JALPAIGURI GOVERNMENT ENGINEERING COLLEGE
JALPAIGURI- 735 102
(An Autonomous Government College)

COURSE STRUCTURE AND SYLLABUS

FOR
M.TECH. IN ELECTRICAL ENGINEERING
(POWER ELECTRONICS AND DRIVES)

(Implemented from the Academic Year 2013-14 -for the new batch only)

Phone: 03561 – 255131 (Principal), Fax: 03561 – 256143

255465 (EPABX)- 105(EE)

www.jgec.org

First Semester

Sl. No.	Field	Theory	Contact Hours/Week				Credits
			L	T	P	Total	
A. THEORY							
01	EMM-101	Advanced Engineering Mathematics	3	1	0	4	04
02	PEM-101	Power Electronics- I	3	1	0	4	04
03	PEM-102	Electrical Machine Analysis	3	1	0	4	04
04	PEM-103	Elective-I	3	1	0	4	04
05	PEM-104	Elective- II (Management)	4	0	0	4	04
Total of Theory			16	04	00	20	20
06	PEM-151	Research Methodology(Optional)	4	0	0	4	04
B. PRACTICAL							
01	PEM-191	Electrical Engineering -I Laboratory	0	0	9	9	06
Total of Practical			00	00	09	09	06
C. SESSIONAL							
Total of Sessional			00	00	00	00	00
Total of Semester			16	04	09	29	26

Second Semester

Sl. No.	Field	Theory	Contact Hours/Week				Credits
			L	T	P	Total	
A. THEORY							
01	PEM-201	Power Electronics- II	3	1	0	4	04
02	PEM-202	Electric Drives	3	1	0	4	04
03	Any three subjects to be chosen from the following pool of Electives	Elective-III	4	0	0	4	04
04		Elective-IV	4	0	0	4	04
05		Elective- V	4	0	0	4	04
Total of Theory			18	02	00	20	20
06	PEM-251	Research Methodology(Optional)	4	0	0	4	04
B. PRACTICAL							
01	PEM-291	Electrical Engineering -II Laboratory	0	0	3	3	02
Total of Practical			00	00	03	03	02
C. SESSIONAL							
01	PEM-281	Seminar	0	0	6	6	04
02	PEM-282	Viva-Voce	0	0	0	0	04
Total of Sessional			00	00	06	06	08
Total of Semester			18	02	09	29	30

Third Semester

A. THEORY							
Sl. No.	Field	Theory	Contact Hours/Week				Credits
			L	T	P	Total	
Total of Theory			00	00	00	00	00
B. PRACTICAL							
Total of Practical			00	00	00	00	00
C. SESSIONAL							
01	PEM-381	Pre-submission Defense of Dissertation	0	0	0	0	06
02	PEM-382	Dissertation (Part-I)	0	0	18	18	12
03	PEM-383	Classroom Teaching Practice	0	0	6	6	4
Total of Sessional			00	00	24	24	22
Total of Semester			00	00	24	24	22

Fourth Semester

A. THEORY							
Sl. No.	Field	Theory	Contact Hours/Week				Credits
			L	T	P	Total	
Total of Theory			00	00	00	00	00
B. PRACTICAL							
Total of Practical			00	00	00	00	00
C. SESSIONAL							
01	PEM-481	Post-submission Defense of Dissertation	0	0	0	0	04
02	PEM-482	Dissertation (Completion)	0	0	24	24	18
Total of Sessional			00	00	24	24	22
Total of Semester			00	00	24	24	22

List of Elective Subjects

PEM-103: Elective-I:

(a) Advanced Control Systems, (b)AI & Soft Computing (c)Optimization Technique (d) Soft Computing in Electrical Engg.

PEM-104- Elective-II: (a) Energy Management & Audit (b) Power Quality Management (c) Industrial Management

Elective-III/IV/V: (Any three subjects to be chosen from the following pool of Electives.)

PEM- 203 Generation of Non conventional Energy 4-0-0-4-4:
PEM -204 Advanced Mathematics-II 4-0-0-4-4:
PEM- 205 Intelligent Control of Drives4-0-0-4-4:
PEM -206 Solid State Power Controller 4-0-0-4-4:
PEM -207 Digital Signal Processing 4-0-0-4-4:
PEM -208 FACT & HVDC Transmission 4-0-0-4-4:
PEM -209 Microcontroller Based System Design 4-0-0-4-4:
PEM -210 Flexible AC Transmission Systems 4-0-0-4-4:
PEM -211 Nonlinear Phenomena in Switching Circuit 4-0-0-4-4:
PEM -212 Special Electrical machines4-0-0-4-4:
PEM -213 Embedded system 4-0-0-4-4:
PEM -214 Digital Image Processing 4-0-0-4-4:
PEM -215 Advanced Power Electronics 4-0-0-4-4:
PEM- 216 Advanced Electric Drives 4-0-0-4-4:
PEM- 217 Application of Power Electronics in Power System 4-0-0-4-4:
PEM-218 Pulse width Modulation for Power Electronic Converters 4-0-0-4-4:
PEM-219 Power Electronics and Distributed Generation 4-0-04-4:
PEM-220 Modeling and Simulation of Systems Using MATLAB and Simulink 4-0-0-4-4:
PEM-221 Modeling and Control of Wind Energy Generation 4-0-0-4-4:

PEM-222 Nonlinear Dynamics and Chaos 4-0-0-4-4
PEM-223 Artificial Neural Network 4-0-0-4-4
PEM-224 Soft Computing4-0-0-4-4
PEM-225 Research Methodologyand Computer Applications4-0-0-4-4

Code	Sub.	Contact Hrs./Week		Code	Sub.	Contact Hrs./Week	
		L –T-P-T	Cr.			L –T-P-T	Cr.
EMM-101	Advanced Engineering Mathematics	3-1-0-4	4	PEM-201	Power Electronics- II	3-1-0-4	4
PEM-101	Power Electronics- I	3-1-0-4	4	PEM-202	Electric Drives	3-1-0-4	4
PEM-102	Electrical Machine Analysis	3-1-0-4	4	Any three subjects to be chosen from the following pool of Electives	Elective-III	4-0-0-4	4
PEM-103	Elective-I	3-1-0-4	4		Elective-IV	4-0-0-4	4
PEM-104	Elective- II (Management)	4-0-0-4	4		Elective- V	4-0-0-4	4
PEM-191	Electrical Engineering Laboratory -I	0-0-9-9	6	PEM-291	Electrical Engineering Laboratory -II	0-0-6-6	4
				PEM-281	Seminar	0-0-3-3	2
				PEM-282	Comprehensive Viva-Voce	0-0-0-0	4
		16-4-9-29	26			18-2-9-29	30
PEM-381	Pre-submission Defense of Dissertation	0-0-0-0	6	PEM-481	Post submission defense of dissertation	0-0-0-0	4
PEM-382	Dissertation (Part-I)	0-0-18-18	12	PEM-482	Dissertation (Completion)	0-0-24-24	18
PEM-383	Classroom Teaching Practice	0-0-6-6	4				
		0-0-24-24	22			0-0-24-24	22

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PEM-103: Elective-I:
(a) Advanced Control Systems, (b) AI & Soft Computing (c)Optimization Technique (d)Soft Computing in Electrical Engg.
PEM-104- Elective-II:
(a) Energy Management & Audit (b) Power Quality Management (c) Industrial Management
Elective-III/IV/V: (Any three subjects to be chosen from the following pool of Electives.)
PEM- 203 Generation of Non conventional Energy 4-0-0-4-4:
PEM -204 Advanced Mathematics-II 4-0-0-4-4:
PEM- 205 Intelligent Control of Drives4-0-0-4-4:
PEM -206 Solid State Power Controller 4-0-0-4-4:
PEM -207 Digital Signal Processing 4-0-0-4-4:
PEM -208 FACT & HVDC Transmission 4-0-0-4-4:
PEM -209 Microcontroller Based System Design 4-0-0-4-4:
PEM -210 Flexible AC Transmission Systems 4-0-0-4-4:
PEM -211 Nonlinear Phenomena in Switching Circuit 4-0-0-4-4:
PEM -212 Special Electrical machines4-0-0-4-4:
PEM -213 Embedded system 4-0-0-4-4:
PEM -214 Digital Image Processing 4-0-0-4-4:
PEM -215 Advanced Power Electronics 4-0-0-4-4:
PEM- 216 Advanced Electric Drives 4-0-0-4-4:
PEM- 217 Application of Power Electronics in Power System 4-0-0-4-4:
PEM-218 Pulse width Modulation for Power Electronic Converters 4-0-0-4-4:
PEM-219 Power Electronics and Distributed Generation 4-0-04-4:

PEM-220 Modeling and Simulation of Systems Using MATLAB and Simulink 4-0-0-4-4:
PEM-221 Modeling and Control of Wind Energy Generation 4-0-0-4-4:
PEM-222 Nonlinear Dynamics and Chaos 4-0-0-4-4:
PEM-223 Artificial Neural Network 4-0-0-4-4
PEM-224 Soft Computing 4-0-0-4-4
PEM-225 Research Methodology 4-0-0-4-4

Detailed Syllabus for M Tech On Power Electronics and Drives

1st Semester:

EMM -101 Advanced Engineering Mathematics 3-1-0-4-4:

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.
Numerical methods: Interpolation by polynomials, Error analysis, Solution of system of linear algebraic equations by Direct Methods (Gauss-Elimination method, LU decomposition method, Thomas Algorithm for Tridiagonal system)and Iterative Methods(Gauss-Jacobi iterative Methods, Gauss- Seidel iterative methods, Successive over–Relaxation Method),Solution of Nonlinear System of equations by Newton-Raphson method , Determination of largest eigenvalue in modulus and the corresponding eigenvector by Power method ,Numerical Integration by Gauss-quadrature, Numerical solution of Partial differential Equations.
Calculus of Variation: Functionals, Euler's equation, Solutions of Euler's equation, Geodesics, Isoperimetric problems, Approximate solution of boundary value problems by Rayleigh-Ritz method.
Linear Algebra:
Vector space, Linear dependence of vectors, basis, Linear transformations, Range and Kernel of Linear Mapping-Fundamental Theorem, Representation of Linear Transformation by Matrices, Inner product space , Gram-Schmidt Process of Orthogonalization.
Books:
1. John B. Conway, Functions of one complex variable, Springer International.
2. James Ward Brown &Ruel V. Churchill, Complex variable and application.,McGraw Hill International edition .
3. John H. Mathews, Numerical Methods for Mathematics , science and Engineering, PHI
4. Scarborough : Numerical analysis,
5. S.S.Rao: Optimisation theory and application, Wiely Eastern limited
6. Hoffman &Kunze. R, Linear Algebra, PHI

