Shivaji University
Kolhapur

Ph. D. course work syllabus for Theory Paper II

Advances in Electrical Engineering

(For Electrical Engineering)

Lectures: 4/week **Theory: 100 Marks**

Unit 1: Digital Measurement Techniques

Voltage ratio measurement techniques : Digital ohmmeter, capacitance meter; impedance meters (polar and cartesin types); Decibel meters; Q meter tan-delta meter;
Sampling theory and its applications in current, voltage, power, energy measurements.
Elements of digital signal processing: FFT, DHT, digital filters.

Unit 2: Matrix Computations

Basic iterative methods for solutions of linear systems and their rates of convergence.
Generalized conjugate gradient, Krylov space and Lanczos methods.
Iterative methods for symmetric, non-symmetric and generalized eigenvalue problems.
Singular value decompositions. Fast computations for structured matrices. Polynomial matrix computations. Perturbation bounds for eigenvalues.

Unit 3: Electric Drives

Methods of DC motor control, non-regenerative controlled rectifiers, fully controlled converters, field control, switching systems for DC motors, chopper regulators, aspects of analysis, performance and stability of variable speed dc drives.
Induction motor control systems, ac regulators and static switches, control of effective rotor resistance, recovery of slip energy, variable frequency control of ac motors, current source inverter fed Induction motor drive, forced commutated inverter fed drives, self-controlled synchronous motor drives and traction drives. Analysis, performance and stability of synchronous and asynchronous drives. solar and battery powered drives. Power Quality issues and its mitigation.

Unit 4: Microprocessor Applications

Review of microcontrollers and digital signal processors, architecture,peripheral modules.
Typical processors for control implementation: memory organisation, CPU details, addressing modes, interrupt structure, hardware multiplier, pipelining.
Fixed- and floating-point data representations.
Assemblers, linkers and loaders. Binary file formats for processor executable files. Typical structure of timer-interrupt driven programs.
Implementing digital processor based control systems for power electronics: Reference frame transformations, PLL implementations, machine models, harmonic and reactive power compensation, space vector PWM.
Numerical integration methods.

Multitasking concepts for power electronics implementations: The need for multitasking, various multitasking methods.

Texts/References

Unit 1

T. S. Rathore, Digital Measurement Techniques, Narosa Publishing House, New Delhi, 1996.
B. S. Sonde, Monographs on System Design using Integrated Circuits, Tata Mc-Graw Hill, 1974.
D. J. DeFatta, J. G. Lucas and W. S. Hodgkiss, Digital Signal Processing, J Wiley and Sons, Singapore, 1988.

Unit 2

Owe Axelsson, Iterative solution methods. Cambridge.1994.
G. Meurant: Computer solution of large linear systems. North Holland, 1999.
Golub and C. Van Loan: Matrix computations. John Hopkins Press 1996.
G. W. Stewart and J. Sun: Matrix perturbation theory. Academic press,1990.

Unit 3

W. Leonhard, Control of Electric Drives, Springer Verlag, 1985.
P.Vas, Vector Control of ac Machines, Clarendon press, Oxford, 1990
S.K.Pillai, Analysis of Thyristor Power Conditioned Motors, University Press, 1992.
G.K.Dubey, Fundamentals of Electrical Drives, Narosa Publications, 1995.
Alexander Kusko and Marc T. Thompson Power Quality in electrical systems, The McGraw Hill Company

Unit 4

1. K Ogata, "Discrete-Time Control Systems", second edition, Pearson Education Asia.
2. N. Mohan, "Power Electronics", third edition, John Wiley and Sons.

Electrical Engineering

Ph. D. course work syllabus for Theory Paper-III

(OPTIONAL PAPERS BASED ON SPECIALISATION: 1 OUT OF 9 PAPERS)

Subject 1: Restructured Power Systems

Teaching Scheme	Examination Scheme
Lect. 3 hrs./week	Theory Paper : 80 Marks,
Practical/Tutorial 1 hr. /week	Term work: 20 marks

Fundamentals of restructured system, Market Architecture, Load Elasticity, Social welfare maximization, OPF: Role in vertically integrated systems and in restructured markets, Congestion Management, Optimal Bidding, Risk assessment and Hedging, Transmission Pricing and Tracing of power, Ancillary Services, Standard Market Design, Distributed Generation in restructured markets, Developments in India, IT applications in restructured markets, Working of restructured power systems : PJM

