
2. An Introduction to Optimization, 3rd Edition by K.P. Chong, Stanislaw H. Zak.

SOFT COMPUTING TECHNIQUES

PSM 104 (B)

L-T-P=4-0-0

Course Outcomes (CO):

Upon successful completion of this course, students should be able to:

CO1: Students Will be able to know the basic ANN architectures, algorithms and their limitations.

CO2: Will be capable of developing ANN based models and control schemes for non-linear system.

CO3: Will be competent to use hybrid control schemes and P.S.O and support vector Regressive.

CO4: Will be knowledgeable to use Fuzzy logic for modeling and control of non-linear systems.

Mapping of Course Outcomes (CO) and Program Outcomes (PO):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓	✓	✓	✓					✓	
CO2	✓	✓	✓	✓		✓			✓		✓	✓
CO3	✓	✓	✓	✓	✓	✓		✓	✓		✓	✓
CO4	✓	✓			✓	✓		✓	✓			✓

Course Contents:

Unit I

Introduction to Soft Computing, components of soft computing, traditional computing and drawbacks, advantages of soft computing techniques

Unit II

Introduction to fuzzy logic: definition, general idea and importance in practical life. Fuzzy set theory: concept of fuzzy set, membership functions, comparison of fuzzy set and classical set. Operations on fuzzy sets, properties of standard operations, T norm and S norm, Extension principle and application.

Height of fuzzy set, core of fuzzy set, support of fuzzy set, normal fuzzy set, normalization of fuzzy set, level set, α cut and strong α cut of fuzzy set, concentration and dilation

of fuzzy sets, fuzzy singleton, crossover points. Fuzzy relation: fundamentals of fuzzy relations, operations on fuzzy relations, composition of fuzzy relations, fuzzy reasoning, fuzzy relation inferences, compositional rule of inference, fuzzification.

Fuzzy methods in control theory: Introduction to fuzzy logic controller, types of fuzzy logic controllers, basic structure of fuzzy knowledge based controllers, defuzzification methods, applications of fuzzy logic control.

Unit III

Introduction to artificial neural networks, artificial neuron model, types of activation functions. Learning in neural networks, feed forward and feedback neural networks, backpropagation training algorithm, Hopfield network, Boltzman machine. Self organizing map, learning vector quantization algorithm.

Unit IV

Basic concept of genetic algorithm, comparison of GA and traditional techniques, objective function and fitness function, crossover, mutation, GA search, applications of GA.

Text Book:

1. Klir, G.J. & Yuan,B.- Fuzzy sets and Fuzzy logic, theory and applications, Prentice Hall of India Private Limited.
2. M. Ganesh - Introduction to fuzzy sets and fuzzy logic, PHI.

Reference Book:

1. N. P. Padhy – Artificial intelligence and intelligent systems, Oxford
2. Timothy J. Ross – Fuzzy logic with engineering applications, Wiley.

DIGITAL SIGNAL PROCESSING

PSM 104 (C)

L-T-P=4-0-0

Course Outcomes (CO):

Upon successful completion of this course, students should be able to:

CO1: Students Will be able to expose the to the fundamentals of digital signal processing in frequency domain& its application.

CO2: Will be capable of compareing Architectures & features of Programmable DSprocessors & develop logical functions of DSProcessors.

CO3: Will be competent to Comprehend the DFTs and FFTs, design and Analyze the digital filters, comprehend the Finite word length effects in Fixed point DSP Systems.

CO4: Will be able to Apply z-transform and inverse Z transform and analyze discrete time systems.

Mapping of Course Outcomes (CO) and Program Outcomes (PO):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓		✓	✓		✓		✓	✓	
CO2	✓	✓	✓		✓	✓			✓		✓	✓
CO3	✓	✓	✓		✓	✓			✓	✓	✓	✓
CO4	✓	✓			✓	✓		✓		✓		✓

Course Contents:

Unit I

Description of Signals and Systems: Types of signals and their characteristics, types of systems and their behavior.

Discrete-time description of signals: Discrete-time sequences, their frequency domain behaviour, comparison with analog signals, convolution of two sequences, sampling a continuous function to generate a sequence, reconstruction of continuous-time signals from discrete-time **sequence.**

Unit II

Discrete-time description of systems: Unit-sample response of a system, Time-invariant systems, Superposition principle for linear systems, Stability criterion for discrete-time systems, Causality criterion for discrete-time systems.

Discrete-time Fourier transform: Definition of Fourier transform (FT), important properties of FT, properties of FT for real- valued sequences, use of FT in signal processing, FT of special sequences, the inverse FT, FT of the product two discrete-time sequences

Unit III

Discrete Fourier Transform: The definition of the Discrete Fourier Transform (DFT), efficient computation of DFT, properties of the DFT.

Digital filter: Definition and anatomy of a digital filter, frequency domain description of signals and systems, replacing analog filters with digital filters, filter categories: IIR and FIR, recursive and non-recursive.

Optimal and adaptive filters: Wiener filtering technique, adaptive filters and their applications.

Unit IV

Spectrum estimation and analysis: Principles, Periodogram method, Blackman – Turkey method, fast correlation method. Autoregressive spectrum estimation.

Wavelet Transforms: Fourier Transform and its limitations, Short Time Fourier Transform, introduction of Continuous Wavelet

Transform, Discretization of the Continuous Wavelet Transform (DWT).

Text Book:

1. Ramesh Babu- Digital Signal Processing

Reference Book:

1. John Proakis – Digital Signal Processing
2. John. G. Proakis, Dimitris G. Manolakis, “Digital signal processing”, Pearson Edu, 2002

OBJECT ORIENTED PROGRAMMING

PSM 104 (D)

L-T-P=4-0-0

Course Outcomes (CO):

Upon successful completion of this course, students should be able to:

CO1: Students Will be able to Develop a simple program in C++ using functions.

