CURRICULAM AND SYLLABUS

(w.e.f. Academic Year 2008-09)

FOR

MASTER OF TECHNOLOGY
IN
POWER SYSTEMS ENGINEERING

ACHARYA NAGARJUNA UNIVERSITY
NAGARJUNA NAGAR
GUNTUR DIST.

ACHARYA NAGARJUNA UNIVERSITY
NAGARJUNA NAGAR

FOUR SEMESTER M.TECH DEGREE COURSE
IN
POWER SYSTEMS ENGINEERING

CURRICULUM & DETAILED SYLLABI

S.No	Course Number	Subject	Periods/week		Internal marks	End Semester Examination	
			L+T	P		Duration	Marks
First Semester							
1.	MT/PSE/PEPS 511	Optimization Techniques	4	--	30	3	70
2.	MT/PSE/PEPS 512	Modern Control Theory	4	--	30	3	70
3.	MT/PSE/PEPS 513	Solid State Power Converters	4	--	30	3	70
4.	MT/PSE/PEPS 514	Advanced Power System Protection	4	--	30	3	70
5.	MT/PSE/PEPS 515	Computer Methods in Power Systems	4	--	30	3	70
6.	MT/PSE 516	High Voltage Engineering	4	--	30	3	70
7.	MT/PSE 551	Power Systems Lab	--	3	25	3	50
8.	MT/PSE 552	Simulation Lab – I	--	3	25	--	--
		TOTAL	24	6	230	--	470
Second Semester							
1.	MT/PSE/PEPS 521	Flexible AC Transmission Systems	4	--	30	3	70
2.	MT/PSE/PEPS 522	Power System Stability	4	--	30	3	70
3.	MT/PSE/PEPS 523	Operation & Control of Power Systems	4	--	30	3	70
4.	MT/PSE 524	Electrical Distribution Systems	4	--	30	3	70
5.	MT/PSE 525	Elective-I	4	--	30	3	70
6.	MT/PSE 526	Elective-II	4	--	30	3	70
7.	MT/PSE 561	Simulation Lab – II	--	3	25	3	50
8.	MT/PSE 562	Seminar	--	3	25	--	--
		TOTAL	24	6	230	--	470
Third Semester							
1.	MT/PSE 611	Project Seminar	--	--	50	--	--
		TOTAL	--	--	50	--	--
Fourth Semester							
1.	MT/PSE 621	Project Presentation	--	--	50	--	100
		TOTAL	--	--	50	--	100

List of Electives:

Electives – I

MT/PSE 525 /1	Power systems planning in deregulated environment
MT/PSE 525 /2	Reliability Engineering
MT/PSE 525 /3	Digital Control Systems
MT/PSE 525 /4	HVDC Transmission Systems
MT/PSE 525 /5	Renewable Energy Resources

Electives – II

MT/PSE 526/1	Fuzzy Logic & Neural Networks
MT/PSE 526/2	Embedded Systems
MT/PSE 526/3	Computer Networks
MT/PSE 526/4	Data Base Management Systems
MT/PSE 526/5	Microprocessors & Microcontrollers

- 1st class with distinction – 70% and above.
- 1st class – 60% to 70%.
- 2nd class – 40% to 60%.
- 40% Marks compulsory in university examinations.
- Other rules and regulations will be as per Acharya Nagarjuna University.

MT/PSE/PEPS 511 OPTIMIZATION TECHNIQUES

UNIT I

LINEAR PROGRAMMING: Definition and Scope of Operations Research, Mathematical formulation of the problem, graphical method, Simplex method , artificial basis technique , Degeneracy , alternative optima , unbounded solution , infeasible solution.

UNIT II

TRANSPORTATION PROBLEM : Introduction to the problem , LP formulation of a ransportation problem . Basic feasible solution by north-west corner method, Vogel's approximation method, least cost method. Finding optimal solution by MODI method, degeneracy , unbalanced transportation matrix.
Non linear programming : Kuhn-Tucker conditions.

UNIT III

PROJECT PLANNING THROUGH NETWORKS : Arrow(Network) Diagram representation. Rules for constructing an arrow diagram , Pert and CPM , Critical path calculations ,earliest start and latest completion times, Determination of critical path ,determination of floats, Probability considerations in project.

UNIT IV

SIMULATION : Definition and applications. Monte Carlo simulation. Application problems in queuing and inventory.

DYNAMIC PROGRAMMING : Characteristics of D.P. model , solution of optimal sub-division problem.

Text Books :

1. Operations Research –H.A. Taha, 6th Edition, PHI
2. Introduction to Operations Research – Hiller and Liberman

Reference Books :

1. Introduction to operations Research-Phillips, Ravindran, James Solegerg.
2. Optimization theory and applications – S.S. Rao 3rd Ed., New Age International
3. Operations Research – Gupta and Hira
4. Pert and CPM principles and applications – L.S.Srinadh

MT/PSE/PEPS 512 MODERN CONTROL THEORY *

UNIT –I STATE VARIABLE ANALYSIS

The concept of state – State Equations for Dynamic systems – Time invariance and Linearity – Nonuniqueness of state model – State diagrams for Continuous-Time State models .

Linear Continuous time models for Physical systems– Existence and Uniqueness of Solutions to Continuous-Time State Equations – Solutions of Linear Time Invariant Continuous-Time State Equations– State transition matrix and its properties.

General concept of controllability – General concept of Observability – Controllability tests for Continuous-Time Invariant Systems – Observability tests for Continuous-Time Invariant Systems – Controllability and Observability of State Model in Jordan Canonical form – Controllability and Observability Canonical forms of State model.