PEM- 101 POWER ELECTRONICS – I 3-1-0-4-4:

Switch Realization:Survey of power semiconductor devices, Power diode, SCR, GTO, LASCR, RCT, SITH, BJT, MOSFET, IGBT etc., Switching losses, driver circuits, protection, cooling, application .
Controlled Rectifiers (Converters): Single Phase /Three Phase, Halfwave / full wave, half controlled /fully controlledconverters with R, RL and RLE loads, Continuous anddiscontinuous current operations- Evaluation of performance parameters. Effects of source inductance- Power factor improvement techniques - twelve pulse converters - Dual converters.
DC- DC Converters: principle of operation of buck, boost, buck-boost, Cuk, fly back, forward, push-pull, half bridge, full bridge Converters with continuous and discontinuousoperation, Input & output filter design, multi-output boost converters, diode rectifier based boost converters. State spaceanalysis of regulators.
Design: Design considerations: Snubbercircuit, driver circuit, temperature control and heat sink, materials, windings. Design of converter and chopper circuits. Triggering circuits for converter and choppers.MMF equations, magnetic. Design of transformers and inductors.
Converter Dynamics / simulations:Feed back control for converters: regulation and control problem, control principles, model for feedback, P and PI control. Non lineardynamic modeling , Control and analysis of choppers, voltage mode and current mode control. Simulation: process, mechanics, techniques, PSPICE simulator.
EMI and Power Quality Problems.Power conditioning. PLL / Micro computer based converters and choppers

Texts:

1. M. H. Rashid, "Power Electronics - Circuits, Devices and Applications", P.H.I Private Ltd. New Delhi,
2. N. Mohan et.al. "Power Electronics- Converters, Applications and Design", John Wiley & Sons (Asia) Private Ltd.
3. Bimal K Bose, " Modern Power Electronics and AC Drives" PHI
4. R W Erickson and D Makgimovic,"Fundamental of Power Electronics" Springer, 2nd Edition.
5. P. T. Krein, "Elements of Power Electronics", OUP

PEM- 102 Electrical Machines Analysis 3-1-0-4-4:

Basic Principles for Analysis: Introduction, Magnetically coupled circuit, Electromechanical Energy Conversion, Machine windings and Air gap MMF, Winding inductances and voltage equations.

Reference Frame Theory:Introduction, Basic idea of Reference Frame, Synchronously rotating Reference Frame andGeneralized Theory, Kron's primitive Machine and its mathematical Model, equation of voltage, power and torque, Other

standard reference frames, Equation of transformation: change of variables, Transformation between reference frames, transformation of a balanced set, balanced steady state phasor relationship and voltage equations.

Induction Machines: Introduction, Voltage and torque equations in machine variables, Equations of Transformation for rotor

circuit, Voltage and Torque Equations in Arbitrary reference Frame Variables, Analysis of steady stateoperation, Freeacceleration characteristics viewed from other reference frame, Dynamic performance during sudden change in load torque, Linearized model, Eigen values and small displacement stability, Reduced order equations and dynamics.

Synchronous Machines: Introduction, Voltage and torque equations in machine variables, Voltage and Torque Equations in Arbitrary reference Frame Variables, Voltage and Torque Equations in Rotor Reference Frame Variables, Torque Equations in Substitute variables, Analysis of steady state operation, Dynamic Performance during a sudden change in Input torque, Linearized model, Eigen values and small displacement stability, Reduced order equations and dynamics.

DC Machines: Introduction, Voltage and torque equations in machine variables, Basic types of the machine, Dynamic characteristics of permanent magnet and DC Shunt Motors, Time domain Block Diagrams and state equations, Solution of Dynamic equation by Laplace Transformation.

Texts:

1. P.C. Krause, "Analysis of electric machinery andDrives", McGraw Hill, New York, 1986 References:
1. Ong Moon Lee "Dynamics Simulation of ElecticalMachines" Prentice Hall
2. Bimbhra P.S., "Generalized Circuit Theory of Electrical Machines", Khanna Publishers, Delhi, 5th Edition, 1995.
3. Adkins B., " The General Theory of Electrical Machines", John Wiley Sons, 1957.
4. Seely S., "Electro-Mechanical Energy Conversion", McGraw Hill, 1962.

PEM -103 (a) Advanced Control Systems 3-1-0-4-4:

Review of Modeling and Analysis of LTI Systems: Modeling of physical Systems. Design specificationsand performance indices, Motion control systems, Transportation lags. Approximation of time-delay functions., Sensitivity of control systems to parameter variations. Effects of disturbance of signals. Disturbance rejection.

Analysis in state-space: A perspective on state-space design. State variables. State models for physical systems. SISO and MIMOsystems. Solution of state equations. Transfer function. Eigenvalues andeigenvectors. Jacobianlinearization technique. State transformations and diagonalisation. Transformation to phase-variable canonical form.Controllability and observability.Duality property.Stability.

Introduction to Discrete-time Systems: Basic elements of discrete-time control system. Z-transform and properties.Inverse Z-transform. Difference equation and its solution by Z-transform method. Z-transfer function.State diagram of digital systems.Time delay. Direct, cascade and parallel decomposition of Z-transfer functions.

Feedback control design: Continuous control design. Proportional, derivativeand integral control action.PID controller tuningrules.Ziegler-Nichols method. Two degree of freedom control systems. Compensator design using Bode diagram in frequency response approach.Lag, Lead, Lag-lead compensator.Control law design for full state feedback by pole placement. Full order observer system. Observer based state feedback. Separation principal.

Non linear system: Classification and types of non-linearity. Phenomena peculiar to non-linear systems.Methods of analysis. Linearization based on Taylor's series expansion. Jacobian Linearization. Phase trajectory and its construction. Phase-plane analysis of linear and non-linear systems. Existence of limit cycles.Describing function of typical non-linearities.Stability analysis by DF method.Introduction to DIDF.Popov's circle criterion. Stability analysis by Lyapunov's indirect and direct methods, Lypunov's theorem.

Reference Books:

1. Ogata, K – Modern Control Engineering, PHI Learning
2. Kuo, B.C. – Automation Control Systems, PrenticeHall
3. Roy Choudhury, D – Modern Control Engineering, Prentice Hall
4. Nagrath, J. J. Gopal, M – Control System Engineering, New Age Pub.

5. Schulz, D.G. and Melsa, .L. – State Functions and Linear Control Systems, McGraw-Hill.
6. Stepheni, Shahian, Savant, Hostetler – Design offeedback control systems, Oxford University Press.
7. Vidyasagar- Nonlinear system analysis, Prentice-Hall.
8. Gibson, J.E.-Non linear system , Mc. Grawhill.
9. Gopal. M, Digital Control and State Variable Methods, TMH.

PEM -103 (b) AI and Soft Computing 3-1-0-4-4:

Introduction: Intelligent Agents – Agents and environments - Good behavior – The nature ofenvironments – structure of agents - Problem Solving - problem solving agents – exampleproblems – searching for solutions – uniformed search strategies - avoiding repeated states –searching with partial information.

Searching techniques: Informed search and exploration – Informed search strategies – heuristic function – localsearch algorithms and optimistic problems – local search in continuous spaces – onlinesearch agents and unknown environments - Constraint satisfaction problems (CSP) –Backtracking search and Local search for CSP – Structure of problems - Adversarial Search –Games – Optimal decisions in games – Alpha – Beta Pruning – imperfect real-time decision– games that include an element of chance.

Knowledge representation: First order logic – representation revisited – Syntax and semantics for first order logic – Usingfirst order logic – Knowledge engineering in first order logic - Inference in First order logic –prepositional versus first order logic – unification and lifting – forward chaining – backwardchaining - Resolution - Knowledge representation - Ontological Engineering - Categories andobjects – Actions - Simulation and events - Mental events and mental objects.

Learning: Learning from observations - forms of learning - Inductive learning - Learning decision trees- Ensemble learning - Knowledge in learning – Logical formulation of learning – Explanationbased learning – Learning using relevant information – Inductive logic programming -Statistical learning methods - Learning with complete data - Learning with hidden variable -EM algorithm - Instance based learning - Neural networks - Reinforcement learning –Passive reinforcement learning - Active reinforcement learning - Generalization inreinforcement learning.

Applications: Communication – Communication as action – Formal grammar for a fragment of English –Syntactic analysis – Augmented grammars – Semantic interpretation – Ambiguity anddisambiguation – Discourse understanding – Grammar induction - Probabilistic languageprocessing - Probabilistic language models – Information retrieval – Information Extraction– Machine translation.

Books:

1. Artificial Intelligence – A Modern Approach", Stuart Russell, Peter Norvig, 2nd Ed. Pearson Education /PHI, 2004.
2. Artificial Intelligence: A new Synthesis, Nilsson. J. Nils , Harcourt Asia Pvt. Ltd., 2000.
3. Artificial Intelligence, Rich Elaine & Knight Kevin, 2nd Edition, Tata McGraw-Hill, 2003.
4. Artificial Intelligence-Structures and Strategies for Complex Problem Solving, Geogre**F. Luger, Pearson Education.**

PEM -103 (c)Optimization Technique 3-1-0-4-4:

Introduction to Optimization: Engineering Applications of Optimization, Classification of Optimization Problems, Optimization Techniques, Solution of Optimization Problems Using MATLAB

Classical Optimization Techniques: Single-Variable& Multivariable Optimization,Convex Programming Problem.

Linear Programming: Simplex Method, MATLAB Solution of LP Problems,Revised Simplex Method,Decomposition Principle, Transportation Problem,Karmarkar's Interior Method,Quadratic Programming,MATLAB Solutions.

Nonlinear Programming: One-Dimensional Minimization Methods, Unimodal Function , ELIMINATION METHODS, INTERPOLATION METHODS,INDIRECT SEARCH (DESCENT) METHODS,Constrained Optimization Techniques-DIRECT METHODS, INDIRECT METHODS, MATLAB Solution

Geometric Programming: Posynomial,Unconstrained Minimization Problem and solutions, Constrained Minimization and solution.