CO2: Design classes and objects with constructors and destructors.

CO3: Create programs using the concept of compile time polymorphism and function overloading.

CO4: Apply hierarchical programs using inheritance and virtual functions

Mapping of Course Outcomes (CO) and Program Outcomes (PO):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓	✓	✓			✓		✓	✓	
CO2	✓	✓	✓	✓	✓	✓			✓			✓
CO3	✓	✓		✓	✓				✓	✓		✓
CO4	✓			✓	✓	✓		✓	✓	✓		✓

Course Contents:

Unit I

Objective oriented programming paradigm: Introduction – reusability – security – object oriented programming fundamentals – abstraction -encapsulation - derivation – object oriented languages and packages

Unit II

Classes and objects: Introduction to C++ - procedural oriented approach to C++ - data types – control structures – problem solving - standard input and output streams – C++ enhancements – function prototypes - defaults reference variables – constant – classes – constructors – destructors – constraint objects – member objects and the functions.

Unit III

Advanced features: Dynamic memory allocation pointers – new and delete operators – classes with pointers – copy constructor – static member –friend classes –friend functions –operator overloading.

Unit IV

Function overloading – connection classes – derived classes – class conservation – protected members – virtual functions – dynamic binding – abstract classes – multiple inheritance – templates error handling.

Case studies: Overview of typical object oriented systems – case studies – application to electrical engineering.

Text Book:

1. Stanley B. Lipman , C++ primer, Addison Wesley, 1989
2. Bertrand Meyar, Object softwere construction, Prentice Hall, 1988

Reference Book:

1. K.R. Dittrich et al , On object oriented data base system , Springer Verlag , 1991

POWER SYSTEM OPERATION AND CONTROL

PSM 201

L-T-P=4-0-0

Course Outcomes (CO):

Upon successful completion of this course, students should be able :

CO1: To understand the fundamentals of speed governing system and the concept of control areas.

CO2: To impart knowledge on the need of state estimation and its role in the daytoday operation of power system

CO3: To understand system load variations and get an overview of power system operations.

CO4:To attain knowledge about hydrothermal scheduling.

Mapping of Course Outcomes (CO) and Program Outcomes (PO):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓					✓		✓		
CO2	✓	✓	✓	✓	✓	✓			✓			
CO3	✓	✓	✓		✓				✓	✓		
CO4	✓		✓	✓		✓		✓	✓	✓		

Course Contents:

Unit I

Optimal Generation Scheduling: Power flow scheduling using economic load dispatch, power flow scheduling using Lagrange multiplier method, penalty factor, scheduling with network losses, hydrothermal coordination with and without losses, cascaded and pump storage plant scheduling, unit commitment, unit commitment solution methods, introduction to optimal power flow solution using Newton Raphson method

Unit II

Automatic Generation Control: Types of alternator exciters, automatic voltage regulators for generator excitation control, static and dynamic performance of AVR loop, automatic load

frequency control, primary automatic load frequency control loop, secondary automatic load frequency control loop, extension of automatic load frequency control loop to multi area systems, tie line power flow model

Unit III

Power System Security: Security analysis, security assessment, contingency analysis, algorithm to determine system security following contingency analysis procedure, security assessment using ac power flow model, security analysis using concept of performance index

Unit IV

State Estimation and load forecasting: Methods of state estimation – least square and weighted least square estimation, bad data detection and suppression of bad data, load forecasting, load forecasting techniques – methods of extrapolation and correlation, estimation of average and trend terms of deterministic part of load – limitation of the method, prediction of deterministic load, generalized load modeling, estimation of periodic components, estimation of stochastic part of load – time series approach

Text Book:

1. Power System Analysis, Operation and Control, Abhijit Chakrabarti and Sunita Halder PHI

Reference Book:

1. Power Generation Operation and Control, Allen J. Wood, Bruce F. Woolenburg

POWER SYSTEM INSTRUMENTATION

PSM 202

L-T-P=4-0-0

Course Outcomes (CO):

Upon successful completion of this course, students should be able :

CO1:TO Differentiate the various types of thermodynamic cycles, Draw block diagram and describe the operation of thermal power plant with auxiliary equipments.

CO2: Clarify the operation of hydro power plants with layout, Select and Governing the water turbines.

CO3: To understand system load variations and get an overview of power system operations.

CO4:To attain knowledge about hydrothermal scheduling.

Mapping of Course Outcomes (CO) and Program Outcomes (PO):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓		✓		✓		✓	✓		
CO2	✓	✓			✓		✓		✓			✓
CO3	✓	✓					✓			✓		✓
CO4	✓	✓			✓			✓		✓		

Course Contents:

Unit I

Introduction: Power generating Station – Thermal, Hydel, Nuclear, Wind – Their functional characteristics as processes, Components of power Grid – interdependency between different blocks, Review of Mechanical, Electrical, Electronics, Thermal, Optical, Pneumatic, fluidics

Unit II

(a) Coal handling plant – coal feed rate measurement, determination of calorific value.

(b) Water treatment

(c) Boiler – Feed water, pressure, temperature, steam flow rate, flue gas analysis, optical pyrometer

(d) Turbine – Speed, shaft eccentricity, temperature

(e) Condenser – pressure, temperature

(f) Generator – Speed, hydrogen leakage

(g) Control and protection systems of a thermal power plant. (h) Thermal power generation from nuclear reactor.

(i) Ash handling and pollution control

Unit III

Hydel Power Plant: Types - flow rate, Water pressure

Wind Power: Principles – synchronization with grids

Transformer: Transformer oil, hot spot, moisture detection,

Transmission Lines: Fibre optics meter for high voltage and high current measurement, Transmission line sag measurement using triangulation technique.