UNIT- II NONLINEAR SYSTEMS

Introduction – Non Linear Systems - Types of Non-Linearities – Saturation – Dead-Zone - Backlash – Jump Phenomenon etc;– Singular Points – Introduction to Linearization of nonlinear systems, Properties of Non-Linear systems – Describing function–describing function analysis of nonlinear systems – Stability analysis of Non-Linear systems through describing functions

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UNIT-III STABILITY ANALYSIS

Stability in the sense of Lyapunov, Lyapunov's stability and Lypanov's instability theorems - Stability Analysis of the Linear continuous time invariant systems by Lyapunov second method– Direct method of Lyapunov – Generation of Lyapunov functions – Variable gradient and Krasoviskii's methods – estimation of transients using Lyapunov functions

UNIT- IV OPTIMAL CONTROL

Introduction to optimal control - Formulation of optimal control problems – calculus of variations – fundamental concepts, functionals, variation of functionals – fundamental theorem of Calculus of variations – boundary conditions – constrained minimization – formulation using Hamiltonian method – Linear Quadratic regulator

TEXT BOOKS:

1. Modern Control System Theory by M.Gopal – New Age International -2/E
2. Modern Control Engineering by Ogata.K – Prentice Hall – 4/E

REFERENCES:

1. Design of Feedback Control Systems by Stefani et.al. – Oxford – 4/E

* CONTINUOUS-TIME SYSTEMS ONLY

MT/PSE/PEPS 513 SOLID STATE POWER CONVERTERS

UNIT-I

LINE COMMUTATED CONVERTERS:

AC to DC Converter- single phase controlled rectifier bridge type - with R load- RL load- with and without FWD- analysis & wave forms- three phase controlled rectifier bridge type with R, RL loads with & without FEWD- analysis & waveforms – performance factors of line commutated converters - advantages- applications - power factor improvements. twelve pulse converter.

UNIT-II

AC VOLTAGE CONTROLLERS:

Single phase Ac voltage controllers- with R & RL loads- Analysis & waveforms- three phase AC voltage controllers- analysis& wave forms – AC synchronous tap changers - Matrix converters.

CYCLO CONVERTER:

Single phase – bridge type- R & RL loads- 3 phase bridge type principle of operation & wave forms.

UNIT-III

INVERTERS:

Bridge type- Single phase Inverters. MC Murray- Bedford inverter- and their analysis & waveforms – Bridge type three phase Inverters –analysis of 180 degree & 120 degree conduction modes. Current Source Inverter- some applications- comparison of VSI & CSI- problems.

UNIT-IV

VOLTAGE CONTROL OF SINGLE PHASE INVERTERS:

single PWM – Multiple PWM – sinusoidal PWM – modified PWM – phase displacement Control – Advanced modulation techniques for improved performance – Trapezoidal, staircase, stepped, harmonic injection and delta modulation –Advantage – application

VOLTAGE CONTROL OF THREE PHASE INVERTERS:

sinusoidal PWM – Third Harmonic PWM – 60 degree PWM – space vector modulation – Comparison of PWM techniques – harmonic reductions

TEXT BOOKS:

1. Power Electronics – Mohammed H. Rashid – Pearson Education – Third Edition – First Indian reprint 2004.
2. Power Electronics – Ned Mohan, Tore M. Undeland and William P. Robbins – John Wiley & Sons – Second Edition.

MT/PSE/PEPS 514 ADVANCED POWER SYSTEM PROTECTION

UNIT-I:
Need for protection systems: Nature and causes of faults, types of faults, effects of faults, fault statistics, evolution of protective relays, zones of protection, primary & back up protection, essential qualities of protection, classification of protective relays and schemes, automatic reclosing, CT, PT, summation transformer, phase-sequence current segregating network.

UNIT-II:
Direct transfer tripping, permissive under-reach and over-reach transfer tripping schemes – carrier acceleration & carrier blocking scheme. Use of optical fibers for protection schemes.

UNIT-III:
Static Relays: Advantages of static relays, working principles of static impedance, static reactance using phase comparator, static distance, static over current, static differential relay using amplitude comparator, use of sampling comparator.

UNIT-IV:
Microprocessor based protection relays – Working principles of μP based over current, impedance, reactance directional, reactance (distance) & mho relays – digital relaying algorithms, various transform techniques employed like discrete Fourier, Walsh-Hadamard, Haar, microprocessor implementation of digital distance relaying algorithms – protection of lines against lightning & traveling waves.

TEXT BOOKS:

1. T.S.M.Rao – Power System Protection : Static Relays With Microprocessor Applications – Tata McGraw-Hill.
2. Badri Ram & DN Viswakarma – Power System Protection & Switch Gear – McGraw Hill.
3. Computer Relaying For Power Systems – Research Studies Press, 1988.

REFERENCE BOOKS:

1. A.R.Van C.Washington – Protective Relays – Their Theory & Practice, Vol.I & II – John Wiley & Sons.
2. D.Robertson – Power System Protection – Reference Manual – Oriel Press – London, 1982.
3. C.R.Mason – The Art and Science of Protective Relaying – John Wiley.
4. S.S.Rao – Switch Gear & Protection – Khanna Publisher's, Delhi.
5. Microprocessors & Microcomputer Development Systems: Designing Microprocessor Based System – by M.Rafiquzzaman.