Dynamic Programming: Multistage Decision Processes, Concept of Suboptimization and Principle of Optimality, Computational Procedure in Dynamic Programming, Example Illustrating the Calculus Method of Solution, Example Illustrating the Tabular Method of Solution,Continuous Dynamic Programming, applications.

INTEGER LINEAR PROGRAMMING: Graphical Representation,Gomory's Cutting Plane Method,

Balas' Algorithm for Zero – One Programming Problems.

INTEGER NONLINEAR PROGRAMMING: Conversion of a Zero – One Polynomial Programming Problem into aZero – One LP Problem, Branch-and-Bound Method, Sequential Linear Discrete Programming ,Generalized Penalty Function Method, Solution of Binary Programming Problems Using MATLAB.

Stochastic Programming: Stochastic Linear Programming ,Stochastic Nonlinear Programming, Stochastic Geometric Programming.

Optimal Control and Optimality Criteria Methods: Optimality Criteria Methods.

Modern Methods of Optimization: Introduction,computation, algorithms and application of Genetic Algorithms, Simulated Annealing,Particle Swarm Optimization,Ant Colony Optimization,Optimization of Fuzzy Systems,

Practical Aspects of Optimization:Reduction of Size of an Optimization Problem,Fast Reanalysis Techniques,Derivatives of Static Displacements and Stresses, Derivatives of Eigenvalues and Eigenvectors, Derivatives of Transient Response,Sensitivity of Optimum Solution to Problem Parameters,Multilevel Optimization,Parallel Processing,Multiobjective Optimization,Solution of Multiobjective Problems Using MATLAB.

Books:

Engineering Optimization:Theory and Practice, Singiresu S. Rao, John Wiley & Sons, Inc.,

PEM 103- (d)Soft Computing in Electrical Engineering3-1-0-4-4:

Introduction to Soft Computing: Introduction, importance, main components, Fuzzy Logic , ANN, Evolutionary Algorithms, Hybrid Intelligent Systems.

Artificial Neural Network and Supervised Learning: Introduction, Comparison of Neural Techniques and AI, Artificial Neuron Structure, Adaline, ANN Learning, Back-Propagation Learning, Properties & Limitations.

Factors Affecting the Performance of Artificial Neural Network Models: NetworkComplexity, problem complexity, learning Complexity.

Development of Generalized Neuron and Its Validation : Existing Neuron Model, Development, Advantages, Learning Algorithm of a Summation Type Generalized Neuron, Benchmark Testing of Generalized Neuron Model, Generalization of GN model, Discussion.

Applications of Generalized Neuron Models: Application Electrical Machine Modeling, Electrical Load Forecasting Problem, Load Frequency Control Problem, Power System Stabilizer Problem, Aircraft Landing Control System.

Introduction to Fuzzy Set Theoretic Approach: Introduction, Uncertainty and Information., Types of Uncertainty, Fuzzy Logic- Introduction, development, Precision and Significance, set, Operations, Union Intersection , Complement, Combination, Concentration, Dilation, Intensification, α-Cuts. Quantifier/Modifier/Hedges, Characteristics, Normality, Convexity, Cross Over Point, Single tone, Height, Cardinality, Properties of Fuzzy Sets, Fuzzy Cartesian Product, shape & defining Membership Functions, Defuzzification, Rule Based System.

Applications of Fuzzy Rule Based System: Introduction, Modeling and Simulation, approach, selection, Steady State D.C. Machine Model, Control Applications- Adaptive Control, PID Control System, Transient Model of D.C. Machine, Fuzzy Control System, Power System Stabilizer Using Fuzzy Logic.

Genetic Algorithms: Introduction, Genetic Algorithms, Effect of Crossover Probability on GA Performance, Effect of Mutation Probability on GA Performance, Main Components of GA, Variants , Applications of Genetic Algorithms in **Load Forecasting,** Development of Improved Genetic Algorithm (IGM), Application of Improved Genetic Algorithm (IGA) to Electrical Load Forecasting Problem .

Synergism of Genetic Algorithms and Fuzzy Systems for Power System Applications: Transmission Planning, Pricing and Structure/Models, GA-Fuzzy System Approach for Optimal Power, Flow Solution, OPF Problem, Synergism of GA-Fuzzy System Approach and OPF Solution (GAF-OPF), Transmission Pricing Model Under Deregulated , Marginal Cost Based Transmission, Hybrid Deregulated transmission Pricing Model, Proposed Methods for Congestion Management . .

Integration of Neural Networks and Fuzzy Systems: Adaptive Neuro-Fuzzy Inference Systems, HIV/AIDS Population Model Using Neuro-Fuzzy, Neuro-Fuzzy Approach of Modeling.

ANN – GA-Fuzzy Synergism and Its Applications: Training of ANN, ANN Learning Using GA, Validation and Verification of ANN-GA Model.

Books:

Soft Computing - Techniques and its Applications in Electrical Engineering, Dr. D.K. Chaturvedi, Springer-Verlag Berlin Heidelberg, 2008

PEM 104- (a) Energy Management And Audit 4-0-0-4-4:

Energy Management & Audit: Definition, need, types, approach-understanding energy costs, Bench marking, Energy performance, Matching energy, efficiencies, optimizing the input, Fuel & energy substitution, instruments.

Energy Action Planning: Key elements, Force field analysis, Energy policy, perspective, Contents, Formulation, Ratification, Organizing –location, top management support, Managerial function, Roles and responsibilities of energy manager, Accountability. Motivation of employees for information, designing barriers, Strategies, marketing and communicating-training and planning.

Financial Management: Investment, appraisal and criteria, Financial analysis techniques-Simple pay back 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.

Project Management: Energy monitor of Electrical system: Power supply, Electricity billing, Electrical load nagement and MD control, PF improvement and its benefit, Selection and location of capacitors, Performance assessment of PF capacitors, distribution and transformer losses. Electric motors: Types, characteristics, losses, efficiency, selection, energy efficient motors, Factors affecting motor performance, Rewinding and motor replacement issues. Energy saving opportunities with Pumps, cooling towers, fans and blower. Lighting System: Light source, Choice of lighting, Luminance requirements, and Energy conservation avenues. Energy Efficient Technologies in Electrical Systems: Maximum demand controllers, Automatic power factor controllers, Energy efficient motors, Soft starters with energy saver, Variable speed drives, Energy efficient transformers, Electronic ballast, Occupancy sensors, Energy efficient lighting controls.

Energy Monitoring and Targeting: Defining monitoring & targeting, Elements of monitoring & targeting, Data and information-analysis, Techniques -energy consumption, Production, Cumulative sum of differences (CUSUM).

Electrical Systems: Electricity billing, Electrical load management and maximum demand control, Power factor improvement and its benefit, Selection and location of capacitors, Performance assessment of PF capacitors, Distribution and transformer losses.

Electric motors: Types, Losses in induction motors, Motor efficiency, Factors affecting motor performance, Rewinding and motor replacement issues, Energy saving opportunities..

Fans and blowers: Types, Performance evaluation, Efficient system operation, Flow control strategies and energy conservation opportunities

Pumps and Pumping System: Types, Performance evaluation, Efficient system operation, Flow control strategies and energy conservation opportunities

Lighting System: Light source, Choice of lighting, Luminance requirements, and Energy conservation avenues

Diesel Generating system: Factors affecting selection, Energy performance assessment of diesel conservation avenues

Cogeneration: Need, principle, technical options, classification, influencing factor, technical parameters, prime mover, performance, merit case study.

Books:

1. Albert : Plant Engineers & Managers Guide to Energy Conservation Page of 18 11
2. WayheC.Tuner : Energy Management Handbook
3. Anthony J. Pansini. : Engineering Economic Analysis Guide Boo
4. D. Paul-Mehta : Handbook of Energy Engineering.

5. Paul O'Callaghan : Energy Management.
6. Books of Energy Management & Auditors, Bureau ofEnergy Efficiency, (A Statutory body under Ministry of Power, Government of India), www.bee-india.nic.in9volume I,II& III

PEM- 104 (b) Power Quality Management4-0-0-4-4:

INTRODUCTION: Power Quality phenomena – Basic terminologies – various events in Power Quality – Causes for reduction in Power Quality — Power Quality Standards

VOLTAGE SAG: Causes of voltage sags – magnitude and duration of voltage sags – effect on adjustable AC Drives, DC drives, computers and consumer electronics – monitoring and mitigation of voltage sags.

INTERRUPTION: Origin of Long and Short interruptions – influence on various equipments – reliability of power supply– basic reliability evaluation techniques – monitoring and mitigation of interruptions

HARMONICS: Origin of harmonics – effect of harmonics on adjustable speed ac drives – harmonic reduction using PWM and harmonic injection.

POWER QUALITY MEASUREMENTS: Interpretation and analysis of Power Quality Measurements, Active Filters as Power Quality Conditioners – Basic concept of Unified Power Quality Conditioners.

Energy Efficient Technologies in Electrical Systems: Maximum demand controllers, Automatic power factor controllers, Energy efficient motors, Soft starters with energy saver, Variable speed drives, Energy efficient transformers, Electronic ballast, Occupancy sensors, Energy efficient lighting controls, Energy saving potential of each technology.