Unit IV

Tariff: Objective, Available based tariff, Digital energy meter, Remote terminal unit (RTU)

Local Dispatch Centre: Data handling – Processing, Logging, Acquisition, Accounting, Display and Storage, SCADA, Techniques of Data acquisition at Central Load Dispatch Centres for coordinated control of the grid.

Computer Control of Power Plant:

IS specification: Introduction, Application and Relevancy of IS specification in perspective of power system instrumentation

Text Book:

1. Modern Power Station Practice – Vol: C, Vol: D, Pergamon Press
2. Principles of Industrial Instrumentation - D Patranabish, TMH, New Delhi

Reference Book:

1. Industrial Instrumentation Control and Automation – S Mukhopadhyay, S.Sen, A. Deb – Jaico Publishing House, Mumbai.
2. B. G. Liptak, Instrument Engineers Handbook, Chilton Book Co. Philadelphia

ADVANCED POWER SYSTEM PROTECTION

PSM 203

L-T-P=4-0-0

Course Outcomes (CO):

Upon successful completion of this course, students should be able :

CO1:TO illustrate concepts of transformer protection.

CO2: familiarize the concepts of Generator protection and Numerical protection.

CO3: To attain knowledge about Distance and Carrier protection in transmission lines.

CO4:To attain a basic knowledge on substation automation.

Mapping of Course Outcomes (CO) and Program Outcomes (PO):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓		✓			✓	✓	✓		
CO2	✓	✓	✓		✓				✓			✓
CO3	✓	✓								✓		✓
CO4	✓	✓			✓			✓		✓		

Course Contents:

Unit I

Introduction: Protective Relays; Basic requirements and type of protection, reviews of relay characteristics and operating equations, protective CTs, PTs, , phase and amplitude comparator, classification of Electromagnetic relays, Plug Setting Multiplier and Time Multiplier setting, Universal Torque Equation, Non Directional Relay, Directional relay, Distant relay, Differential relay.

Unit II

Protection of Alternators: Protection against Stator fault (Phase to Phase and Phase to Ground), Balanced earth fault protection, Stator inter turn protection, Unbalanced loading of Alternator, Prime Mover failure, Overvoltage protection, Overloading (or over current) Protection, Restricted Earth fault and standby earth fault protection, Rotor Fault Protection.

Protection of Transformer: Overcurrent and unrestricted Earth fault protection, Different CT connections, Balanced (Restricted) earth fault protection, Harmonic restraint, Frame leakage protection

Unit III

Bus bar, Feeder, Transmission line Protection: Bus bar Protection: Circulating Current Protection, Frame Leakage Protection. Feeder protection: Time Graded protection, Differential Protection. Transmission Line Protection: Introduction to distance relay, Simple Impedance relay, Reactance relay, Mho relays, comparison of distance relay – Choice between Impedance, Reactance and Mho relay, High speed Impedance relay, setting of distance relays. Pilot Relaying Schemes: Wire Pilot Protection, Carrier Current Protection

Unit IV

Static Relay Introduction: Basic construction of static relays, advantages and disadvantages of Static Relay, different types of static relays (static over current, static time over current, static instantaneous over current, directional static over current, static differential and static distance relay) comparators and associated elements, system switching and transient effects.

Unit V

Protection of High Voltage Capacitor Bank: Including consideration of inrush current, over current and over voltage, and differential protection scheme.

Protection Of large Motors: Differential protection, Earth fault Protection, Thermal overload protection, Starting and Stalling currents and effect of negative Sequence current.

Digital Relay: Introduction, protection philosophy, basic hardware and protection schemes, protection algorithms, and microprocessor based digital relaying

Text Book:

1. A. Chakrabarti,M.L. Soni, P. V. Gupta, U. S. Bhatnagar “A text book on Power System Engineering”, Dhanpat Rai and Co.
2. Paithankar.Y.G and Bhide.S.R, “Fundamentals of Power System Protection”, Prentice-Hall of India.
3. Badri Ram and Vishwakarma.D.N, “Power System Protection and Switchgear”, Tata McGraw- Hill Publishing Company,2002.
4. Arun K. Phadke, James. S. Thorp, “Computer relaying for Power system”, John Wiley and sons, New York, 1998

Reference Book:

1. Power System Protection, PM Anderson, IEEE Press Book
2. Protective Relays Application and Guide, GEC Measurements

3. Jones D., " Analysis and protection of electrical power systems", Pitman Publishing, 1971.
4. "Power system reference manual, Ray rolls protection", Orient press, 1982.
5. Stanley H., Horowitz (ED), "Protective relaying for power system", IEEE press, 1980

POWER SYSTEM TRANSIENTS

PSM 204 (A)

L-T-P=4-0-0

Course Outcomes (CO):

Upon successful completion of this course, students should be able :

CO1: To Explain the concept of transients and Compute the solution of transient current equation for RL and RLC system.

CO2: To Apply the concept of reflection and refraction, Draw the Bewley Lattice diagram for different systems.

CO3: To Illustrate the importance of switching transients, Explain the concept of resistance switching, load switching and capacitance switching.

CO4: To analyze the concept of short line (or) Kilometric fault and justify the EMTP for transient computation.

Mapping of Course Outcomes (CO) and Program Outcomes (PO):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓	✓	✓		✓		✓	✓	✓	
CO2	✓	✓	✓		✓	✓	✓		✓		✓	✓
CO3	✓	✓	✓				✓			✓	✓	✓
CO4	✓	✓			✓	✓	✓	✓		✓	✓	

Course Contents:

Unit I

Introduction and survey: Review of various types of power system transients – effect of transients on power systems –relevance of the study and computation of power system transients

Unit II

Lighting surges: Electrification of thunderclouds – lightning current surges – lightning current parameters and their values – stroke to tower and midspan – induced lightning surges

Switching surges: Closing and reclosing of lines – load rejection – fault initiation – fault clearing – short line faults – Ferro –resonance – isolator switching surges – temporary over voltages – surge on an integrated system – switching – harmonics.