MT/PSE/PEPS 515 COMPUTER METHODS IN POWER SYSTEMS

UNIT-I:

Network Matrices and Modeling: Introduction, linear transformation techniques (bus, branch, loop frame of references), single phase modeling of transmission lines, off-nominal transformer tap representation, phase shift representation, 3-phase models of transmission lines, modeling of loads, representation of synchronous machines

UNIT-II:

Power flow solutions: Review of power flow equations - GS, NR and FDC methods of solving power flow equations, power flow methods for contingency

Three Phase Load Flows: Formulation of three phase power flow equations, Fast-decoupled three phase algorithm and computer program structure

UNIT-III:

Fault System Studies: (Generators, transformers, cables & systems): Analysis of three phase faults - admittance matrix equation - impedance matrix equation - fault calculations - analysis of unbalanced faults - admittance matrices - fault calculations - short circuit faults - open circuit faults - program description and typical solutions.

UNIT-IV:

Z_{BUS} methods in Contingency Analysis: Adding and removing multiple lines (current injection methods), piece wise solution of interconnected systems, analysis of single and multiple contingencies, external system representation for fault and contingencies by Ward and REI approaches.

***TEXT BOOKS*:**

1. Stagg G.Ward, El-Abiad: Computer methods in power system analysis. McGraw Hill, ISE, 1968.
2. J.Arrilaga and C.P.Arnold: Computer modeling of electric power systems, John Wiley & Sons, N.Y. 1983.
3. J.J.Grainger, W.D.Stevenson JR, Power system analysis, TMH, Delhi 2007.

***REFERENCES*:**

1. Nagarath & Kothari Modern power system analysis 3rd Edition, TMH.
2. Nagsarkar & Sukhija, Power system analysis, Oxford press, New Delhi, 2007

MT/PSE 516 HIGH VOLTAGE ENGINEERING

UNIT I:

Conduction and Breakdown in Gases:
Ionization process, Twonsend's current growth equation, current growth in the secondary processes, Twonsend's criterion for breakdown, streamer theory of breakdown in gases, Paschen law, breakdown in non uniform fields and corona discharge.

Generation of High Voltage and Currents:
Generation of high D.C., alternating voltages, impulse voltages, generation of impulse currents, tripping and control of impulse generators

UNIT II:
Measurement of high voltage and currents:
Measurement of high d.c.voltages, Measurement of high a.c. and impulse voltages, Measurement of high d.c., a.c. and impulse currents. Cathode Ray Oscilloscope for impulse voltage and current measurements.

UNIT III:
Testing of Materials and Apparatus
Measurement of D.C. resistivity, measurement of dielectric constant and loss factor, partial discharge measurements, testing of insulators, bushing, circuits breakers, transformers and surge diverters.

Over Voltage Phenomenon Insulation Coordination:
Causes of over voltage, lighting phenomenon, switching over voltages and power frequency over voltages in power systems,

UNIT IV:
Insulation Coordination:
Principle of insulation coordination on high voltage and extra high voltage power systems.
Gas insulated substations:
Advantages of Gas Insulated Substations, Comparison of Gas Insulated substations and Air Insulated Substations, Design and Layout of Gas Insulated Substations, Description of Various components in GIS.

TEXT BOOKS:
1. High Voltage Engineering by M.S.Naidu and V.Kamaraju – TMH.
2. High Voltage Engineering fundamentals by Kuffel and Zungel, Elsavier Publications
3. Switchgear By BHEL, TMH

REFERENCES:
1. Fundamentals of Gaseous Ionization and plasma Electronics by Essam Nasser – Wiley - Inter Science.
2. High Voltage Technology by ALSTOM
3. Gaseous Dielectrics by Arora, TMH

MT/PSE 551 POWER SYSTEMS LAB

List of Experiments*

1. Evaluation of ABCD parameters for transmission line
2. Sequence reactances and fault studies on synchronous machine
3. Surge Impedance Loading limits of transmission line
4. Voltage control by capacitor compensation and tap changing transformers
5. Active and Reactive power control of synchronous machine connected to infinite bus
6. Line and load compensation of power system network
7. Characteristics of electromagnetic relays
8. Implementation of microprocessor based relays
9. Characteristics of static relays
10. Study of 3-phase bridge converter
11. Study of characteristics of Dual converter
12. Study of single-phase inverter
13. Study of PWM controlled 3-phase inverter
14. H.V. testing of insulators
15. High voltage testing of Cables
16. Study of corona phenomenon

*** Any eight experiments to be completed**

MT/PSE 552 SIMULATION LAB – I

List of Experiments*

1. Solution of simultaneous algebraic equations of Electrical network
2. Solution of simultaneous differential equations of a given network
3. Formation of incidence matrices
4. Formation of network matrices by singular or nonsingular transformations
5. Formation of Y_{bus} by inspection method
6. Formation of Z_{bus} by step by step algorithm using MATLAB
7. Fault analysis in power system using matrix method
8. Simulation of electric networks using MATLAB
9. Simulation of transmission line using MATLAB
10. Power flow solution using Gauss seidel method
11. Simulation of 1-phase diode bridge rectifier
12. Simulation of 1-phase controlled rectifier
13. Simulation of Single Phase AC voltage Controller
14. Transfer function analysis of given system using Simulink
15. State space analysis of a control system using MATLAB
16. Conversion of the given state system into a suitable diagonal form

*** Any eight experiments to be completed**

MT/PSE/PEPS 521 FLEXIBLE AC TRANSMISSION SYSTEMS

UNIT-I
FACTS Concept and General system Considerations:

Power Flow in AC system - definitions on FACTS - Basic types of FACTS Controllers. Converters for Static Compensation – Basic concept of voltage-sourced converters. Single phase, three phase full wave bridge converters operation, Transformer connections for 12 pulse 24 and 48 pulse operation. Three level voltage source converter, pulse width modulation converter, basic concept of current source Converters, comparison of current source converters with voltage source converters.

