Ph.D. Syllabus (Odd Semester)

EE 701 RANDOM SIGNALS AND FILTERING THEORY 3 0 0 6

Probability and random variable: Fundamental concept of probability, conditional probability, Bayes' theorem, concept of random variable, probability density function, central limit theorem, generation of random numbers, multiple random variables, point mass representation of probability density function. Random processes: Concept of random process, stationarity and ergodicity, auto correlation function, cross correlation function and their properties, Gaussian process, Markov process, white noise. Introduction to filtering theory: concept of system, noise, filtering, smoothing and prediction, Kalman filtering, convergence and stability, application of Kalman filtering, nonlinear filtering, brief introduction on post Kalman filtering.

Text/Reference:

1. R. G. Brown and Patrick Y. C. Hwang, *Introduction to Random Signal and Applied Kalman Filtering With Matlab Exercise and Solutions*, John Willey & Sons, (1996)
2. X. Rong Li, *Probability Random Signal and Statistics*, CRC press, (1999)
3. B. D. O Anderson and J. B. Moore, *Optimal Filtering*, Dover publication, (2005)
4. T. Kailath, A. H. Sayed and B. Hassibi, *Linear Estimation*, Prentice Hall, (2000)
5. A. H. Jazwinski, *Stochastic Processes and Filtering Theory*, Dover publication, (2005)

EE 711 **WIRELESS COMMUNICATION** **3 0 0 6**

Random Signal Theory: Joint Probability, Statistical independence, Cumulative Distribution function and Probability Density function, Error function, Rayleigh and Gaussian Probability Density, Stationary and Ergodic Process, Power Spectral Density of digital data. Base band Data Transmission: Base band Signal receiver, Probability of error, Optimum filter, Matched filter, Coherent reception, ISI and Turbo Equalization. Digital Modulation Techniques: Performance Analysis of BPSK, DPSK, QPSK, M-ary PSK, BFSK, M-ary FSK, MSK, QAM,OFDM for wireless transmission. Propagation & Fading: Propagation path loss, Free-space propagation model, Outdoor propagation models (Okumura model & Hata model), Indoor propagation models (Partition Losses in the same floor and between floors), Multipath fading, time dispersive and frequency dispersive channels, delay spread and coherence bandwidth, LCR and ADF. Mobile Radio Interferences & System Capacity: Co-channel Interference and System Capacity, Channel planning for Wireless Systems, Adjacent channel interferences, Power control for reducing interference, Inter-symbol Interference; The Cellular Concept: Frequency Assignment and Channel Assignment, Frequency Reuse, Handoff, Sectoring, Microcell zone, Spectral efficiency, Multiple Access techniques: FDMA, TDMA, CDMA, OFDMA, OFDM-CDMA, MIMO-OFDM and QOS issues. Multiuser Detection: Linear and Non-Linear Multiuser Detectors, BER Analysis, Turbo Multiuser Receiver, Iterative Interference Cancellation, Capacity Analysis, BER Analysis, Multiuser Detection for 4G wireless Systems.

Text/Reference:

1. D. Tse, P. Viswanath, *Fundamentals of Wireless Communications*, Cambridge Press, (2005)
2. G. L. Stuber, *Principles of Mobile Communication*, Kluwer Acdemic, (1996)
3. J. G. Proakis, *Digital Communications*, McGraw-Hill, (1995)
4. T. S. Rappaport, *Wireless Communications: Principles and Practice*, Prentice Hall, (1996)
5. A. J. Viterbi, *CDMA Systems: Principles of Spread Spectrum Communication*, Addison Wesley, (1995)
6. S. Verdu, *Multiuser Detection*, Cambridge University Press, (1998)
7. H. Wymeersch, *Iterative Receiver Design*, Cambridge University Press, (2007)

EE 751 MODELING AND SIMULATION OF MODERN POWER SYSTEMS 3 0 0 6

Structure and Operation of Modern Power Systems: Introduction to generation, transmission and distribution systems, Technical and commercial aspects involved with ESI. Modeling of Power System Components: Generators, Transmission lines, Transformers, Different types of loads. Application of Graph Theory to Power Networks: Concepts of graph theory, Oriented graphs, Primitive impedance and admittance matrices, System graph for transmission network, Network representations, Network matrices, Network reduction. Load Flow Studies: Nonlinear numerical techniques, Gauss-Seidel method, Newton's method, Convergence criteria, Classification of buses, Load flow studies, Fast decoupled method, DC load flow method, Power flow studies in system design and operation. Power System Security and Contingency Analysis: Factors affecting power system security, Contingency analysis. Power System Stability: Classification, Small signal and Transient stability, Voltage stability. Introduction to FACTS Controllers: Development and application, Shunt, Series and Shunt-Series controllers.