Unit III

Computation of transient in conversion equipment: Travelling wave method – Beweley's Lattice diagram – analysis in time and frequency domain – eigen value approach – Z-transform – EMTP software

Unit IV

Insulation coordination: Over voltage protective devices – shielding wires, rods gaps and surge diverters, principles of insulation co ordination-recent advancements in insulation co ordination – design of EHV system.

Text Book:

1. Allan Greenwood, Electrical transients in Power Systems, Wiley Interscience, New York, 1971.
2. Klaus Ragaller, Surges in High Voltage Networks, Plenum Press, New York, 1980.
3. Diesendrof W., Over Voltages On High Voltage Systems, Renselaer Bookstore, Troy New York, 1971.

Reference Book:

1. Peterson H.A., transients in power systems, Dover Publications, New York, 1963.
2. Rakosh Das Begamudre, Extra High VoltageAC Transmission Engineering, Wiley Estern Itd, New Delhi, 1990

FLEXIBLE AC TRANSMISSION SYSTEM

PSM 204 (B)

L-T-P=4-0-0

Course Outcomes (CO):

Upon successful completion of this course, students should be able :

CO1: To explain the reactive power control in electrical power transmission lines and the importance of FACTS devices.

CO2: To understand the need for control of Real and Reactive power flows.

CO3: To Outline the operation, modeling and applications of TCSC

CO4: To Evaluate the performance and stability of power systems with FACTS controllers**.**

Mapping of Course Outcomes (CO) and Program Outcomes (PO):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓		✓	✓		✓			✓		
CO2	✓	✓			✓		✓				✓	
CO3	✓	✓					✓			✓	✓	
CO4	✓	✓			✓		✓			✓		

Course Contents:

Unit I

Introduction: FACTS – a toolkit, basic concepts of static VAR compensator, Resonance Damper, thyristor controlled series capacitor, static condenser, phase angle regulator and other controllers.

Unit II

Series compensation schemes: Sub-synchronous resonance, torsional interaction, torsional torque, compensation of conventional, ASC, NGH damping schemes, modeling and control of thyristor controlled series compensators.

Unit III

Unified power flow control: Introduction, Implementation of power flow control using conventional thyristors, Unified power flow concept, Implementation of unified power flow controller. Phasor Monitoring Units; Power System Control using Synchrophasors.

Unit IV

Design of facts controllers: Approximate multi-model decomposition, variable structure FACTS controllers for power system transient stability, non-linear variable-structure control, variable structure series capacitor control and variable structure resistor control.

Unit V

Static var compensation: Basic concepts, thyristor controlled reactor(TCR), Thyristor Switched Reactor(TSR), Thyristor Switched capacitor(TSC), saturated reactor(SR), fixed capacitor(FC).

Text Book:

1. Narin G. Hingorani, Flexible AC transmission, IEEE Spectrum, April 1993, pp40-45
2. Narin G. Hingorani, High Power Electronics and flexible Ac Transmission systems, IEEE High Power Engineering Reiview, 1998.

Reference Book:

1. Gyugyi L., Unified Power Flow Control Concept For Flexible Ac Transmission, IEEE Proc-C Vol.-139, No.-4 July, 1992

ADVANCED ELECTRICAL DRIVES

PSM 204 (C)

L-T-P=4-0-0

Course Outcomes (CO):

Upon successful completion of this course, students should be able :

CO1: To explain Power devices and Motor Drive.

CO2: To understand Speed control of Induction motor (IM) drives, Vector control of IM, Direct torque control (DTC) of induction motor drives.

CO3: To apply their knowledge to prepare control schemes as per different types of motors used in industries.

CO4: To estimate & solve harmonic and power factor related problems in controlling AC and DC drives.

Mapping of Course Outcomes (CO) and Program Outcomes (PO):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓		✓	✓		✓			✓	✓	
CO2	✓	✓		✓	✓		✓				✓	✓
CO3	✓	✓		✓			✓					✓
CO4	✓	✓		✓	✓		✓	✓		✓		

Course Contents:

Unit I

Power devices and Motor Drive: An introduction to modern electrical drives, Power devices and their switching , Electric machines, Power converters , controllers and load

Unit II

Reference frame theory and transformation: Three phase transformation, abc-axis to dq-axis transformation, space vector and transformation

Unit III

Modeling and Control of DC Machines: Electromechanical modelling, state-space modeling Block diagram and transfer function, Control of separately excited dc motor drives for Inner current loop and speed control design

Unit IV

Speed control of Induction motor (IM) drives: V/f control, dq0 model and state space model of three phase IM, Vector control of IM, Direct torque control (DTC) of induction motor drives, Comparison of DTC and Vector control

Unit V

Brushless DC motor drives and an introduction to Microcontroller based control of electrical drives: Brushless DC motor drives, Introduction of Microcontroller and DSP based control of electrical drives and some industrial applications

Text Book:

1. B.K. Bose: Modern Power Electronics and AC Drives, 1st Edition, Pearson, 2002

Reference Book:

1. R. Krishanan: Electric Motor Drives Mode

ADVANCED CONTROL SYSTEM

PSM 205 (A)

L-T-P=4-0-0

Course Outcomes (CO):

Upon successful completion of this course, students should be able :

CO1: To Develop mathematical models of physical systems.

CO2: To represent the time-invariant systems in state space form as well as analyze, whether the system is stabilizable, controllable, observable and detectable**.**

CO3: To Use the techniques such as describing function, Lyapunov Stability, Popov's Stability Criterion and Circle Criterion to assess the stability of certain class of non-linear system.