Books:

1. Math. H. J. Bollen, "Understanding Power QualityProblems – Voltage Sags and Interruptions", IEEE Press, 2000
2. David D. Shipp and William S. Vilcheck, "Power Quality and Line Considerations for Variable Speed AC Drives", IEEE Transactions on Industry Applications, Vol. 32, March / April – 1996
3. Po – Tai Cheng, Subhashish Bhattacharya and Deepak. D. Divan, "Line Harmonics Reduction in High – PowerSystems Using Square – Wave Inverters – Based Dominant Harmonic Active Filter", IEEE Transactions on Power Electronics, Vol. 14, No. 2, March 1999
4. Hideaki Fujita and HifofumiAkagi, "The UnifiedPower Quality Conditioner: The Integration of Seriesand Shunt Active Filters", IEEE Transactions onPower Electronics, Vol. 13, No. 2, March 1998.
5. Christopher J. Melhorn and Mark. F. McGranaghan, "Interpretation and Analysis of Power Quality Measurements", Electrotek Concepts, Inc.1998
6. Harmonic Distortion in the electric supply system", – Technical Note No. 3 from Integral Energy Power Quality Centre, University of Wollongong, March2000

PEM- 104 (c) Industrial Management4-0-0-4-4:

Basic concepts of management, objectives, classification and hierarchy, different schools of management thought, principal functions of management, Management as an organizing and directing force, Structureof the management decision making process, Organization structure, authority and responsibility, Organization dynamics, Managerial leadership, communication systems, Managing human factors in business and industry, Industrial relation, Union activities, trade union acts, collective bargaining,disciplinary procedure. Organizational objectives and long range forecasting, planning, organizing, programming and controlling process, managerial control strategies; quantity and quality control, cost benefit analysis, present work and breakeven analysis, budgetary control, use of management science for the efficient administration of economic units, production, financial and marketingmanagement. Adoption of statistical and computer methods and techniques to managerial research and managerial decision making and general management.

Books:

1. Industrial Management - S C Jain, W S Bawa, DhanpatRai& Co. (P) Ltd.
2. Industrial Management, Vol.1 L.C. Jhamb, EPH,
3. Industrial Engineering & Production Management -MartandTelsang, S. Chand
4. Industrial & Business Management - Martand T. Telsang, S. Chand
5. Introduction to Materials Management - J Tony Arnold & Stephen N. Chapman, Pearson Education Asia
6. Production & Operations Management – Adam, Pearson Education /PHI
7. Industrial Relations, Trade Unions &Labour Legislation - Sinha, Pearson Education Asia

8. Business Organisation& Management - Tulsian, Pearson Education Asia

PEM- 191 Electrical Engineering Lab. – I 0-0-9-9-6:

Laboratory based on the theoretical subjects covered in 1st semester.

2nd semester:

PEM- 201 POWER ELECTRONICS – II 3-1-0-4-4:

Inverters: Single and three phase bridge inverters with R, RL and RLE loads, Voltage control, Harmonic reduction,square wave inverters, PWM inverters, modulation techniques, SPWM, Selective Harmonic Elimination PWM and delta modulation. blanking time. harmonic spectrum and comparison among different PWM techniques. Boost inverter. Current source inverters, Inverter Circuit Design .

Resonant Pulse Converters: Series and parallel resonant inverters - zero current and Zero voltage switching resonantconverters, frequency response. Two quadrant zero voltage switching resonant converters, Resonant dc link inverters, design and analysis, soft switching, load dependent problem.

Multi level inverters: types, operations, features.

Cycloconverters:Single phase and three phase cycloconverters with R, RL and RLE loads – Voltage control , Harmonic analysis, operation waveforms designs.

AC voltage controllers:Single phase and three phase ac voltage controllers with R, RL and RLE loads, Voltage control, Harmonic analysis, operation waveforms PWM, Matrix converter, design.

Dynamics of above converters:Modeling and control of inverters, resonant pulse converters, cyclo-converters, ac voltage controllers. Application of microcomputer .

Design: Method for control design: averaging method, small signal analysis, linearization, challenge. Geometric control: hysteresis control, boundary control. Triggering circuit. Design of inverters, resonant pulse converters, cyclo-converters, ac voltage controllers circuits.

PLL / Micro computer based inverters, cycloconverters, AC voltage controllers.

Books:

1. M. H. Rashid, "Power Electronics - Circuits, Devices and Applications", P.H.I Private Ltd. New Delhi, Second Edition,
2. N. Mohan et.al. "Power Electronics- Converters, Applications and Design", John Wiley & Sons (Asia) Private Ltd.,
3. Bimal K Bose, " Modern Power Electronics and AC Drives" PHI
4. R W Erickson and D Makgimovic,"Fundamental of Power Electronics" Springer, 2nd Edition.
5. P. T. Krein, "Elements of Power Electronics", OUP
6. Joseph Vithayathil, "Power Electronics - Principles and Applications", McGraw Hill Inc., New York, 1995.
7. VedamSubrahmanyam, "Power Electronics", New AgeInternational (P) Limited, New Delhi, 1996.
8. R. Bausiere& G. Seguier, Power Electronic Converters, Springer- Verlag, 1987.
9. D.M.Mitchell, DC-DC Switching Regulator Analysis McGraw Hill, 1987

PEM- 202 Electric Drives– I 3-1-0-4-4:

Review of Conventional Drives: speed –torque relation, Steady state stability, methods of speed control, braking for DC motor – Multi quadrant operation , Speed torque relation of AC motors, Methods of speed control and braking for Induction motor, Synchronous motor . Criteria for selection of motor for drives.

Converter Control of DC Drives:Analysis of series and separately excited DC motorwith single phase and three phaseconverters operating in different modes and configurations.

Chopper Control of DC Drives:Analysis of series and separately excited DC motors fed from different choppers for both time ratio control and current limit control, four quadrant control.

Design of DC Drives:Single quadrant variable speed chopper fed DC drives, Four quadrant variable speed chopper fed DC Drives, Single phase/ three phase converter, Dual converter fed DC Drive, current loop control, Armature current reversal, Field current control, Different controllers and firing circuits, simulation.

Inverter fed AC Drives: :Analysis of different AC motor with single phase and three phase inverters Operations in different modes and configurations., Problems and strategies.

Cyclo-converter fed AC Drives:Analysis of different AC motor with single phase and three phase cycloconverters Operations in different modes and configurations., Problems and strategies, vector Control and Rotor side Control

AC Voltage controller fed AC Drives:Speed Control and braking, Analysis of different AC motor with single phase and three phase ac voltage controllers. Operations in different modes and configurations.Problems and strategies.

Control and estimation o AC drives: Induction motor: Small signal models, scalar control, FOC control, sensor less control, DTC, adaptive control. Synchronous motor: sin SPM, synchronous reluctance machines, sin IPM machines, trapezoidal SPM, wound fitted SM, sensor-less operation, switched reluctance machines, Dynamics and Modeling of AC Drives.

Books :

1. Bimal.K. Bose, "Power Electronics and Variable frequency drives", Standard Publishers Distributors, New Delhi, 2000
2. Murphy J.M.D, Turnbull, F.G, "Thyristor control of AC motor, Pergamon press, Oxford, 1988.
3. M. H. Rashid, "Power Electronics - Circuits, Devices and Applications", P.H.I Private Ltd. New Delhi, Second Edition,
4. N. Mohan et.al."Power Electronics- Converters, Applications and Design", John Wiley & Sons (Asia) Private Ltd.,

5. Bimal K Bose, " Modern Power Electronics and AC Drives" PHI
6. R. Krishnan, "Electric motor drives: modeling, analysis and control, Pearson.
7. Dubey G.K. "Power Semiconductor controlled drives", Prentice Hall
8. Sheperal, Wand Hully, L.N. "Power Electronic andMotor control" Cambridge University Press Cambridge 1987
9. Dewan,S. Slemon B., Straughen,A. G.R., "Power Semiconductor drives", John Wiley and Sons, NewYork 1984.
10. Sen. P.C. "Thyristor DC Drives", John Wiley andsons, NewYork, 1981.
11. Subramanyam, V. "Electric Drives – Concepts and applications", Tata McGraw Hill Publishing Co., Ltd., New Delhi

PEM- 203 Generation of Non conventional Energy 4-0-0-4-4:

INTRODUCTION TO SOLAR AND WIND ENERGY:Recent trends in energy consumption – World energyscenario – Energy sources and their availability – Conventional and renewable sources – Need to develop new energy technologies – Solar radiation and measurement – Solar cells and their characteristics – Influence of insulation and temperature – PV arrays – Electrical storage with batteries – Solar availability in Indi8a – Switching devices for solar energy conversion – Stand alone inverters – Charge controllers – Water pumping – Audio visual equipments, Street lighting, Analysis ofPV systems

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

WIND ENERGY CONVERSION SYSTEM:Basic principle of wind energy conversion – natureof wind – Wind survey in India – Power in the wind – components of a wind energy conversion system – Performance of Induction Generators for WECS – Classification of WECS

INDUCTION GENERATOR: Self excited Induction Generator for isolated Power Generators – Theory of self e excitation – Capacitance requirements – Power conditioning schemes – Controllable DC Power from SEIGs

OPTIMISATION TECHNIQUE:Wind / Solar PV integrated systems – selection of power conversion ratio – Optimization of system components – Storage

Books :

1. Rai G.D., "Non – Conventional Energy Sources", Khanna Publishers, 1993.
2. Rai G.D., "Solar Energy Utilisation", Khanna Publishers, 1993.
3. Daniel, Hunt V, "Wind Power – A Handbook of WECS", Van Nostrend Co., New York, 1981.
4. Gary L. Johnson, "Wind Energy Systems", Prentice Hall Inc., 1985.
5. Freris L. L., "Wind Energy Conversion", Prentice Hall (UK) Ltd., 1990

PEM -204 Advanced Mathematics 4-0-0-4-4:

Advanced Matrix Theory : Computation of the greatest and the least eigen values of a matrix by power method, Modal matrix, Spectral matrix, Real Quadratic form. Sylvester's theorem.

Linear Programming : Graphical method, Simplex method, Charnes' Big M Technique, Two phase Technique, Revised Simplex method. Duality theory, Dual simplex method, Transportation Problems and Assignment problems.

Nonlinear Programming : Nonlinear Programming with special reference to quadratic programming, Kuhn-Tucker conditions, Wolfe's modified simplex method.

Network Analysis : Shortest Path Problem (Dijkstra Algorithm, Floyd Algorithm), Maximal- Flow Problem(Ford Fulkerson Algorithm), Project Scheduling by PERT-CPM.

Integral Equations : Integral Equations, Fredholm Integral Equations, Volterra Integral Equations , Deduction of Differential Equations to Integral Equations and vice-versa. Solution of FredholmIntegral Equations of 2nd kind with Separable Kernel. Iterative Methods for solving Integral Equations of the 2nd kind. The Numann Series.