UNIT-II
Static Shunt Compensators:
SVC and STATCOM - Operation and Control of TSC, TCR, STATCOM - Comparison between SVC and STATCOM - STATCOM for transient and dynamic stability enhancement.

UNIT-III
Static Series Compensation:
GCSC, TSSC, TCSC and SSSC - Operation and Control - External System Control for series Compensators - SSR and its damping - Static Voltage and Phase Angle Regulators - TCVR and TCPAR - Operation and Control.

UNIT-IV
UPFC and IPFC:
The unified Power Flow Controller – Operation - Comparison with other FACTS devices - control of P and Q - Dynamic Performance - Special Purpose FACTS controllers - Interline Power flow Controller - Operation and Control.

TEXT BOOKS:
1. Understanding FACTS: Concepts and Technology of Flexible AC Transmission Systems, IEEE Press, 2000 by N.G. Hingorani & L.Gyugyi
2. FACTS Controllers in power transmission and Distribution, K.R.Padiyar, New Age Int. Publisher, 2007

REFERENCE BOOKS:
1. Power Electronics by Ned Mohan et. al , John Wiley & sons
2. Reactive Power Control in Electric Systems by T.J.E. Miller , John Wiley & sons

MT/PSE/PEPS 522 POWER SYSTEM STABILITY

UNIT – I

Steady state stability: Steady state power limits of a two machine system and multi machine systems – Analytical and graphical methods of calculating steady state stability limits – analysis of SMIB system with excitation system . Power system stabilizer – characteristics of small signal stability.

UNIT – II

Voltage stability analysis: Voltage stability concepts – voltage collapse phenomenon – prevention of voltage collapse.

Voltage stability of Single machine connected to infinite bus system – PV curves – QV curves. Effect of compensation – Series, shunt and SVCs.

UNIT – III

Transient stability: Review of transient stability – numerical integration methods – Swing Equation and it's Solution by equal area criterion: Sudden change in mechanical input – Sudden loss of one of parallel lines – Short circuit at one end of line – Short circuit away from line ends – Line reclosure.

Swing Equation solution by point by point method – modified Euler's method and Gauss Seidel method. Evaluation of transient stability by direct method.

UNIT – IV

Effects on stability due to losses – governor action – inertia – saturation – SCR – saliency – damper windings – methods of grounding.

Methods of improving stability: High speed fault clearing, Reduction of transmission system reactance, regulated shunt compensation, Dynamic braking, Reactor switching, Single pole switching, Steam turbine fast valving, Generator tripping, load shedding, High speed excitation systems, HVDC transmission links, SVC.

TEXT BOOKS:

1. Prabha Kundur., " Power system stability and control", Tata McGraw Hill
2. Kimbark E.W. " Power system stability and control – Vol I, Elements of stability calculations", John Wiley & Sons
3. Kimbark E.W. " Power system stability and control – Vol III, synchronous machines", John Wiley & Sons

REFERENCES:

1. Anderson P.M., and Foud A.," Power system control and stability" Galgotia publications
2. Taylor C.W. " Power systems voltage stability", TMH
3. K.R. Padiyar, " Power systems Dynamics stability and control", Interline publishing pvt., ltd., Bangalore.

MT/PSE/PEPS 523 OPERATION AND CONTROL OF POWER SYSTEMS

UNIT-I:

Economic dispatch: Economic importance - characteristics of thermal, nuclear and hydro-generator units - Economic dispatch problem – Thermal system dispatch with network losses – line loss formula – The Lambda iteration method – first order gradient method – base point and participation factors – Economic dispatch Vs unit commitment.

UNIT-II:

Load frequency control: Definition of control area – single area control – Block diagram representation – steady state analysis – dynamic response – proportional plus integral control of single area block diagrams – AGC multi area system – modeling – static and dynamic response – tie line bias control – Inter connected systems.

Automatic voltage control: Importance – Various methods of voltage control – load compensation – line compensation – modeling of AVR loop – components.

UNIT-III:

Computer control of power systems: Energy control centre – various levels – SCADA system – computer configuration functions – monitoring – data acquisition and controls – EMS system – expert system applications for power system operation.

Security control: Security analysis and monitoring – system operating states by security control functions – generator and line outages by linear sensitivity factors.

UNIT-IV:

State estimation: Power system state estimation – Weighted least square state estimation – state estimation of AC network . Treatment of bad data – network observability and pseudo measurements.

***TEXT BOOKS*:**

1. *Allen J. Wood and Bruce F. Wollenberg* "Power Generation, Operation & Control" 2nd edition, John Wiley and Sons.
2. *I.J. Nagarath & D. P. Kothari* , "Modern power system analysis" 3rd Edition, TMH
3. *Mahalanabis A.K., Kothari D.P. and Ahson S.I.,* "Computer aided power system analysis and control", TMH
4. J.J.Grainger, W.D.Stevenson JR, Power system analysis, Tata McGraw Hill N.D. 2007.

REFERENCES:

1. *I. Elgard* , "Electric Energy Systems Theory – An Introduction" TMH.
2. *Abhijit Chakrabarti & Sunita Halder " Power System Analysis operation and Control " 1st edition, PHI*

MT/PSE 524 ELECTRICAL DISTRIBUTION SYSTEMS

UNIT – I

Distribution systems planning: Planning and forecast techniques - Present and future role of computers in distribution system planning - Load characteristics Definitions load growth – tariffs - Diversified demand method.