CO4: To Design complex nonlinear systems with linearization**.**

Mapping of Course Outcomes (CO) and Program Outcomes (PO):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓		✓			✓			✓	✓	
CO2	✓	✓	✓	✓			✓	✓			✓	✓
CO3	✓	✓	✓	✓			✓		✓			✓
CO4	✓	✓		✓			✓	✓		✓		

Course Contents:

Unit I

Overview of Control Systems: LTI Motion Control System; Temperature & Voltage Regulators; Modeling of Servo-motors, Hydraulic & pneumatic actuators. Computation of Relative stability using Bode plot and Nyquist method. Hierachical Control Of Power System; System Control; Load scheduler and Optimiser; Real Reactive power Flow Control; AVR and Turbine Speed governor set points

Unit II

Control System Performance: Improvement of System Performance through Compensation; Design of lag; Lead and Lag load Compensators; PI, PD & PID control; PID Controller Design and tuning; Disturbance rejection; System Uncertainty and performance Robustness.

Unit III

Analysis in state space: State model for SISO & MIMO Systems; State Diagram; Solution of state equation; State Transformations; Jacobian Linearization Technique; Stability; Controllability & Observability; Perspective on State-Space design; Full-State Feedback Design of continuous time control system; Full Order observer System**.**

Unit IV

Digital Control system: Configuration of Digital Control System; Supervisory Control; Direct digital control; Single-Loop Digital controllers; Sampling Process; Sampling theorem; Data reconstruction; Digital transfer function & System response; Stability Tests ; Mapping between s-plane & z-plane; Bilinear transformation; Error constants; Pole assignment design based on full state feedback; Compensator design in w-plane using Bode plot

Unit V

Common non-linearities ; Methods of Analysis; Linearization; Phase Plane method; Describing function Analysis; Limit Cycles; Relay with dead-zone and hysteresis; Stability analysis by Lyapunov's methods

Optimal Control: Characteristics of optimal control problems; Linear optimal Control with quadratic performance index; Selection of performance measure; State and Output regulators; Optimal state regulator problem with matrix Ricatti equation

Text Book:

1. Ogata, k – modern control engineering, p.h learning.
2. Kuo, b.c – automatic control systems, prentic hall.

Reference Book:

1. Gopal, m – digital control and state variable methods, tata mcgraw –hill.

MODELING AND SIMULATION OF DYNAMIC SYSTEMS

PSM 205 (B)

L-T-P=4-0-0

Course Outcomes (CO):

Upon successful completion of this course, students should be able :

CO1: To Develop mathematical models of physical systems.

CO2: To represent the time-invariant systems in state space form as well as analyze, whether the system is stabilizable, controllable, observable and detectable**.**

CO3: To Use the techniques such as feedback control, industrial regulation, feed forward control.

CO4: To use Sensor modeling techniques , application of Finite Element method.

Mapping of Course Outcomes (CO) and Program Outcomes (PO):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓		✓			✓					
CO2	✓	✓	✓	✓			✓					
CO3	✓	✓	✓	✓			✓					
CO4	✓	✓		✓			✓					

Course Contents:

Unit I

Introduction, State space representation of systems of different kind.Simulation of the state model.Describing equations and different kinds of models.Eigen values and vectors, Similarity X'formation, invariants.Stability, controllability, observability, Leverrier's algorithm. Linearization of nonlinear systems

Unit II

Theorem on feedback control, pole placement controller. Full order and reduced order observer design. Theory of industrial regulation, feed forward control. Application - motor speed control with disturbance rejection.

Unit III

Heat flow in one dimension, finite element method. Modeling and simulation through bond graphs. Qualitative reasoning: M & S with Incomplete Knowledge

Unit IV

Sensor modeling: Lumped parameter and distributed parameter models, Thick and thin film models. Numerical modeling techniques, model equations, application of Finite Element method. Different effects on modeling - temperature, radiation, mechanical, chemical, magnetic, electrical (e.g. capacitive, resistive, piezo-resistive, frequency, etc.). Examples of modeling: micro-modeling of photodiodes, magnetic, capacitive, mechanical sensors.

Text Book:

1. D M Wiberg State Space and Linear Systems Schaum's Outline Series McGraw Hill 1971
2. 2. W B J Zimmerman Process Modeling and Simulation with Finite Element Methods Univ. of Sheffield UK 2004

Reference Book:

1. Thomas Kailath Linear Systems Prentice Hall 1980
2. M Gopal Modern Control System Theory Wiley Eastern 1984

ADVANCED MICROPROCESSOR AND MICROCONTROLLER

PSM 205 (C)

L-T-P=4-0-0

Course Outcomes (CO):

Upon successful completion of this course, students should be able :

CO1: Through this course, the students will be exposed to hardware details of 8085 microprocessor with the related signals and their implications.

CO2: To Analyze the architecture of various Interfacing Devices like 8255 PPI, 8259 PIC, ADC and DAC and Programming of all the Interfacing IC's.

CO3: To Microprocessor based Voltage, Current, Power and Speed measurement.

CO4: To Microcontroller Architecture, Organization and Programming Techniques.

Mapping of Course Outcomes (CO) and Program Outcomes (PO):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓		✓			✓					
CO2	✓	✓		✓			✓	✓	✓			
CO3	✓	✓	✓	✓			✓		✓			
CO4	✓	✓	✓	✓			✓	✓				

Course Contents:

Unit I

Introduction: Review of Intel 8085 and 8086 – Architecture and Organization

Components and functions: Execution Unit, Bus Interface Unit, Registers, Minimum and Maximum Mode of Operation, Bus Arbiter, Interrupt Structure, Interrup Vector Table, I/O Ports, Experimental identification of Ports and Pins.