Books:

1. Taha H A :Operations research-An introduction , Macmillan publishing Co.
2. Simmons DM : Nonlinear Programming for Operations Research, PHI
3. Bazara, Shetty and Sherali : Nonlinear Programming
4. S SRao : Optimization Techniques, Wiley Eastern
5. Francis B Hildebrand : Methods of Applied Mathematics,1992

PEM- 205 Intelligent Control of Drives 4-0-0-4-4:

INTRODUCTION TO NEURAL NETWORKS :Introduction – biological neurons – Artificial neurons – activation function – learning rules – feed forward networks – supervisedlearning – perception networks – adaline – madaline – back propagation networks – learning factors – linear separability –Hopfield network – discrete Hopfield networks.

ARCHITECTURE – TYPES:Recurrent auto association memory – bi-directionalassociative memory – temporal associative memory – Boltzmann machine Hamming networks – self – organizing feature maps – adaptive resonance theory network – Instar – Outsar model – counter propagation network– radial basis function networks

INTRODUCTION TO FUZZY SETS AND SYSTEMS: Crisp set – vaguness – uncertainty and imprecision – fuzzy set – fuzzy operation- properties – crisp versus fuzzy relations – fuzzy relation – cardinality operations, properties – fuzzy Cartesian product and composition – non – interactive fuzzy sets – tolerance and equivalence relations – fuzzy ordering relations – fuzzy morphism – composition of fuzzy relations

FUZZY LOGIC CONTROLLER: Fuzzyto crisp conversion – Lambda cuts for fuzzy sets and relations – definition methods – structure of fuzzy logic controller – database – rule base – Inference engine

APPLICATION AND DESIGN:Applications of Neural network and Fuzzy system for single phase fully controlled converter, single phase ac voltage controller, DC Drive and ACDrive

Designing of controllers using Simulation Software Fuzzy Logic Toolbox – Modeling of DC Machines usingSimulation Software and Simulink Toolbox

Books:

1. Lawrence Fausatt, “Fundamentals of neural networks”, Prentice Hall of India, New Delhi, 1994.
2. Timothy J. Ross, “Fuzzy Logic with Engineering Applications”, McGraw Hill International Edition, USA, 1997.
3. Bart kosko, “ Neural Networks and Fuzzy Systems”, Prentice Hall of India, New Delhi, 1994

PEM -206 Solid State Power Controller 4-0-0-4-4:

FACTS CONCEPTS:Electrical Transmission Network – Necessity – Power Flow in AC System – Power Flow and dynamic stability considerations of a transmission interconnection – relative importance of controllable parameter – opportunities for FACTS – possible benefits for FACTS Technology – FACTS Controllers – Types, brief description and definitions

STATIC VAR COMPENSATION:Need for compensation – introduction to shunt and series compensation – objectives of shunt and series compensation – configuration and operating characteristics – Thyristor Controlled Reactor (TCR) – ThyristorSwitched Capacitor (TSC) – Fixed Capacitor - Thyristor Controlled Reactor (FC – TCR) – Comparison of TCR, TSC and FC – TCR

SERIES COMPENSATORS:Commutation in DC motors, difference between mechanical and electronic Commutators, Hall sensors, Optical sensors, Multiphase Brushless motor, Square – Wave permanent magnet brushless motor drives, torque and EMF equation, torque – speed characteristics of Permanent Magnet Brush less DC Motors – controllers PMDC Motor

STATIC VOLTAGE AND PHASE ANGLE REGULATORS:Objectives of voltage and phase angle regulators – approaches to Thyristor – Controlled Voltage and Phase Angle Regulator

EMERGING FACTS CONTROLLERS:Construction and principle of operation of Linear Induction Motor - Universal Motor - Hybrid Motor – Linear Synchronous motor – Applications

POWER QUALITY: Power Quality problems in distribution systems, harmonics, harmonics creating loads, modeling,harmonic propagation, Series and parallel resonances, harmonic power flow, Mitigation of harmonics, filters, passive filters, Active filters, shunt, series hybrid filters, voltage sags & swells, voltage flicker. Mitigation of power quality problems using power electronic conditioners. IEEE standards.

Books:

1. Narain G. Hingorani and Laszlo Gyugyi, "Understanding FACTS – Concepts and Technology of Flexible ACTransmission Systems", Standard Publishers, New Delhi, 2001.
2. R. Mohan Mathur and Rajiv K. Varma, "Thyristor Based FACTS Controller for Electrical Transmission Systems", Wiley Interscience Publications, 2002
3. Narain G. Hingorani, "Flexible AC Transmission",IEEE Spectrum, April 1993, pp 40 – 45
4. Narain G. Hingorani, "High Power Electronics in Flexible AC Transmission", IEEE Power Engineering Review, 1998
5. Elinar V. Larsen, Juan J Sanchez – Gasca Joe H. Chow, "Concepts for design of FACTS controllers to damp power swings", IEEE Transactions on Power Systems, Vol. 10, No. 2, May 1995.
6. G.T. Heydt, Power Quality, Stars in a Circle Publications, Indiana, 1991.
7. T.J.E. Miller, Static Reactive Power Compensation, John Wiley & Sons, New York, 1982.

PEM- 207 Digital Signal Processing 4-0-0-4-4:

Introduction to Signal Processing: Review of Laplace transform, Z transform, Fourier transform. Discrete Fourier transform, Fast Fourier transform,Algorithms and complexity, Introduction to linear optimal filtering Digital Filter: Definition and anatomy of a digital filter, Frequency domain description of signals and systems, Typical application of digital filters, Replacing analog filters with digital filters, Filtercategories: recursive and non-recursive

Digital Filter Structures: The direct form I and II structures, Cascade combination of second order sections, Parallel combination of second order sections, Linear- phase FIR filter structures, Frequency sampling structure for the FIR filter

Effect of Word Length: Round off error, Truncation error, Quantization error, Limit cycle Introduction to DSP Hardware: Application of DSP in control system and instrumentation

Suggested Readings:

1. S. K. Mitra, Digital Signal Processing,
2. J. C. Proakis, and D. G. Maniolakis, Digital Signal Processing: Principles, Algorithms and Applications, Prentice Hall.
3. Oppenheim, and R. W. Shaffer, Discrete Time Signal Processing, Prentice Hall, 1992.
4. J. Johnson, Digital Signal Processing, Prentice Hall.
5. B. VenkataRamani, and M. Bhaskar, Digital Signal Processors, New Delhi: Tata McGraw Hill.

PEM- 208 FACT & HVDC Transmission 4-0-0-4-4:

INTRODUCTION: Introductionto AC and DC Transmission – application of DC Transmission – description of DCtransmission – DC system components and their functions – modern trends in DC Transmission

CONVERTER: PulseNumber – Converter configuration – analysis of Graetz circuit – converter bridge characteristics – characteristics of 12 Pulse converter.

HVDC CONTROLLERS:General principle of DC link control – converter control characteristics – system control hierarchy –firing angle control – current and extinction anglecontrol – Dc link power control – high level controllers

FILTERS:Introduction to harmonics – generation of harmonics – design of AC filters – DC filters – carrier frequency and RI noise

PROTECTION:Basics of protection – DC reactors – voltage and current oscillations – circuit breakers – over voltage protection – switching surges – lightning surges – lightning arresters for DC systems

Text/Reference:

1. Kimbark, "Direct Current Transmission – Vol. I",John Wiley and Sons Inc., New York, 1971
2. Padiyar. K. R., "HVDC Power Transmission Systems", Wiley Eastern Limited, New Delhi, 2000.
3. Arrillaga. J, "High Voltage Direct Current Transmission", Peter Peregrines, London, 1983

PEM- 209 Microcontroller Based System Design 4-0-0-4-4:

Introduction – embedded systems and their characteristics, review of micro – processors, MPU design options, Instruction sets – CISC and RISC – instruction pipelining, the microcontroller – its applications and environment.

16 bit microcontroller – Intel 8096 CPU structure, register file – assembly language overview – addressing modes – Instruction set – simple programs , Introduction, PIC microcontrollers PIC 16 C6x/7x, architecture, register file structure and addressingmodes, Instruction set, simple programs
Peripheral functions of PIC 16C6x/7x - Interrupts -Interrupts constraints – Interrupt servicing – Critical regions – External Interrupts – Use of Timers in interrupt Handling – Compare and capture mode – PWM outputs, I/O port expansion – Synchronous serial port module– State machines and key switches LCD display – I2C bus operations and subroutine – serial EEPROM
Analog to Digital converter: Characteristics and use
UART : Initialization – Data Handling circuitry andUSE
Special Features of PIC – Reset Alternatives Low power operation – Serial programming – parallel slaveport
REFERENCE BOOKS :

John B. Peatman, "Design with PIC Microcontrollers", Pearson Education Asia, 2000.
John B. Peatman, "Design with Microcontrollers", McGraw Hill, 1995.

PEM -210 Flexible AC Transmission Systems 4-0-0-4-4:

Basics of Power Transmission: Control of Power Flow in AC Transmission Line, Controllers, Application of FACTS Controllers in Distribution Systems.
AC Transmission Line and Reactive Power Compensation: Analysis of Uncompensated AC Line, Passive Reactive Power Compensation, Compensation by a Series Capacitor Connected at the Mid-point of the Line, Shunt Compensation Connected atthe Midpoint of the Line, Comparison between Series and Shunt Capacitor, Compensation by STATCOM and SSSC.
Static Var Compensator: Analysis of SVC, Configuration of SVC,SVC Controller, Voltage Regulator Design, Harmonics and Filtering, Protection Aspects, Modelling of SVC, Applications of SVC.
Thyristor and GTO Controlled Series Capacitor: Introduction, Basic Concepts of Controlled Series Compensation, Operation of TCSC, Analysis of TCSC, Control of TCSC, Modelling of TCSC for StabilityStudies, GTO Thyristor Controlled SeriesCapacitor (GCSC), Mitigation of Subsynchronous Resonance with TCSC and GCSC, Applications of TCSC.
Static Phase Shifting Transformer: General, Basic Principle of a PST, Configurations of SPST, 5.4 Improvement of Transient Stability Using SPST, Damping of Low Frequency Power Oscillations, Applications of SPST.
Static Synchronous Compensator (STATCOM): Introduction, Principle of Operation of STATCOM, A Simplified Analysis of a Three Phase Six Pulse STATCOM, Analysis of a Six Pulse Using Switching Functions, Multi-pulse Converters, Control of Type 2 Converters, Control of Type 1 Converter, Multilevel Voltage Source Converters, Harmonic Transfer and Resonance in VSC, Applications of STATCOM.
Static Synchronous Series Compensator: Introduction, Operation of SSSC and the Control of Power Flow, Modelling and Control of SSSC, SSSC with an Energy Source, Analysis of SSR with a SSSC, Applications of SSSC.
Unified Power Flow Controller: Introduction, Operation of a UPFC, Control of UPFC, Protection of UPFC, Modelling of UPFC, SSR Characteristics of UPFC, Applications of UPFC.
Power Quality and Introduction to Custom Power Devices: Introduction, Electromagnetic Phenomena and Power Quality, Custom Power Devices, Definitions of Reactive Power, Reactive Power Compensation in Single Phase Circuits, Reactive Power Compensation in Three Phase Circuits,
Load Compensation and Distribution STATCOM: Introduction, Three Phase Three Wire Systems, Three Phase Four Wire Systems, Synchronous Reference Frame Based Extraction of Reference Currents, Instantaneous Active and Reactive Current Based Extraction of Reference Currents, Application of DSTATCOM forReactive Power Compensation and Voltage Regulation, Current Control Techniques for PWM Converters, Application of CompositeCompensation..
Dynamic Voltage Restorer and Unified Power Quality Conditioner: Introduction, Dynamic Voltage Restoration, Series Active Filtering, Unified Power Quality Conditioner.
Books:

1. FACTS CONTROLLERS IN POWER TRANSMISSION AND DISTRIBUTION by K. R. Padiyar, New Age Publication.
2. Flexible AC Transmission Systems: Modelling and Control byXiao-Ping Zhang, Christian Rehtanz, Bikash Pal, Springer.

3. HVDC and FACT Controller: Application os Static Converter in Power System by Vijay Sood, Kluwer Academic publisher.
4. VAR Compensation in Power Systems POWER QUALITY by R. SastryVedam, Mulukutla S. Sarma, CRC Press.

PEM- 211 Nonlinear Phenomena in Switching Circuit 4-0-0-4-4:

Basics of Nonlinear Dynamics: System, state and state space model, Vector field- Modeling of Linear, nonlinear and Linearized systems, Attractors , chaos, Poincare map, Dynamics of Discrete time system, Lyapunov Exponent, Bifurcations, Bifurcations of smooth map, Bifurcations in piece wise smooth maps, border crossing and border collision bifurcation .

Techniques for investigation of nonlinear Phenomena:Techniques for experimental investigation, Techniques for numerical investigation, Computation of averages under chaos,Computations of spectral peaks, computation of thebifurcation and analyzing stability.

Nonlinear Phenomena in DC-DC Converters:Border collision in the Current Mode controlled Boost Converter, Bifurcation and chaos in the Voltage controlled Buck Converter with latch, Bifurcation and chaos in the Voltagecontrolled Buck Converter without latch, Bifurcation and chaos in Cuk Converter. Nonlinear phenomenon in the inverter under tolerance band control

Nonlinear Phenomena in Drives: Nonlinear Phenomenon in Current controlled and voltage controlled DC Drives, Nonlinear Phenomenon in PMSM Drives.

Control of Chaos:Hysteresis control, Sliding mode and switching surface control, OGY Method, Pyragas method, Time Delay control. Application of the techniques to the Powerelectronics circuit and drives.

Books:

1. S Banerjee, Dynamics for Engineers, Jhon Wiley
2. S Banerjee, Nonlinear Phenomena in Power Electronics, IEEE Press
3. Steven H Strogatz, Nonlinear Dynamics and Chaos, Westview Press

PEM- 212 Special Electrical machines 4-0-0-4-4:

Stepper Motor: Introduction, Types, Hybrid stepper motor- construction, principle of operation, two phases energized at a time, conditions for operation, different configurations,VR Stepper motor- single stack and multi stack, Drive systems and circuit for open loop and Closed loop control of stepping motor. Dynamic characteristics. Single phase stepper Motor, Expression of voltage , current and torque for stepper motor and criteria for synchronization.

Switched Reluctance Motor: Constructional features, principle of operation, Design Aspects and profile of the SRM, Torque equation, Power converters and rotor sensing mechanism, expression of torque and torque-speed characteristics,

Permanent Magnet Materials: Permanent magnet materials, properties, minor hysteresis loop and recoil line, equivalent circuit, stator frames with permanent magnets,

Brushless DC Motor : Construction, operation, sensing and switching logic scheme, Drive and power circuit, Theoretical analysis and performance prediction, transient Analysis.

Linear Induction Motor: Construction and principle of operation of Linear Induction Motor, Approximate calculation of the force on rotor.

Books :

1. Venkatratnam, “Special Electrical Machines”, Universities Press
2. Fitzeraldand Kingsley,” Electrical Machines” McGraw Hill. Miller. T. J. E., “Brushless PermanentMagnet and
3. Reluctance Motor Drives”, Clarendon Press, Oxford, 1989.
4. Kenjo. T and Nagamori. S, “Permanent Magnet and Brushless DC Motors”, Clarendon Press, Oxford, 1989.
5. Kenjo. T, “Stepping Motors and their Microprocessor Control”, Clarendon Press, Oxford, 1989
6. Krishnan R, “Switched Reluctance Motor Drives”, Modelling, Simulation, Analysis, Design and applications, CRC press

PEM- 213 Embedded system 4-0-0-4-4:

Introduction to Embedded systems: Introduction – Features – Microprocessors – ALU - Von Neumann and Harvard Architecture - CISC and RISC - Instruction pipelining.

Microcontroller: characteristics and Features, Overview and architectures of Atmel 89C52 and Microchip PIC16F877 and 18F452.

Examples of embedded Systems: Bar-code scanner, Laser printer, Underground tank monitoring.
PIC Microcontroller: PIC Microcontrollers: 16F877 Architecture and Instruction Set. External Interrupts, Timers, watch-dog timer, I/O port Expansion, analog-to-digital converter, UART, I2C and SPI Bus for Peripheral Chips, Accessories and special features
Software architecture and RTOS: Software Architecture: Round Robin- Round Robin with interrupts -Function Queue. Scheduling
Architecture RTOS: Architecture -Tasks and Task States -Tasks and Data -Semaphores and Shared Data - Message Queues -Mail Boxes and pipes -Timer Functions -Events -Memory Management, Interrupt , Routines

Basic design using a real time operating system: Overview. General principles.Design of an embeddedsystem.
Software development tools and debugging techniques: Development Tool: Cross-Compiler, Cross-Assemblers,Linker/locator. PROM Programmers, ROM Emulator, In-Circuit Emulators. Debugging Techniques. Instruction set simulators. The assert macro. Testing using laboratory tools.

Books:

1. Embedded Systems Architecture, Programming and Design, Ral KamalTMH, 2008.
2. An Embedded Software Primer, D.E. Simon. Pearson Education, 1999.
3. Design with PIC Microcontrollers, J.B. Peatman,Pearson Education, 1998
4. Embedded Systems Design, Heath Steve, Second Edition-2003, Newnes,
5. Computers as Components; Principles of EmbeddedComputing System Design, Wayne Wolf Harcourt India, Morgan Kaufman Publishers, First Indian Reprint. 2001.
6. Embedded Systems Design – A unified Hardware /Software Introduction, Frank Vahid and Tony Givargis, John Wiley,

PEM- 214 Digital Image Processing 4-0-0-4-4:

Introduction to structure of human eye, Image formation in the human eye, Brightness adaptation and discrimination, Image sensing and acquisition, storage, Processing, Communication, Display Image Sampling and quantization, Basic relationships betweenpixels.
Image Transforms (implementation):Introduction to Fourier transform, DFT and 2-D DFT, Properties of 2-D FT, FFT, IFFT,Walsh transform, Hadamard transform, Discrete cosine transform, Slant transform, Optimumtransform: Karhunen – LoeveHotelling) transform.
Image Enhancement in the Spatial and Frequency Domain:Gray level transformations, Histogram processing, Arithmetic and logic operations, Spatialfiltering: Introduction, Smoothing and sharpening filters. Frequency domain filters: Homomorphic filtering.
Image Data Compression:Fundamentals, Redundancies: Coding, Inter pixel Psycho-visual, fidelity criteria, Imagecompression models, Error free compression, Lossy compression, Image compressionstandards: Binary image and Continuous tone Still Image compression standards, Videocompression standards.
Morphological Image Processing:Introductions, Dilation, Erosion, Opening, closing, Hit -or-miss transformation,Morphological algorithm operations on binary Images, Morphological algorithm operationson gray-scale Images.Image Segmentation, Representation and Description:Detection of discontinuities, Edge linking and Boundary detection, Thresholdingregionbased segmentation, Image Representation schemes, Boundary descriptors, and Regional descriptors.

Books:

1. Digital Image Processing, R.C Gonzalez and R. Woods, Pearson publication.
2. Digital Image Processing, Anil K. Jain, Prentice-Hall, India.
3. Digital Image Processing, W.K. Pratt 2nd Edition, John Wiley & Sons.
4. Digital Image Processing and Analysis, B. Chanda& D. DuttaMajumder Prentice-Hall, India.
6. Image Processing- Theory, Algorithms & Architecture, M. A. Sid-Ahmed, McGraw-Hill.

PEM- 215 Advanced Power Electronics 4-0-0-4-4:

Modeling of DC-to-DC Power Converters: Buck Converter, Boost Converter, Buck-Boost Converter, Non-inverting Buck-Boost Converter, C´uk Converter, Sepic Converter, Zeta Converter, Quadratic Buck Converter, Boost-Boost Converter, Double Buck-Boost Converter, Power Converter Models with Non-ideal Components, A General Mathematical Model for Power Electronics Devices.

Controller Design Methods: Sliding Mode Control, Variable Structure Systems, Control of the Buck Converter , Control of the Boost Converter, Control of the Buck-Boost Converter, Control of the C´uk Converter, Control of the Zeta Converter, Control of the Quadratic Buck Converter, Multi-variable Case, Control of the Boost-Boost Converter, Control of the Double Buck-Boost Converter, $\Sigma-\Delta$Modulation.

Approximate Linearization in the Control of PowerElectronics Devices: Linear Feedback Control, Buck Converter, Boost Converter, Buck-Boost Converter, Non-inverting Buck-Boost Converter, C´uk Converter, Sepic Converter, Zeta Converter, Quadratic Buck Converter, Boost-Boost Converter.