Distribution Automation: Introduction – description – benefits – distribution automation components – distribution SCADA – distribution management system – functions of DMS.

UNIT – II

Distribution transformers: Types - Regulation and Efficiency - Use of monograms for obtaining efficiency - distribution factors – KW KVA Method of determining regulation.

Deign of sub transmission lines and distribution substations: Introduction – sub transmission systems - distribution substation – Sub station bus schemes - description and comparison of switching schemes – sub station location and rating - Application of network flow techniques in rural distribution networks to determine optimum location of sub-station.

UNIT – III

Design considerations on primary systems: Introduction - types of feeders - voltage levels - Radial type feeders - feeders with uniformly distributed load and non-uniformly distributed loads.

Design considerations of secondary systems: Introduction - secondary voltage levels - Secondary banking - existing systems improvement.

Distribution system Protection: Basic definitions - over current protection devices - fuses, automatic circuit reclosures, automatic line sectionalizers - objectives of distribution system protection - coordination of protective devices - Fuse to Fuse co-ordination, Fuse to circuit breaker coordination, Reclosure to circuit breaker co-ordination.

UNIT-IV

Voltage drop and power loss calculations: Three phase primary lines - non 3 phase primary lines - 4 wire multi grounded primary lines - copper loss - Distribution feeder costs - loss reduction and voltage improvement in rural distribution networks.

Applications of Capacitors to distribution systems: Effect of series and shunt capacitors - Power factor correction - economic justification for capacitors - a computerized method to determine the economic power factor - Procedure to determine the best and optimum capacitor location

Distribution System Voltage Regulation: Basic definitions - Quality of service - voltage control - line drop compensation.

TEXT BOOKS:

1. *Turan Gonen* "Electric Power Distribution system Engineering", MGH.
2. *Dr. V. Kamaraju* "Electrical distribution systems", Right Publishers .

REFERENCE BOOK:

1. *A.S. Pabla* "Electric Power Distribution" TMH, 4th Ed., 1997.

MT/PSE 525/1 POWER SYSTEMS PLANNING IN DEREGULATED ENVIRONMENT

UNIT – I
INTRODUCTION
Power industry restructuring - Electricity market models - Electricity market fundamentals for planning purpose

UNIT – II
POWER SYSTEM PLANNING FUNDAMENTALS & RELIABILITY
Planning criteria - Uncertainties - Planning process - Generation planning - Transmission planning - Least cost planning - Risks and making choices in planning.
Power system reliability - Reliability assessment - Security assessment.

UNIT - III
SHORT TERM LOAD AND PRICE FORECASTING
Short term load forecasting - Short term market price forecasting - Regression models for load forecasting - Artificial neural networks for load forecasting - Other approaches for forecasting such as data mining approaches; Issues in load and price forecasting.

UNIT - IV
NEW CHALLENGES OF POWER SYSTEM PLANNING IN A DEREGULATED ENVIRONMENT
Deterministic vs probabilistic approaches - Probabilistic power system reliability assessment - Probabilistic power system security assessment and Probabilistic power system planning.

TEXT BOOKS :

1. M. Ilic, F. Grliana, L. Fink “Power System Restructuring” Kluwer Academic Publisher.
2. R.L. Sullivan “Power System Planning “ Tata McGraw-Hill

REFERENCES:

1. E.O. Crousillat, P. Dorfner, P. Alvarado, H.M. Merrill “ Conflicting Objectives and Risk in Power System Planning”(IEEE Trans. Power Systems, Vol. 8, No. 3, pp. 887 – 893 August 1993.
2. B. Zhang & Z.Y. Dong “An Adaptive Neural-wavelet Model for Short Term Load Forecasting “ International Journal of Electric Power Systems Research. Vol. 59 pp. 121-129 2001.
3. T. De la Torre, J.W. Feltes, T. Gomez and H.M. Merrill “Deregulation, Privatization, and Competition: Transmission Planning under Uncertainty” IEEE Trans. Power Systems, Vol. 14, No. 2, pp. 460-465 May 1999.

MT/PSE 525/2 **RELIABILITY ENGINEERING**

UNIT-I

Elements of Probability theory: Introduction, rules for combining probabilities of events, Bernoulli's trials; probability distributions: Random variables, density and distribution functions- Binomial, Poisson, normal and exponential distributions; expected value and standard deviation of Binomial distribution and exponential distribution – Bath tub curve.

UNIT-II

Reliability of engineering systems:

Component reliability, hazard models, reliability analysis of networks with nonrepairable components- series, parallel, series- parallel configurations and non-series-parallel configurations- minimal tie-set, minimal cut-set and decomposition methods, reliability measures, MTTF, MTTR, MTBF.

UNIT-III

Markov Chains:

Introduction; transition probabilities and the stochastic transition probability matrix; classification of states; evaluation of limiting state probabilities; Markov processes – one component repairable system, time dependent probability evaluation using Laplace Transform approach, evaluation of limiting state probabilities using STPM; two component repairable modes - frequency and duration concept-evaluation of frequency of encountering state, mean cycle time for one, two component repairable models, evaluation of cumulative probability and cumulative frequency of encountering merged states.