Text / References :

1. Understanding electric utilities and de-regulation, Lorrin Philipson, H. Lee Willis, Marcel Dekker Pub., 1998.
2. Power system economics: designing markets for electricity Steven Stoft, John Wiley & Sons, 2002.
3. Operation of restructured power systems. Kankar Bhattacharya, Jaap E. Daadler, Math H.J. Boolen, Kluwer Academic Pub., 2001.
4. Restructured electrical power systems: operation, trading and volatility Mohammad Shahidehpour, Muwaffaq Alomoush, Marcel Dekker Pub., 2001.

Subject 2: Flexible AC Transmission Systems

Teaching Scheme	Examination Scheme
Lect. 3 hrs./week	Theory Paper : 80 Marks,
Practical/Tutorial 1 hr. /week	Term work: 20 marks

AC transmission line and reactive power compensation, Static shunt compensation, static phase shifting transformers, , Static synchronous compensators (STATCOM), Static synchronous series compensation, UPF, inert phase power controllers, Application examples like improvement in damping power oscillations, Improvement of transient stability

Text/References:

1. FACTS controllers in power system transmission and distribution, K. R. Padiyar, New Age International Publications

2. 2. Understanding FACTS, N. G. Hingorani&L. Gyugyi, IEEE press, Standard publishers and distributers

Subject 3: Computational Electromagnetic

Teaching Scheme	Examination Scheme
Lect. 3 hrs./week	Theory Paper : 80 Marks,
Practical/Tutorial 1 hr. /week	Term work: 20 marks

Introduction to electromagnetic fields: review of vector analysis, electric and magnetic potentials, boundary conditions, Maxwell's
equations, diffusion equation, Poynting vector, wave equation
Finite Difference Method (FDM): Finite Difference schemes, treatment of irregular boundaries, accuracy and stability of FD solutions,
Finite-Difference Time-Domain (FDTD) method
Finite Element Method (FEM): overview of FEM, Variational and Galerkin Methods, shape functions, lower and higher order elements, vector
elements, 2D and 3D finite elements, efficient finite element computations
Method of Moments (MOM): integral formulation, Green's functions and numerical integration, other integral methods: boundary element method,
charge simulation method
Special topics: hybrid methods, coupled circuit - field computations, electromagnetic - thermal and electromagnetic - structural coupled
computations, solution of equations.
Applications: low frequency and high frequency electrical devices, static / time-harmonic / transient problems in transformers, rotating machines,
waveguides, antennas, scatterers

Texts / References:

1. M. V. K. Chari and S. J. Salon, Numerical methods in electromagnetism, Academic Press, 2000.
2. M. N. O. Sadiku, Numerical techniques in electromagnetics, CRC Press, 1992.
3. N. Ida, Numerical modeling for electromagnetic non-destructive evaluation, Chapman and Hall, 1995.
4. S. R. H. Hoole, Computer aided analysis and design of electromagnetic devices, Elsevier Science Publishing Co., 1989.
5. J. Jin, The Finite Element Method in electromagnetics, 2nd Ed., John Wiley and Sons, 2002.
6. P. P. Silvester and R. L. Ferrari, Finite elements for electrical engineers, 3rd Ed., Cambridge University Press, 1996.

Subject 4: Modeling and Identification of Dynamical Systems

Teaching Scheme	Examination Scheme
Lect. 3 hrs./week	Theory Paper : 80 Marks,
Practical/Tutorial 1 hr. /week	Term work: 20 marks

Classification of inputs and models, analytical and experimental methods of modelling: transform methods, impulse and frequency response, Fourier transform. Response to random inputs, state-space models, Z transform, correlation technique. pseudo-random signal testing parameter tracking, regression and least-square methods Discrete time series models: FIR and ARX models, development of ARX models by least square estimation, Unmeasured disturbance Modeling: AR-MAX, OE, Box-Jenkin's models,Time-series analysis, AR and ARX models, least-squares setting.