Nonlinear Methods in the Control of Power Electronics Devices : Feedback Linearization, Passivity Based Control, Exact Error Dynamics Passive Output Feedback Control,Error Dynamics Passive Output Feedback, Control via Fliess' Generalized Canonical Form, Nonlinear Observers for Power Converters, Reduced Order Observers, GPI Sliding Mode Control.

Applications: DC-to-AC Power Conversion-Nominal Trajectories in DC-to-AC Power Conversion, An Approximate Linearization Approach, A Flatness Based Approach, A Sliding Mode Control Approach, Exact Tracking Error Dynamics Passive Output Feedback control.

AC Rectifiers: Boost Unit Power Factor Rectifier, Three Phase Boost Rectifier, A Unit Power Factor Rectifier-DC Motor System, A Three Phase Rectifier-DC Motor System.

Books:

Control DesignTechniques in PowerElectronics Devices, HeberttSira-Ramírez andRamón Silva-Ortigoza, Springer.

PEM- 216 Advanced Electric Drives 4-0-0-4-4:

Dynamics of Electromechanical Systems: Mechanical Systems, Constraints, Classification of Constraints and Effects of Their Imposition, Electromechanical Systems.

Induction Machine in Electric Drives:Mathematical Models of Induction Machines, Dynamic and Static Characteristics of Induction Machine Drives, Methods and Devices for Forming Characteristics of an Induction Motor, Control ofInduction Machine Drive,

Brushless DC Motor Drives (BLDC):Permanent Magnet – Basic Description in the Mathematical Model, Mathematical Model of BLDC Machine with Permanent Magnets, Characteristics of BLDC Machine Drives, Control of BLDC Motor Drives.

Switched Reluctance Motor Drives:Operating Principle and Supply Systems of SRM Motors,Magnetization Characteristics and Torque Producing in SRM Motor, Mathematical Model of SRM Motor, Dynamic Characteristics of SRM Drives, Characteristics of SRM Machines,Control of SRM Drives

Books:

Dynamics and Control of Electrical Drives, PiotrWach,Springer.

PEM- 217 Application of Power Electronics in Power System 4-0-0-4-4:

Review of transmission lines, radial & symmetrical lines, shunt & seriescompensation; FACTS & Power Quality; SVC: TCR, FC-TCR, TSC-TCRvariants;

STATCOM: Circuit , operation & control , active filters, hybrid activefilter

TCSC: Circuit, operation andcontrol, critical modes;

DVR: Circuit , operation, control modes;

UPFC: Circuit , operation, steady-state behavior and dynamiccontrol , advantage over previous compensators;

IPFC: Circuit , steady-statebehavior and control , advantage over UPFC

Books:

1. N. G. Hingorani&LazsloGyugi , "Understanding FACTS", IEEE Press.
2. K. R. Padiyar, "FACTS Controllers in Power Transmission andDistribution",New Age International(P) Ltd.
3.ArindamGhosh& Gerard Ledwich, "Power Quality Enhancement UsingCustom Power Devices", Kluwer Academic 4. A joint venture by IISc and IITs, funded by MHRD, Govt of India http://nptel.iitm.ac.in

PEM- 218 Pulse width Modulation for Power Electronic Converters 4-0-0-4-4:

Converter topologies for AC/DC and DC/AC power conversion, overview ofapplications of voltage source converters; pulsewidth modulation techniques for 1-phase and 3-phase bridge converters, sine-triangle PWM, bus

clamping PWM,space vector based PWM, advanced PWM techniques; calculation of switchingand conduction losses; compensation for dead time and DC voltage regulation;estimation of current ripple and torque ripple in inverter fed drives; overmodulation; extension of modulation methods to multilevel inverters.

Books:

1. Technical Literature – papers published in power electronics relatedjournal s.

PEM- 219Power Electronics and Distributed Generation 4-0-0-4-4:

Introduction to distribution systems, distribution system equipment , grounding,sequence analysis and fault calculations, relaying requirement s for DistributedGeneration (DG) systems.Intentional and unintentional islanding, power converter topologies for gridinterconnection, inverter modeling, filtering requirements. Selection of powerconverter component s, DC bus design, considerations for power loss andreliability in the design procedure, thermal cycling of power semi conductormodules, insulation grade selection, and thermal design implications.Control of grid interactive power converters, synchronization and phase lockingtechniques,

current control , DC bus control , converter fault s, grid parallel andstand al one operation. Power quality , voltage unbalance, harmonics, flicker,voltage and frequency windows, and recent t rends in power electronic DGinterconnection.

Books:

1. Technical literature – papers published in power electronics relatedjournal s and IEEE standards.
2. Arthur R. Bergen, Vi j ay Vittal , Power Systems Analysis, Prentice Hal l ,1999.
3. Ned Mohan, T M. Undeland, W. P. Robbins, Power Electronics:Converters, Applications, and Design; Wiley,
4. Ajoint venture by IISc and IITs, funded by MHRD, Govt of India http://nptel.iitm.ac.in

PEM-220 Modeling and Simulation of Systems Using MATLAB and Simulink 4-0-04-4:

Introduction to Systems: System ,Boundary, Components, Interactions, Classification of Systems, Analysis of Systems, Synthesis of Systems,

Systems Modeling: Introduction , need, method, Classification- Physical , Abstract Model, Mathematical , Descriptive ,Static, Dynamic , Steady State, Transient , Open, Feedback, Deterministic, Stochastic , Continuous, Discrete Model, Model Evaluation, Mathematical Modeling of Mechanical, Electrical, Electromechanical Systems.

Formulation of State Space Model of Systems: Computation of Parameters of a Component, Single Port and Multiport Systems, Techniques of System Analysis, Formulation of System Model for Physical Systems, Development of State Model of Degenerative System, Solution of State Equations, Controllability, Observability, Sensitivity, Liapunov Stability.

Model Order Reduction: Need, principle, method, application.

Analogous of Linear Systems: D'Alembert'sPrinciple,Force–Voltage Analogy, Force–Current analogy **Interpretive Structural Modeling:** Graph Theory, modeling.

System Dynamics Techniques: System dynamics , Traditional Management, Sources of Information, System Dynamics Technique, Dynamo Equations.

Simulation: Introduction, Advantages, Numerical Methods, Comparison, error.

Nonlinear and Chaotic System: Linear vs. Nonlinear System , Types of Nonlinearities, Nonlinearities in Flight Control of Aircraft, different controllers (P, I, D, PD, PI, PID, and Fuzzy) design, Chaotic System, Bifurcations, Lorenz Equation: A Chaotic Water Wheel.

Modeling with Artificial Neural Network: Neuron, Characteristics, Selection ,Testing Phase, application.

Modeling Using Fuzzy Systems: Sets, features, operations, characteristics, relation, Approximate Reasoning, Defuzzification Methods, Fuzzy Rule-Based Systems, Applications of Fuzzy Systems to System Modeling, Steady State DC Machine Model, Transient Model of a DC Machine.

Discrete-Event Modeling and Simulation: Definitions, Queuing System, Discrete-Event System Simulation, Components, Modeling, test.

Books :

Modeling and Simulation of Systems Using MATLAB and Simulink , Dr. D.K. Chaturvedi, CRC press.

PEM-221 Modeling and Control of Wind Energy Generation 4-0-0-4-4:

Electricity Generation from Wind Energy- Wind Farms , Wind Energy-generating Systems , Wind Turbines , Wind Turbine Architectures , Wind Generators Compared with Conventional Power Plant, impacts, Grid Code Regulations for the Integration of Wind Generation ,

Power Electronics for Wind Turbines: Soft-starter for FSIG Wind Turbines, Voltage Source Converters (VSCs), Application of VSCs for Variable-speed Systems, VSC with a Diode Bridge,

Modeling of Synchronous Generators, Generator Equations in thedqFrame, control.

Fixed-speed Induction Generator (FSIG)-based WindTurbines.FSIG Model as a Voltage Behind a Transient, Dynamic Performance of FSIG Wind Turbines, Small Disturbances, performance.

Doubly Fed Induction Generator (DFIG)-based Wind Turbines: Configuration, Characteristics, Control Strategies for a DFIG, Steady-state, Control for Optimum Wind Power Extraction, Dynamic Performance Assessment, Fully Rated Converter-based (FRC) Wind Turbines, FRC Induction Generator-based (FRC-IG) Wind Turbine.

Influence of Rotor Dynamics on Wind Turbine Operation: Blade Bending Dynamics , derivation, example, assessment.

Influence of Wind Farms on Network DynamicPerformance, Dynamic Stability and its Assessment .

Books:

WIND ENERGY GENERATION: Modelling and Control, Olimpo Anaya-Lara, University of Strathclyde, Glasgow, UK, Nick Jenkins, Cardiff University, UK, JanakaEkanayake, Cardiff University, UK, Phill Cartwright, Rolls-Royce plc, UK, Mike Hughes, Consultant and Imperial College London, UK, A John Wiley and Sons, Ltd., Publication,

PEM-222 NONLINEAR DYNAMICS AND CHAOS 4-0-0-4-4:

Dynamics in State Space of One and Two Dimensions : Introduction, State Space, Systems Described by First-Order Differential Equations, The No-Intersection Theorem , Dissipative Systems and Attractors One-Dimensional State Space, Taylor Series Linearization Near Fixed Points, Trajectories in a One-Dimensional State Space, Two-Dimensional State Space, Dynamics and Complex Characteristic Values, Dissipation and the Divergence Theorem, The Jacobian Matrix for Characteristic Values, Limit Cycles, Poincare Sections and the Stability of Limit Cycles, Bifurcation Theory .

Three-Dimensional State Space and Chaos: Overview, Routes to Chaos, Three-Dimensional Dynamical Systems, Fixed Points in Three Dimensions, Limit Cycles and Poincare Sections, Quasi-Periodic Behavior,

The Routes to Chaos: Period-Doubling, Quasi-Periodicity, Intermittency and Crises, Chaotic Transients and Homoclinic Orbits, Homoclinic Tangles and Horseshoes, Lyapunov Exponents and Chaos.