UNIT-IV

Power system reliability:

Generation system reliability analysis- reliability model of generation system, recursive relation for unit addition and removal, load modeling, merging of generation model with load model, evaluation of transition rates for merged state model; cumulative probability, cumulative frequency of failure evaluation; LOLP. LOLE. Expected value of the Demand not served E (D)

Distribution system reliability analysis- radial networks, weather effects on transmission lines; evaluation of load and energy indices

Composite system reliability – decomposition method

TEXT BOOKS:

1. Reliability evaluation of engineering systems by R.Billinton and Ronald N.Allan, Plenum press, NY&London

2. Reliability evaluation of power systems by R.Billinton and Ronald N.Allam, Plenum press, NY&London

3. An introduction to reliability and maintainability engineering by Sharles E.Ebeling, TMH

REFERENCE BOOKS:

1. Reliability modelling in electric power systems by J.Endrenyi, John Wiley & sons, NY

2. Power System planning by R.Sullivan , McGraw Hill (P.T.O)

3. Probability, Random variables and Stochastic processes by Athanasios Papoulis and S.Unnikrishna Pillai, TMH

MT/PSE 525/3 DIGITAL CONTROL SYSTEMS

UNIT – I
SAMPLING AND Z-PLANE ANALYSIS
Introduction, sample and hold operations, Sampling theorem, Reconstruction of original sampled signal to continuous-time signal.
Review of Z-transforms
Z-Transform method for solving difference equations; Pulse transforms function, block diagram analysis of sampled – data systems, mapping between s-plane and z-plane: Primary strips and Complementary Strips.

UNIT – II
STATE SPACE ANALYSIS
State Space Representation of discrete time systems, Pulse Transfer Function Matrix solving discrete time state space equations, State transition matrix and it's Properties, Methods for Computation of State Transition Matrix, Discretization of continuous time state – space equations

Concepts of Controllability and Observability, Tests for controllability and Observability. Duality between Controllability and Observability, Controllability and Observability conditions for Pulse Transfer Function.

UNIT – III
STABILITY ANALYSIS
Stability Analysis of closed loop systems in the Z-Plane. Jury stablility test – Stability Analysis by use of the Bilinear Transformation and Routh Stability criterion. Stability analysis using Liapunov theorems.

DESIGN OF DISCRETE TIME CONTROL SYSTEM BY CONVENTIONAL METHODS
Design of digital control based on the frequency response method – Bilinear Transformation and Design procedure in the w-plane, Lead, Lag and Lead-Lag compensators and digital PID controllers. Design digital control through deadbeat response method.

UNIT – IV
STATE FEEDBACK CONTROLLERS AND OBSERVERS
Design of state feedback controller through pole placement – Necessary and sufficient conditions, Ackerman's formula.
State Observers – Full order and Reduced order observers.

LINEAR QUADRATIC REGULATORS
Min/Max principle, Linear Quadratic Regulators

TEXT BOOKS:

1. Discrete-Time Control systems - K. Ogata, Pearson Education/PHI, 2nd Edition
2. Digital Control and State Variable Methods by M.Gopal, TMH

REFERENCE BOOKS:

1. Digital Control Systems, Kuo, Oxford University Press, 2nd Edition, 2003.
2. Digital Control Engineering, M.Gopal

MT/PSE 525/4 H.V.D.C. TRANSMISSION

UNIT I:

H.V.D.C. Transmission: General considerations, Power Handling Capabilities of HVDC Lines, Basic Conversion principles, static converter configuration.

Static Power Converters: 3-pulse, 6-pulse and 12-pulse converters, converter station and Terminal equipment, commutation process, Rectifier and inverter operation, equivalent circuit for converter – special features of converter transformers.

UNIT II:

Harmonics in HVDC Systems, Harmonic elimination, AC and DC filters.

Control of HVDC Converters and systems: constant current, constant extinction angle and constant Ignition angle control., DC power flow control.

UNIT III:
Interaction between HV AC and DC systems – Voltage interaction, Harmonic instability problems and DC power modulation.

Multi-terminal DC links and systems; series, parallel and series parallel systems, their operation and control.

UNIT IV:
Transient over voltages in HVDC systems : Over voltages due to disturbances on DC side, over voltages due to DC and AC side line faults

Component Models for the Analysis of AC/DC Systems; Modelling of DC Network, Modelling of AC Networks,
Modelling of DC Links, Solution of DC Load Flow..

TEXT BOOKS:

1. HVDC transmission by Adamson and Hingorani.

2. H.V.D.C.Transmission by J.Arillaga : Peter Peregrinus ltd., London UK 1983.

3. H.V.D.C Power transmission systems : Technology and system interactions by K.R.Padiyar, New Age International (P) Ltd.

REFERENCE BOOKS:

1. Direct current Transmission, by . E.W. Kimbark , Wiely Inter Science – NewYork.

2. EHV-AC & HVDC transmission Engg. & Practice" by S.Rao, Khanna Publishers.

MT/PSE 525/5 **RENEWABLE ENERGY RESOURCES**

UNIT-I

Principle of Renewable Energy:

Comparison of renewable and conventional energy sources - Ultimate energy sources - natural energy currents on earth - primary supply to end use - Spaghetti & Pie diagrams - energy planning - energy efficiency and management.

UNIT-II

Solar Radiation:

Extra terrestrial solar radiation - terrestrial solar radiation - solar thermal conversion - solar thermal central receiver systems - photovoltaic energy conversion - solar cells – 4 models.

UNIT-III

Wind energy:

Planetary and local winds - vertical axis and horizontal axis wind mills - principles of wind power - maximum power - actual power - wind turbine operation - electrical generator.

UNIT-IV

Energy from Oceans:

Ocean temperature differences - principles of OTEC plant operations - wave energy - devices for energy extraction – tides - simple single pool tidal system.