Unit II

Peripheral devices: PPI 8255, Mode 0, Mode 1, Mode 2 and BSR Mode. Interrupt Controller, DMA Controller, ADC, DAC

Development of waveforms: Square, Triangular, Ramp, Staircase, Sine wave.

Relays: Microprocessor based Electromagnetic Relays, IDMT, Differential Relay.

Unit III

Instrumentation & protection (smart grid): Microprocessor based Voltage, Current, Power and Speed measurement, Frequency Monitoring, Overvoltage, Undervoltage, Overcurrent and Undercurrent protection, Speed Control of Motors, Traffic Light Controller, Washing Machine Controller

Unit IV

Microcontroller: Architecture, Organization and Programming Techniques

Text Book:

1. A. K. Mukhopadhyay - Microprocessor, Microcontroller and their Applications, Narosa Publishing / Alpha Publication, Oxford University
2. Microprocessor and Microcontroller – Gaonkar

Reference Book:

1. A. K. Mukhopadhyay – Microprocessor based Laboratory experiments and Projects, I. K. International

BASICS OF PEDAGOGY AND ACADEMIC MANAGEMENT

EMM 301

L-T-P=4-0-0

Course Outcomes (CO):

Upon successful completion of this course, students should be able :

CO1: To Use the collaborative learning into a course in a way that aligns with students learning objectives and intended outcomes.

CO2: Develop knowledge, Understanding and an insight of the various underlying concepts of research.

CO3: To understand Research designs , tools and techniques of gathering data.

CO4: To understand Academic Institution Management, Quality-concept-deciphering, PERT, CPM – SWOT Analysis.

Mapping of Course Outcomes (CO) and Program Outcomes (PO):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓			✓			✓		✓		✓	
CO2	✓			✓			✓	✓	✓	✓	✓	
CO3	✓		✓	✓			✓		✓	✓	✓	
CO4	✓		✓	✓			✓	✓	✓		✓	✓

Course Contents:

Unit I

Fundamentals of Pedagogy - Psychology of learning – Introduction – Theories of Learning – Memory and Forgetting – Personality and Attitude – student Motivation.

Class room management - Effective Classroom Communication - Classroom Motivation principles and techniques - Techniques of Class room management.

Student evaluation - Principles of evaluation - Tools and techniques of evaluation - Statistical analysis of evaluation process.

Student feedback - Tools and techniques - Evaluation of teacher performance

Unit II

Research methodology and tools - Definition of research and research methodology - objectives and types research - criteria of a good research.

Data collection – primary data (questionnaire, interview, etc.) and secondary data (case study, journals, etc.) – sampling - census and sample survey - need for sampling - characteristics of a good sample - criteria of selecting sampling procedure - different types of sample design

Data analysis - frequency distribution - measures of central tendency - correlation and regression (concepts only) Research proposal - selection of topic - literature survey - development of hypothesis - hypothesis testing (concepts only)

Report writing - Interpretation and report writing – techniques of interpretation - significance of report writing - different steps in report writing and format for report writing.

Plagiarism in research.

Unit III

Intellectual Property Right and Patent Laws in India

What is intellectual property - importance of IPR. Patent -types of patents - patentable inventions - what is not patentable - application and registration of patents - who can apply - rights and duties of patentee - infringement and remedies.

Copyright - coverage provided by copyright - Transfer of copyright - Infringement of copyright

Trademark - Well-known trademarks and associated trademarks - Service marks - Certification Trademarks. R & D activities in educational institutes – IPR and patent issues

Unit IV

Academic Institution Management - Organisation - Types- structure-Institution as an organization

Institutional process - objectives - purpose - responsibilities

Management - fuctions - skills - motivational theories- communication- types- nature-importance-channel richness - how to increase effectiveness of organisational communication. Transparency in academic institutions. Quality-concept-deciphering quality aspect of different products, services as also that of educational system and institution. Quality improvement in institutional activities - identification of potential areas. Washington Accords – goal – salient features – implications Customer – different classes - orientation – satisfaction of stake holders Basics of project management - concept - types - life - cycle - phases - feasibility - viability - cost benefit analysis – PERT and CPM – SWOT Analysis -dimensions of educational projects – case studies

Text Book:

1. Rao and Reddy - Learning & Teaching, , Commonwealth Publishers, New Delhi, 1992
2. Chauhan S S - Advanced Educational Psychology, Vikas Publishing House Pvt. Ltd, 2002
3. Cooper J.M.(Ed) - Classroom Teaching Practice, D.C.Heath and Co
4. Romiszwoski A J - Designing Instructional Systems, Kogan Page
5. Gronlund N E - Measurement and Evaluation in Teaching, Macmillan Publishing Co., New York, 1981
6. Kulkarni M V - Research Methodology, EPH
7. Das N G – Statistical Methods (Vol I and II), M Das and Co.

8. Natarajan, S - Introduction to Economics of Education, Sterling Publishers, New Delhi
9. Rao Usha – Education Technology, Himalaya Publishing House, Delhi.
10. Hirwade and Hirwade – Fundamentals of Intellectual Property Right, Himalaya Publishing House, Delhi.
11. Pandya S R – Administration and Management of Education, Himalaya Publishing House, Delhi.
12. Chary S N – Production and Operations Management, TMH

Reference Book:

1. Saylor A. and Lewis H - Curriculum Planning for Better Teaching & Learning, Rinehart & Winston, Inc., 1981.
2. Beard I. J. and Senior I. J. - Motivating Students, Routledge & Kegan Paul Ltd, 1980.
3. Barnard H C - An Introduction to Teaching, University of London Press Ltd., London, 1965
4. Bigge M L - Learning Theories for Teachers, Harper & Row, Publication, New York, Second edition, 1971
5. Heywood J - Pitfalls and Planning in Student Teaching, Kogan Page
6. Reay G D - Selecting Training Methods, Kogan Page Ltd., London, 1994
7. Lorin W A - The Effective Teacher, McGraw-Hill Book Company, 1981.
8. Brown G - Lecturing & Explaining, Methuen & Co.
9. Cohen L and Manion L - A Guide to Teaching Practice, Methuen & Co
10. Romiszwoski A J - Producing Instructional Systems, Kogan Page
11. Betrand A and Cebula J P - Tests, Measurement and Evaluation – A
12. Taylor B, Sinha G and Ghoshal T - Research Methodology, Prentice Hall of India.
13. Chakraborty S K – Business Statistics New Age International Publishing.
14. Trochim W M K – Research Methods, Biztantra
15. Sallis E - Total Quality Management in Education, Kogan page, London,1996.
16. Bulchandani K R -: Business Law, Himalaya Publishing.
17. Gopalkrishnan and Ramamoorthy - Text Book of Project Management; McMillan
18. Chandra, P – Projects, TMH, 6th Edition.

NON CONVENTIONAL ENERGY

PSM 301 (A)

L-T-P=4-0-0

Course Outcomes (CO):

Upon successful completion of this course, students should be able :

CO1: To identify various renewable energy resources available for power generation

CO2: Conceptual knowledge of the technology, economics and regulation related issues associated with wind and solar energy.

CO3: To Advocacy of strategic and policy recommendations on usage of wind, solar energy and Bio-mass energy.

CO4: To conceptualize operation of renewable sources in standalone mode and grid connected mode.

Mapping of Course Outcomes (CO) and Program Outcomes (PO):

Course Outcome	**Program Outcomes**											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	√	√	√	√	√							
CO2	√	√		√	√							
CO3	√	√	√	√	√							
CO4	√	√		√	√							

Course Contents:

Unit I

Introduction to solar energy: Recent trends in energy consumption – World energy scenario – Energy sources and their availability – Need to develop new energy technologies – Solar radiation and measurement – Solar cells and their characteristics – Electrical storage with batteries – Production and transfer of solar energy – Sun-Earth angles – Availability and limitations of solar energy – Measuring techniques and estimation of solar radiation – Solar thermal collectors – General description and characteristics – Flat plate collectors –Short term and long term collector performance – Solar concentrators – Design, analysis and performance evaluation. – Analysis of PV systems

Unit II

Wind energy conversion system: Basic principle of wind energy conversion – nature of wind – Wind survey in India Site selection considerations– Power in the wind –components of a wind

energy conversion system -Types of wind power conversion systems – Wind data analysis, tabulation, Wind resource estimation, Betz's Limit, Turbulence Analysis Performance of Induction Generators for WECS – Classification of WECS.

Unit III

Bio-mass energy: Biomass: Generation and utilization, Properties of biomass, Agriculture Crop & Forestry residues used as fuels. Biochemical and Thermo-chemical Conversion, Combustion, Gasification, Biomass gasifiers and types etc. Concept of Bio-energy: Photosynthesis process, Biomass resources Bio based chemicals and materials Thermo-chemical Conversion: Pyrolysis, Combustion, Gasification, Liquification. Bio-Chemical Conversion: Aerobic and Anaerobic conversion, Fermentation etc.

Bio-fuels: Types of Bio-fuels, Bio fuel applications, Ethanol as a fuel for I.C. engines, Importance of biogas technology,

Different Types of Biogas Plants. Aerobic and anaerobic bioconversion processes, various substrates used to produce Biogas. Removal of CO2 and H2O, Bio-hydrogen production

Unit IV

Geothermal, tide and wave energy: Availability of Geothermal Energy-size and Distribution, Recovery of Geothermal Energy, Various Types of Systems to use Geothermal Energy, Direct heat applications, Power Generation using Geothermal Heat, Sustainability of Geothermal Source, Status of Geothermal Technology, Economics of Geothermal Energy.

Unit V

Power conditioning converters: DC Power conditioning converters – Maximum Power point tracking algorithms – AC power conditioners – Line commutated inverters – synchronized operation with grid supply – Harmonic problem

Text Book:

1. B. Reddy, McGraw Hill Book Company, N.Y. 2002
2. Rai G.D., "Non – Conventional Energy Sources", Khanna Publishers, 1993.
3. Rai G.D., "Solar Energy Utilisation", Khanna Publishers, 1993.
4. Gary L. Johnson, "Wind Energy Systems", Prentice Hall Inc., 1985.

Reference Book:

1. Eastop T.D & Croft D.R, Energy Efficiency for Engineers and Technologists,. Logman Scientific & Technical, ISBN- 0-582-03184, 1990.
2. D. Yogi Goswami, Frank Kreith, Jan. F. Kreider, "Principles of Solar Engineering", 2nd Edition, Taylor & Francis, 2000, Indian reprint, 2003
3. Chakraverthy A, "Biotechnology and Alternative Technologies for Utilization of Biomass or Agricultural Wastes", Oxford & IBH publishing Co, 1989.
4. Shah, Kanti L., Basics of Solid & Hazardous Waste Management Technology, Printice Hall, 2000.
5. Hand Book of Batteries and Fuel cells, 3rd Edition, Edited by David Linden.

POWER SYSTEM HARMONICS

PSM 301 (B)

L-T-P=4-0-0

Course Outcomes (CO):

Upon successful completion of this course, students should be able :

CO1: To identify various renewable energy resources available for power generation
CO2: To identify various Types of harmonic sources in various machines.
CO3: To understand various effects of Harmonic Distortion in Power Systems and on consumer equipments.

CO4: Apply the various methods of firing and harmonic reduction techniques.