Text/ References:

1. E.O. Doeblin, System Modelling and Response, John Wiley Sons, 1980.
2. Desai and Lalwani, Identification Techniques, Tata McGraw Hill, 1977 •
3. L. Ljung, System Identification: Theory for the User, Prentice Hall, 1992

Subject 5: Optimization

Teaching Scheme	Examination Scheme
Lect. 3 hrs./week	Theory Paper : 80 Marks,
Practical/Tutorial 1 hr. /week	Term work: 20 marks

Introduction to interval analysis. Interval numbers and interval arithmetic. Functions of intervals. Interval linear equations and linear inequalities. Taylor series. Interval Newton method for nonlinear equations of one variable and systems of nonlinear equations. Covering algorithm for parameter dependant systems of nonlinear equations. Global optimization using interval analysis. Applications of interval analysis tools to control systems, robotics, neural networks and other areas of science and engineering.

Text/ References:

1. E. Hansen, Global Optimization Using Interval Analysis, Second edition, Marcel Dekker, New York, 2005.
2. R. E. Moore, Methods and Application of Interval Analysis, SIAM, Philadelphia, 1979.

Subject 6: Computer aided Power System Analysis

Teaching Scheme	Examination Scheme
Lect. 3 hrs./week	Theory Paper : 80 Marks,
Practical/Tutorial 1 hr. /week	Term work: 20 marks

Loadflow for AC systems, fast decoupled load flow, optimal power flow.
Z - matrix for short circuit studies.

State estimation, LO algorithm, fast decoupled state estimation.
Security and contingency studies. Unit Commitment. Load frequency control.
Optimal hydro-thermal scheduling. AI applications.

Texts/References

1. O.I.Elgerd, Electric Energy Systems Theory, McGraw Hill, 1971.
2. G.W.Stagg and A.H.El-Abiad, Computer Methods in Power System Analysis, McGraw Hill 1968.
3. G.L.Kusic, Computer Aided Power Systems Analysis, Prentice Hall, 1986.
4. I.J.Nagrath and D.P.Kothari, Modern Power Systems Analysis, Tata McGraw Hill, 1980.
5. A.J.Wood and B.F.Wollenberg, Power Generation, Operation and Control, John Wiley, 1984.

Subject 7: Artificial Neural Networks

Teaching Scheme	Examination Scheme
Lect. 3 hrs./week	Theory Paper : 80 Marks,
Practical/Tutorial 1 hr. /week	Term work: 20 marks

Basic neuroscience and Artificial Neuron Model, Graphs, Algorithms, Perceptrons and the LMS learning, Multilayer networks, Learning using feedforward networks, Adaptive structure networks, Symmetric and asymmetric recurrent networks, Competative learning and self organizing networks, Applications of neural networks

Text

1. Neural network algorithms with graphs, algorithms and applications, N. K. Bose and P. Liang, Tata McGrawhill edition

Subject 8: Power System Protection

Teaching Scheme
Lect. 3 hrs./week
Practical/Tutorial 1 hr. /week

Examination Scheme
Theory Paper : 80 Marks,
Term work: 20 marks

Over current protection, Differential protection, Transformer protection, Busbar protection, Distance protection of Tr. Lines, Carrier aided protection, Generator protection, , Im protection, Static relays, Numerical protection,

Text:

1. Fundamentals of Power System Protection, Y. G. Paithankar and S. R. bhide, Prentice-Hall of India
2. The art and Science of Protective relaying, Masson C. R. , John-Wiley and sons
3. Digital Protection for power systems, Johns A. T. and S. K. Soman, Peter Peregrinus/IEE

Subject 9: Numerical Methods for Linear Control Systems

Teaching Scheme
Lect. 3 hrs./week
Practical/Tutorial 1 hr. /week

Examination Scheme
Theory Paper : 80 Marks,
Term work: 20 marks

Linear numerical algebra, Canonical forms and orthogonal transformations, Linear state space models and solutions, Controllability and Observability and distance to uncontrollability, Stability-inertia and robust stability, Lyapunov and Sylvester equations, Realization and subspace identification, Optimal control, Eivenvalue assignment problem, Observer and KAlman filter, Riccati equations, Internal balancing and model reduction,

Text:

1. Numerical Methods for Linera control systems, B. N. Datta, Elsevier Publications