Geothermal energy:

Origin and types - Bio fuels – classification - direct combustion for heat and electricity generator - anaerotic digestion for biogas - biogas digester - power generation.

TEXT BOOKS:

1.Renewable Energy Sources by John Twidell & Toney Weir : E&F.N. Spon

REFERENCE BOOKS:

1. Power plant technology by EL-Wakil, Mc Graw-Hill
2. Non-Conventional Energy Sources by G.D.Rai, Khanna Pub.

MT/PSE 526/1 **FUZZY LOGIC AND NEURAL NETWORKS**

UNIT – I

Fuzzy logic: Classical & Fuzzy Sets - Introduction to classical sets - properties, Operations and relations; Fuzzy sets, Membership, Uncertainty, Operations, properties, fuzzy relations, cardinalities, membership functions.

Fuzzy Logic System Components Fuzzification, Membership value assignment, development of rule base and decision making system, Defuzzification to crisp sets, Defuzzification methods.

UNIT – II

Neural Networks: Introduction Humans and Computers - Biological Neuron – distributed representation – training of Artificial Neural Network – perceptorn and adaptive linear element.

Unit–III

Multi layer feed forward networks – Back propagation – activation functions- deficiencies – applications. Recurrent networks **–** Generalised delta rule – Hopfield network. Self organizing networks – Competitive learning – Kohenen network – principal component network – Adaptive resonance theory.

UNIT IV

Neural network applications: Process identification, Function Approximation, control and Process Monitoring, fault diagnosis and load forecasting.

Fuzzy logic applications: Fuzzy logic control and Fuzzy classification specific applications to power systems load frequency control, fault diagnosis.

TEXT BOOKS:

1. Chennakesava R Alavala “Fuzzy logic and neural networks”, New Age International Publishers.
2. Neural Networks, Fuzzy logic, Genetic algorithms: synthesis and applications by Rajasekharan and Rai – PHI Publication.
3. Introduction to Artificial Neural Systems - Jacek M. Zuarda, Jaico Publishing House, 1997.

REFERENCES:

1. Neural and Fuzzy Systems: Foundation, Architectures and Applications, - N. Yadaiah and S. Bapi Raju, Pearson Education
2. Neural Engineering by C.Eliasmith and CH.Anderson, PHI

MT/PSE 526/2 **EMBEDDED SYSTEMS**

UNIT – I

A First Look at the Embedded Systems: Examples of Embedded Systems (Telegraph, cordless Barcode scanner, Laser Printer, underground tank monitor, Nuclear Reactor Monitor), Typical Hardware.

Hardware Fundamentals: Terminology, Gates, A few other basic considerations, Timing Diagrams, Memory.

Advanced Hardware Fundamentals: Micro Processors, Buses, Direct Memory Access, interrupts, other common parts, Built-ins on the Micro Processor, conventions used on the Schematics.

Interrupts: Micro Processor Architecture, Interrupt Basics, the shared data problem, Interrupt Latency.

UNIT – II

Survey of Software Architectures: ROUND-ROBIN, ROUND-ROBIN with Interrupts, Function- Queue-Scheduling Architecture, Real Time Operating System Architecture, Selecting an Architecture.

Introduction to Real Time Operating Systems: Tasks and Task states, Tasks and data Semaphores and shared data.

UNIT – III

More Operating System Services: Message Queues, Mail boxes and pipes, Timer Functions, Events, Memory Management, Interrupt Routines in an RTOS environment.

Basic Design Using a Real Time Operating System: Overview, Principles, An Example, Encapsulating Semaphores and Queues, Hard Real Time Considerations, Saving Memory Space, Saving Power.

UNIT – IV

Embedded Software Development Tools: Host and Target Machines, Linker/Locators for Embedded Software, Getting Embedded Software into the target System.

Debugging Techniques: Testing on Host Machine, Instruction Set Simulators, the *assert* macro, using Laboratory Tools.

TEXTBOOKS:

David E.Simon, 'An Embedded Software Primer', Pearson Education Asia.

REFERENCE BOOKS:

1. D.Gajski, F.Vahid, S.Narayan, J.Gong, 'Specification and Design of Embedded Systems', Prentice Hall of India Pvt. Ltd.,
2. Raj Kamal, 'Embedded Systems Architecture & Programming', Tata McGraw-Hill.

MT/PSE 526/4 **COMPUTER NETWORKS**

UNIT-I

Evolution of computer Networks -Needs/advantages and problems of computer networks - Network Topologies - Transmission media- Modems and multiplexers.

UNIT-II

Network protocols - Network switching methods - Network Architecture - OSI model - Purpose layered design – Error detection and correction - Data link protocols - sliding window protocols - data compression techniques.

UNIT-III

Local Area Networks - Medium access methods - IEEE 802. x standards - Wide Area Networks - Routing Algorithms - Network Interconnectivity -Bridges and Gateways. Congestion control algorithms.

UNIT-IV

Evolution of the Internet - TCP/IP protocols, DNS, electronic mail - File Transfer Protocols, World Wide Web - File Transfer Access and Management - Virtual terminals.

TEXT BOOKS :

1. Andrew S Tannenbaum, "Computer Networks" 3rd Edition, PHI

REFERENCES:

1. Kurose & Ross, "Computer networks – A top down approach featuring the Internet", Pearson Education.
2. Leon-Gartia, Indra Widjaja, " Communication networks Fundamental Concepts and Key architectures", TMH
3. Nader F. Mir, " Computer and Communication networks", PHI.