Mapping of Course Outcomes (CO) and Program Outcomes (PO):

Course Outcome	**Program Outcomes**											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	√	√	√	√	√							
CO2	√	√		√	√							
CO3	√	√	√	√	√							
CO4	√	√		√	√							

Course Contents:

Unit I

Harmonic Analysis: Representation of harmonics, Fourier series and Coefficients, odd, even and half wave symmetry, phase sequence. Measures of harmonic distortion: voltage and current distortion factors, active and reactive power, apparent power, distortion power, power factor, current and voltage crest factors. Power in passive elements: power in a pure resistance, power in a pure inductance and power in a pure capacitance. Series and parallel resonance

Unit II

Harmonic Sources: Types of harmonic sources, Harmonic in transformers, normal excitation characteristics, determination of current waveshape in transformers, inrush current harmonics in transformers, Harmonic in rotating machines: mmf distribution of ac windings, slot harmonics, voltage harmonics produced by synchronous machines, rotor saliency effects, voltage harmonics produced by induction motors. Distortion caused by arcing devices: Electric arc furnaces and discharge type lighting. Distortion caused by dc power supplies.

Unit III

Effects of Harmonic Distortion in Power Systems: Thermal losses in harmonic environment: Copper losses, iron losses, dielectric losses. Harmonic amplification in capacitor banks. Effects of harmonics in transformers. Effects of harmonics in rotating machines: induced emf, chorded windings, distributed winding, winding factor. Harmonic interference with power system protection: harmonic problems during fault conditions. Effects of harmonics on consumer equipment. Interference with Communications

Unit IV

Limits of Harmonic Distortion: Voltage harmonic distortion limits: IEEE limits, IEC limits EN limits and NORSOK limit. Current harmonic distortion limits: IEEE limits IEC limits and NORSOK limits

Unit V

Elimination of Power System Harmonics

Passive filters: Tuned filters and damped filters

Active filters: Series and parallel connection of active filters

Role of power converters, transformers, rotating machines and capacitor banks in reduction of harmonics. Harmonic filter design: Series tuned filters and second order damped filters

Text Book:

1. "Power System Harmonics" by J. Arrillaga and N. R. Watson, Wiley

Reference Book:

1. "Power Systems Harmonics" by George J. Wakileh, Springer

ENERGY MANAGEMENT & AUDIT

PSM 301 (C)

L-T-P=4-0-0

Course Outcomes (CO):

Upon successful completion of this course, students should be able :

CO1: To Understand the need and significance of energy audit and management.
CO2: Identify the equipment and domain of energy conservation and audit in power system.
CO3: To know the concepts of metering and factors influencing cost function.

CO4: Learners will learn about basic concepts of economic analysis and load management.

Mapping of Course Outcomes (CO) and Program Outcomes (PO):

Course Outcome	**Program Outcomes**											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	√	√	√	√	√							
CO2	√	√		√	√							
CO3	√	√	√	√	√							
CO4	√	√		√	√							

Course Contents:

Unit I

Introduction: Energy Scenario – global, sub continental and Indian, Energy economy relation, Future energy demand and supply scenario, Integrated energy planning with particular reference to Industrial Sector in India, Captive power units and others – demand v/s supply

Unit II

Types of Energy: Physical Aspects of Energy: Classification of energy – Hydel, Thermal, Nuclear, Wind, & from Waste Products. Efficiency and effectiveness of energy utilization in Industry. Energy and energy analysis. Renewable and non- renewable energy, Conventional and unconventional energy

Unit III

Demand Side Management:
Energy Demand Management:
Energy utilization, Instrumentation and data analysis, Financial aspects of energy management, Energy management as a separate function and its place in plant management hierarchy.
Energy Planning, Energy Staffing, Energy Organization, Energy Requirement. Energy Costing, Energy Budgeting, Energy Monitoring, Energy Consciousness, Energy Conversions, Energy

Efficient Equipment, Energy Management Professionals, Environment Pollution due to Energy Use, Components of Pollution, Harmful Effects of Pollution, Measures taken to combat Pollution.

Unit IV

Energy Audit and Energy Saving: Energy Audit and analysis, Energy load measurements, System evaluation and simulation, Energy saving techniques and guidelines: Administrative control, Proper Measurement and monitoring system, Process control, proper planning & scheduling, Increasing capacity utilization, Improving equipment control, waste heat recovery, Change of energy source. Upgradation of Technology. Change of product specifications, Use of High efficiency equipment, Design modification for better efficiency, Improved periodic maintenance

Unit V

Energy Control Centers: Remote Telemetry; Remote Terminal Units; IEC TC 57 (870-5-1) Protocol Standard; Data Acquisition Procedure; Data Handling and Organization; Real Time Database; Alarm and Events; Disturbance Processing; Fault Locating Technology; Real Time Display; MIMIC Boards; Supervisory Remote Control; Load Dispatch Control Centers; Distribution Control Centers; Time Keeping Systems

Unit VI

Integration of Distributed and Renewable Energy Systems to Power Grids: DC-to-AC Converters; AC-to-AC Converters; DC-to-DC Converters; Plug-In Hybrid Electric Vehicles; Energy Storage Technologies; Micro grids

Unit VII

Legal Provisions: The Prevention and Control of Pollution Act, 1974, The Energy Conservation Act, 2001, The Environmental Protection Act, 1986. The Electricity Act, 2003. National Electricity Policy. Rural Electrification

Text Book:

1. Paul W., O'callaghan; "Energy Management", McGraw Hill Book Company
2. Steve Doty, Wayne C. Turner; "*Energy Management Handbook"*, Fairmont Press. Inc., GA 30047
3. Barny L. Capehart, Wainey C. Turner, William J. Kennedy; "*Guide to Energy Management*", Fairmont Press Inc., GA 30047

Reference Book:

1. Handbook of Energy Engineering, Albert Thumann & Paul Mehta, The Fairmont Press, INC.
2. NPC energy audit manual and reports