Iterated Maps: Introduction, Poincare Sections and Iterated Maps, One-Dimensional Iterated Maps, Bifurcations of Smooth Maps, Pitchfork Bifurcation, Saddle-Node Bifurcation, Period-Doubling Bifurcation, Neimark Bifurcation, Chaos, Lyapunov Exponents, Qualitative Universal Behavior: The U-Sequence, Feigenbaum Universality , Tent Map, Shift Maps and Symbolic Dynamics The Gaussian Map, Two-Dimensional Iterated Maps, The Smale Horseshoe Map.

Quasi-Periodicity and Chaos: Introduction, Quasi-Periodicity and Poincare Sections, Quasi-Periodic Route to Chaos, Universality in the Quasi-Periodic Route to Chaos, Frequency-Locking, Circle Map, The Devil's Staircase and the Farey Tree, Continued Fractions and Fibonacci Numbers, Chaos and Universality.

Intermittency and Crises: Intermittency, The Cause of Intermittency, Quantitative Theory of Intermittency, Types of Intermittency, Crises.

Quantifying Chaos: Introduction,Time-Series of Dynamical Variables, Lyapunov Exponents, Universal Scaling of the Lyapunov Exponent, Invariant Measure, Fractal Dimension(s), Correlation Dimension.

Bifurcations in Piecewise-Smooth Maps: Normal Form, Bifurcations in the One-Dimensional Normal Form, Border Collision Pair Bifurcation, Border-Crossing Bifurcations, Bifurcations in the Two-Dimensional Normal Form, Classification of Border Collision Bifurcations, Border Collision Pair Bifurcation, Border-Crossing Bifurcations, Nonstandard Bifurcations in Discontinuous Maps.

Control of Chaos: The OGY Method, Review of the OGY Method, Pyragas Methods, A Combination of OGY and Pyragas Methods, Controlling Border-Collision Bifurcations, Time-Delay Control of Chaos, TDAS for the Current-Mode Boost Converter.

Books:

1. Chaos and Nonlinear Dynamics:An Introduction for Scientists and Engineers Second Edition, Robert C. Hilborn, Oxford University Press.
2. Nonlinear Dynamics And Chaos: With Applications To Physics, Biology, Chemistry, And Engineering (Studies in Nonlinearity) ,Steven H. Strogatz.

3. NONLINEAR PHENOMENA IN POWER ELECTRONICS :Attractors, Bifurcations, Chaos, and Nonlinear Control, Soumitro Banerjee, George C. Verghese, Wiley.
4. CHAOS: An Introduction to Dynamical Systems, by Kathleen T. Alligood,Tim D. Sauer,James A. Yorke, Springer.
5. DIFFERENTIAL EQUATIONS,DYNAMICAL SYSTEMS, AND AN INTRODUCTION TO CHAOS by Hirch, Smale, Devaney, Elsavier.
6. An Introduction to Chaotic Dynamical System, 2nd Edition, byDevaney, Addison Wiseley.
7. Nonlinear Oscillations, Dynamical Systems, and Bifurcations of Vector Fields by John Guckenheimer , Philip Holmes , Springer.
8. Elements of Applied Bifurcation Theory,Second Edition by Yuri A. Kuznetsov, Springer.
9. Introduction to Applied Nonlinear Dynamical Systems and Chaos by Stephen Wiggins**, Springer.**
10. Controlling Chaos: Suppression, Synchronization and Chaotification by Huaguang Zhang, Derong Liu, Zhiliang Wang, Springer.

PEM-223 Artificial Neural Network 4-0-0-4-4:

Overview of Artificial Intelligence, AI Programming Languages – LISP/PROLOG
Knowledge Representation - Formalized Symbolic Logics. Dealing with Inconsistencies, and Uncertainties. Probabilistic Reasoning.
Structured Knowledge: Graphs, Frames, andRelated Structures.Object-Oriented Representations.Search and Control Strategies, General Problem solving, Production systems,
Control strategies: forward and backward chaining Exhaustive searches: Depth first Breadth
first search, Heuristic search techniques: Hill climbing, Branch and Bound technique, Best first search and A* algorithm, AND/OR Graphs, Problem reduction and AO*, algorithm, Constraint Satisfaction problems Game Playing Minmax search procedure, Alpha-Beta cutoffs, Additional Refinements, Matching Techniques. Knowledge Organization and Management
Basic understanding of Fuzzy Logic, Artificial Neural Network, Perceptron, NaturalLanguage Processing, Pattern Recognition, overview on Expert Systems
Text Books:
1. Introduction to Artificial Intelligence and Expert Systems by D.W. Patterson
2.Artificial Intelligence: A Modern Approach - 3rd edition by Stuart Russell &PeterNorvig
3.Artificial intelligence by Elaine Rich&Kevin Knight
4.Principles ofArtificial Intelligence by J. Nilsson, Narosa Publishing House

PEM-224 Soft Computing 4-0-0-4-4:

Neural Networks: Supervised Learning Neural Networks – Perceptrons - Adaline – Backpropagation Multilayer Perceptrons – Radial Basis Function Networks – UnsupervisedLearning Neural Networks – Competitive Learning NetworksHebbian Learning.
Fuzzy Set Theory: Introduction toNeuro– Fuzzy and Soft Computing – Fuzzy Sets –Basic Definition and Terminology – Set-theoretic Operations – Member Function
Formulation and Parameterization – Fuzzy Rules,Introduction to Fuzzy Reasoning –Extension Principle and Fuzzy Relations
Genetic Algorithm: Difference between Traditional Algorithms and GA, The basicoperators, Schema theorem, convergence analysis, stochastic models, applications insearch and optimization. Encoding, Fitness Function, Reproduction, Cross Over,Mutation,Application of Genetic Algorithm.
Neuro Fuzzy Modeling: Adaptive Neuro-Fuzzy Inference Systems – Architecture – Hybrid
Learning Algorithm – Learning Methods that Cross-fertilize ANFIS and RBFN – Coactive
Neuro Fuzzy Modeling – Framework Neuron Functions for Adaptive Networks – Neuro-Fuzzy Spectrum.
Text Books:
1.M. Mitchell, An Introduction to Genetic Algorithms, Prentice-Hall, 1998.

2.D. E. Goldberg, Genetic Algorithms in Search, Optimization, and MachineLearning, Addison-Wesley, 1989.
3.S. V. Kartalopoulos, Understanding Neural Networks and Fuzzy Logic: BasicConcepts and Applications, IEEE Press - PHI, 2004.
4.S. Rajasekaran& G. A. VijayalakshmiPai, Neural Networks, Fuzzy Logic andGenetic Algorithms: Synthesis & Applications, PHI, 2003.
5.S. N. Sivanandam& S. N. Deepa,Principles of SoftComputing, Wiley - India,2007

PEM-225 RESEARCH METHODOLOGY & COMPUTER APPLICATIONS 4-0-0-4-4:

1. Research Methods:
Topic 1: Introduction to research; Definitions and characteristics of research; Types of research; Main components of any research work.
Topic 2: Topic Selection: Learning Objectives; Problem identification; Criteria for prioritizing problems for research.
Topic 3: Analysis and Statement of the problem: Learning Objectives; Analyzing the problem; Formulating the problem statement.
Topic 4:Literature review: Uses of literature review; Source of information; Organization of information on index cards.
Topic 5: Objectives: Learning Objectives; Definitions; Formulation of the research objectives.
Topic 6: Research methodologies: Study population;Variables; Sampling; Sample size determination; Plan for data collection; Methods of
data collection; Plan for data processing and analysis; Ethical considerations.
Topic 7: Work Plan; Major components and outline ofthe different phases in a research process; Summary of the major components of a research propo
sal; Fieldwork; Writing a research report.
2. Quantitative Methods: a) Statistics: Probability & Sampling distribution;Estimation, Hypothesis testing & application; Correlation & regression analysis.
b) Types of study designs/ Experiment design – Orthogonal array, ANOVA, interaction, Signal-to-Noise ratio, replication;
3. Computer Applications: a. Spreadsheet tool: Introduction to spread-sheet applications, features & functions, using formulae & functions, data storing, features for statisticaldata analysis, generating charts/graphs & other features. [Tools: Microsoft Excel, Open office and similar orother advanced tools]
b. Presentation tool: Introduction to presentation tool, features & functions, creating presentations, customising presentation. [Tools used: Microsoft Powerpoint, Open Office or any other tool]
c. Web Search: introduction to internet, Use of Internet & www, using search engines using advanced search tools.
d. Thesis writing & Scientific editing tools.
References:

1. Montgomary, Douglas C. (2007) 5/e, Design and Analysis of Experiments (Wiley India)
2. Montgomary, Douglas C. &Runger, George C. (2007) 3/e, Applied Statistics & probability for Engineers (Wiley India)
3. Kothari C.K. (2004) 2/e, Research Methodoloy – Methods and Techniques (New Age International, New Delhi)
4. Krishnswamy, K.N., Shivkumar, AppaIyer and Mathiranjan M. (2006) Management Research Methodology; Integration of Principles, Me thods and Techniques (Pearson Education, New Delhi)
5. The Complete reference Office Xp- Stephan L. Nelson , Gujulia Kelly (TMH)
6. Basic Computer Science and Communication Engineering – R. Rajaram (SCITECH)

PEM- 291 Electrical Engineering Lab. – I 0-0-6-6-4:

Laboratory based on the theoretical subjects covered in 2nd semester.

PEM- 281 Seminar0-0-6-6-4:

Seminar based on the theoretical subjects covered in 1st and 2nd semester.

Third semester:

PEM- 381 Pre-submission Defense of Dissertation 0-0-0-0-6:

Pre-submission seminar to be delivered beforesubmission of intermediate Dissertation.

PEM- 382 Dissertation(Part-I) 0-0-18-18-12:

An intermediate thesis on the work done till end of odd semester to be submitted and that will be evaluated.

PEM- 383 Classroom Teaching Practice0-0-6-6-4:

Each student has to take classes of B.Tech. Courses and those will be evaluated. Students feedback will be given due importance in this regard.

4th semester:

PEM- 481 Post-submission Defense of Dissertation 0-0-0-0-4:

Post-submission seminar to be delivered aftersubmission of final Dissertation.

PEM- 482 Dissertation(Completion) 0-0-24-24-18:

Afinal thesis on the final work done till end of even semester to be submitted and that will be evaluated.

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