MT/PSE 526/4 DATABASE MANAGEMENT SYSTEMS

UNIT-I
Databases and Database users
Database systems, concepts and Architecture
Data Modeling using the Entity-Relationship model

UNIT-II
The Relational Data Model, Relational constraints, and the Relational Algebra
SQL-The Relational Database standard.
ER and EER – to – Relational mappings, and other relational languages.

UNIT-III
Functional Dependencies and Normalizations for Relational Database
Relational Database Design Algorithms and Further Dependencies
Database system Architectures and the system catalog

UNIT-IV
Transactions Processing Concepts
Concurrency Control Techniques

TEXT BOOK:

1. Fundamentals of Database Systems, 3rd edition by Elmasri and Navathe, Addison Wesley, Pearson Education, Inc. 2000.

REFERENCE BOOKS:

1. An introduction to Database Systems by Bipin C. Desai, West Publishing Company, 2000
2. An introduction to Database Systems, 6th Edition, Addison Wesley Longman Inc., 1999

MT/PSE 526/5 MICROPROCESSORS & MICROCONTROLLERS

UNIT – I

Microprocessors: Introduction to Microcomputers and Microprocessors, Introduction to 8086 microprocessor family, 8086 internal architecture, Addressing modes, Programming the 8086, Instruction descriptions, Assembler directives.

UNIT – II

Digital & Analog Interfacing: Addressing memory and ports in Microcomputer system, 8086 interrupts and Interrupt Responses, Programmable parallel ports and Handshake input/output, Interfacing a microprocessor to keyboards.

D/A converter operation, Interfacing and applications, A/D converter specifications types and interfacing.

UNIT – III

Programmable Devices: Introduction to programmable peripheral devices: 8253/8254, 8259, 8251. The DMA data transfer, RISC Vs CISC, RISC properties, RISC evaluations, overview of RISC development and current schemes.

UNIT – IV

8051 Microcontrollers: Introduction to 8 bit and 16 bit microcontrollers; 8031/8051 microcontroller architecture and memory organization, Addressing modes, Instruction formats, CPU timings, Interrupt structure and interrupt priorities; port structures and operations. Accessing internal and external memories, Timer / Counter functions and different modes of operations. Interfacing of stepper motor , LED display , and robotic control.

TEXT BOOKS:

1. Dougles V Hall, Microprocessor and Interfacing: Programming and hardware, 2nd Editon, TMH 2003
2. Barry B. Brey – The Intel Microprocessors 8086/ 8088, 80186/80188, 80286, 80386, 80486, Pentium and Pentium Preprocessor, Architecture, Programming and Interfacing, PHI, 4th Edition.

REFERENCE BOOKS:

1. Yu-Cheng Liu, Glenn A Gibson, Microcomputer systems: the 8086/8088 Family, Architecture, Programming and Design, 2nd Edition, PHI, 2003
2. A K Ray, K M Bhurchandi, Advanced Microprocessors and Peripherals: Architecture, Programming and Interfacing, TMH 2004
3. Deniel Tabak – Advanced Microprocessors, McGraw Hill , 2nd edition
4. The Intel Manuals – Microcontrollers Manual MC 8031/8051
5. Malvino Leech – Microprocessors.

MT/PSE 561 **SIMULATION LAB – II**

List of Experiments*

1. Power flow solution by NR method.
2. Power flow solution by FDC.
3. Contingency studies using load flows for generator & line outages.
4. Solution of Economic load dispatch problem.
5. Transient stability study of SMIB.
6. Contingency studies using Z_{BUS}.
7. Simulation of State Estimator for power flow using WLSE method
8. Simulation of single area load frequency control.
9. Simulation of two area load frequency control.
10. Simulation of power system stabilizer.
11. Simulation of voltage stability problem.
12. Design of LQR state feed back for a given system
13. Design of State feedback controller and observer through Pole assignment.
14. PSPICE Simulation of Three phase full converter using RL &E loads.
15. PSPICE Simulation of Three phase inverter with PWM controller.
16. PSPICE Simulation of resonant pulse commutation circuit.

*** Any eight experiments to be completed**

Nine important differences between syllabus and curriculum are presented in this article. One such difference is that the syllabus is described as the summary of the topics covered or units to be taught in the particular subject.Â Difference Between Syllabus and Curriculum. Last updated on May 18, 2017 by Surbhi S. When it comes to education, the two concepts which pop up in our mind which are commonly misconstrued are syllabus and curriculum. Syllabus vs Curriculum One should carefully understand the difference between syllabus and curriculum as they are two important words in the field of.Â Difference Between Syllabus and Curriculum. June 5, 2011 Posted by koshal. Syllabus vs Curriculum. One should carefully understand the difference between syllabus and curriculum as they are two important words in the field of education that are often confused as if they mean the same. Strictly speaking, they are two different words that give different meanings. The terms syllabus are curriculum are often used interchangeably. We have listed similarities and differences between syllabus and curriculum. Syllabus Vs. Curriculum. What is syllabus? Syllabus is basically a document that defines the subject. It explains the things you need to know about a subject. When a student starts a specific subject in a class, he needs to know about the subject. The syllabus is the document which guide towards the subject. What is included in syllabus? Curriculum and syllabus are two essential components in any educational program. Curriculum is the set of courses, coursework and their content offered at a school or anther educational institute. Syllabus is the focused outline of a subject. Therefore, the main difference between curriculum and syllabus is that curriculum is a set of guidelines set out for educators whereas a syllabus is a more descriptive list of concepts that are to be taught in a class. What is a Curriculum.