Text/References:

1. J. J. Grainger and W.D. Stevenson Jr., *Power System Analysis*, Tata McGraw-Hill, (1994)
2. D. P. Kothari and I.J. Nagrath, *Modern Power System Analysis*, Tata McGraw-Hill, Third Edition, (2003)
3. A. J. Wood and B.F. Wollenberg, *Power Generation Operation and Control*, Wiley India Edition, Second Edition, (2003)
4. M. A. Pai, *Computer Techniques in Power System Analysis*, Tata McGraw-Hill, Second Edition, (2006)

Ph.D. Syllabus (Even Semester)

EE 712 **INFORMATION AND CODING THEORY** **3 0 0 6**

The concept of Amount of Information, Average Information, Entropy, Information rate, Shannon's Theorem, Channel Capacity, Capacity of a Gaussian Channel, Bandwidth- S/N Trade-off. Channel Capacity & Coding: Introduction to Channel Capacity & Coding, Channel Models, Channel Capacity Theorem, Shannon Limit. Error Control Coding: Introduction, Forward & Backward error Correction, Hamming Weight and Hamming Distance, Linear Block Codes, Encoding and decoding of Linear Block-codes, Parity Check Matrix, Syndrome Decoding, Hamming Codes. Cyclic Codes: Introduction, Method for generating Cyclic Codes, Matrix description of Cyclic codes, Burst error correction, Cyclic redundancy check (CRC) codes, Circuit implementation of cyclic codes. Convolutional and Turbo Codes: Introduction, Polynomial description of Convolutional Codes, Generating function, Matrix description of Convolutional Codes, Viterbi Decoding of Convolutional codes, Turbo Codes, Turbo Encoder and Decoder. Introduction to Image Compression, The JPEG standard for lossless and Lossy Image Compression & Decompression, Video Compression and Transmission Standards for Wireless Channels.

Text/References:

1. R. Bose, *Information Theory and applications*, 2nd Edition, TMH, (2008)
2. J. G. Proakis, *Digital Communications,* McGraw-Hill, (1995)
3. D. Tse, P. Viswanath, *Fundamentals of Wireless Communications*, Cambridge Press, (2005)

EE 752 OPERATION AND CONTROL OF RESTRUCTURED POWER SYSTEMS 3 0 0 6

Restructuring of Electricity Supply Industry: Power systems operation - old vs new, Key issues associated with the restructuring of ESIs, International experiences. Economic Operation of Power Systems: Economic load dispatch (ELD), Unit commitment (UC), Optimal power flow (OPF), OPF in system design and operation. Electricity Markets: Models of competition, Bilateral trading, Electricity pools, Spot market, Settlement process. Power System Controls: Load frequency control, Generator-voltage control. System Security and Ancillary Services (AS) Management: Balancing issues, Network issues, System restoration, AS provision, FACTS controllers in AS provision, Co-optimization of AS and energy. Transmission Pricing and Congestion Management: Electric power wheeling, Transmission open access, Pricing of electric power transmission, Congestion management techniques, FACTS in congestion management.

Text/References:

1. O.L. Elgerd, *Electric Energy Systems Theory: An Introduction*, Second Edition, TMH Edition, (1996)
2. L. L. Lai, *Power System Restructuring and Deregulation: Trading, Performance and Information Technology*, Wiley, (2001)
3. A.J. Wood and B.F. Wollenberg, *Power Generation Operation and Control*, Second Edition, Wiley India Edition, (2003)
4. K. Bhattacharya, M.H.J. Bollen and J.E. Daaler, "*Operaiton of Restructured Power System*", Kluwer Power Electronics and Power Systems Series, (2001)

EE 760 BASICS OF POWER ELECTRONICS CONVERTERS 3-0-0-6

Power Semiconductor Devices: BJT, MOSFET, IGBT, GTO and MCT; AC-DC Converters; Forced Communication; Buck, boost, buck-boost, cuk, flyback configuration, resonant converters; DC-AC Converters; PWM Inverters; Synchronous Link Converters; Active Filters.

Text/References:

1. N. Mohan, T. M. Undeland, and W. P. Robbins, *Power Electronics,Converters, Applications and Design.* John Wiley & Sons Inc., Singapore, 1989.
2. Erickson and Maksimovic, *Fundamentals of Power Electronics*, 2nd edition, Springer Science, ISBN 0-7923-7270-0.
3. M. H. Rashid*, 'Power Electronics Hand Book'*, Academic Press, New York, 2001.

EE 765 FUNDAMENTALS OF ELECTRICAL DRIVES (3-0-0-6)

Motor Load Dynamics, Starting, Braking & Speed Control of DC and AC motors; DC drives: Converter and Chopper control; AC Drives: Operation of Induction and Synchronous Motors from Voltage and Current Inverters, Slip Power Recovery, Pump Drives using AC Line Controller and Self-Controlled Synchronous Motor Drives; Stepper Motor and Switched Reluctance Motor Drives - Permanent Magnet AC and Brushless DC Motor Drives - Solar and Battery Powered Drives - Traction Drives - Energy Conservation in Electrical Drives - Electrical Drive Systems and Components.

Text/References:

1. G.K. Dubey, 'Fundamentals of Electrical Drives', Narosa Publishing House, New Delhi, 2008.
2. G.K. Dubey, 'Power Semiconductor Controlled Drives', Prentice Hall, N. Jersey, 1989.
3. Vedam Subramaniam, ‘Power Semiconductor Drives’, Tata McGraw Hill, New Delhi, 2007.
4. M. H. Rashid, ‘Power Electronics Hand Book’, Academic Press, New York, 2001.