FACULTY OF ENGINEERING

SavitribaiPhule Pune University

Syllabus for the

M.E (Electronics & Telecommunications Engineering –Communication Networks)

(2017 Course)

(w.e.f . June 2017)

M.E. E&TC (Communication Networks),

2017 Pattern

Syllabus Structure

First Year – Semester I

Sr.No.	Subject Code	Subject	Examination Scheme					Total	Credits
				Paper					
			L/P	ISA	ESA	TW	OR		
1	504501	Modeling and Simulation of Communication Networks	4	50	50	-	-	100	4
2	504502	High Speed Communication Networks	4	50	50	-	-	100	4
3	504503	Network Security	4	50	50	-	-	100	4
4	504504	Research Methodology	4	50	50	-	-	100	4
5	504505	Elective I	5	50	50	-	-	100	5
6	504506	Lab Practice I	4	-	-	50	50	100	4
Total			**25**	**250**	**250**	**50**	**50**	**600**	**25**

Elective I :

1. Coding and Modulation Techniques
2. Detection and Estimation Theory
3. Mathematics for Communication Networks
4. Neural Networks in Communications

*LATEX

First Year – Semester II

Sr.No.	Subject Code	Subject	Examination Scheme					Total	Credits
				Paper					
			L/P	ISA	ESA	TW	OR		
1	504507	Traffic Analysis and QoS	4	50	50	-	-	100	4
2	504508	Broadband Wireless Technologies	4	50	50	-	-	100	4
3	504509	SDR and Cognitive Radio	4	50	50	-	-	100	4
4	504510	Elective II	5	50	50	-	-	100	5
5	504511	Lab Practice II	4	-	-	50	50	100	4
6	504512	Seminar I	4	-	-	50	50	100	4
Total			**25**	**250**	**250**	**50**	**50**	**600**	**25**

Elective II :

1. Advanced Techniques for Wireless Reception
2. Spread Spectrum & CDMA System
3. Optical Networks
4. RF MEMS

* Software Tools

Second Year – Semester I

Sr.No.	Subject Code	Subject	Examination Scheme					Total	Credits
				Paper					
			L/P	ISA	ESA	TW	OR		
1	604501	4G LTE Cellular Systems	4	50	50	-	-	100	4
2	604502	Modern Communication Receiver Design & Technology	4	50	50	-	-	100	4
3	604503	Elective III	5	50	50	-	-	100	5
4	604504	Seminar II	4	-	-	50	50	100	4
5	604505	Project Stage I	8	-	-	50	50	100	8
Total			**25**	**150**	**150**	**100**	**100**	**500**	**25**

Elective III : Topics for 3 Credits

1. Value Education, Human Rights and Legislative Procedures
2. Environmental Studies
3. Renewable Energy Studies
4. Disaster Management
5. Knowledge Management
6. Foreign Language
7. Economics for Engineers
8. Engineering Risk – Benefit Analysis

Elective III Topics for 2 Credits

1.. Optimization Techniques
2 Fuzzy Mathematics
3. Design and Analysis of Algorithms
4. CUDA

Note: Syllabus for Elective III is common for all discipline.

*****Open Elective will be electives from other disciplines.

Second Year – Semester II

Sr.No.	Subject Code	Subject	Examination Scheme					Total	Credits
				Paper					
			L/P	ISA	ESA	TW	OR		
1	604506	Seminar III	5	-	-	50	50	100	5
2	604507	Project Work Stage II	20	-	-	150	50	200	20
Total			**25**	**-**	**-**	**200**	**100**	**300**	**25**

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Semester I

504501 Modeling & Simulation of CommunicationNetwork

Credits: 4

Teaching Scheme: **Examination Scheme:**

Lecture : 4 hr/week **In-Sem : 50 Marks**
End-Sem : 50 Marks

Course Objectives:

The Objectives of this course are to:-

- Categorize Simulation Methods of communication networks.
- Describe random signal generation and processes.
- Develop Monte Carlo algorithm and Traffic Modeling
- Design different channel models and their simulation

Course Outcomes:

Having successfully completed this course, students will be able to:

Describe basic Simulation Methods for different signals and systems.

1. Analyze random processes and apply the knowledge to improve the performance of communication network
2. Construct Monte Carlo algorithm and Design Traffic Modeling.
3. Design different channel models and Time varying systems.

Course Contents

Module I : Simulation Methodology(10 Hrs)

Introduction, Aspects of methodology, Performance Estimation,Simulation sampling frequency, Low pass equivalent simulation models for bandpass signals, Multicarrier signals, Non-linear and time-varying systems, Post processing – Basic graphical techniques and estimations.

Module II : Random Signal Generation & Processing(8Hrs)

Uniform random number generation, mappinguniform random variables to an arbitrary pdf, Correlated and Uncorrelated Gaussian random number generation, PN sequence generation, Random signal processing, testing of random number generators.

Module III : Monte Carlo Simulation& Network and Traffic Modeling(10Hrs)

Fundamental concepts, Application to communication systems, Monte Carlo integration, Semi-analytic techniques, Case study: Performance estimation of a wireless system.

Queuing theory related to network modeling, Poissonian and Non-Poissonian modeling of network traffic; Specific Examples

Module IV:Advanced Models & Simulation Techniques (8 Hrs)

Modeling and simulation of non-linearities:Types, Memory-less non-linearities, Non-linearities with memory, Modeling and simulation of Time varying systems: Random process models, Tapped delay line model, Modeling and simulation of waveform channels, Discrete memory-less channel models, Markov model for discrete channels with memory, Tail extrapolation, pdf estimators, Importance sampling methods

Reference Books:

1. William.H.Tranter, K. Sam Shanmugam, Theodore. S. Rappaport, Kurt L. Kosbar, Principles of Communication Systems Simulation, Pearson Education (Singapore) Pvt. Ltd, 2004.

2. M.C. Jeruchim, P.Balaban and K. Sam Shanmugam, Simulation of Communication Systems: Modeling, Methodology and Techniques, Plenum Press, New York, 2001.

3. Averill. M. Law and W. David Kelton, Simulation Modeling and Analysis, McGraw Hill Inc., 2000.
4. Geoffrey Gorden, System Simulation, Prentice Hall of India, 2nd Edition, 1992.
5. Jerry Banks and John S. Carson, Discrete Event System Simulation, Prentice Hall of India, 1984

Laboratory Assignments/Experiments:

1. Write the MATLAB code for estimating the performance of following communication system using Monte Carlo Simulation
   a. AWGN Channel
   b. Binary Phase Shift Keying
   c. Binary Frequency Shift Keying

2. For uniform Random number use Monte Carlo integration method as an approximated integration technique. Integrate f(x) on {0,1} interval for the following integral function
   a. $F(x) = x$
   b. $F(x) = x^2$
   c. $F(x) = \cos(\pi x)$

3. A simulation of memory channel using Markov model is demonstrated and system error probability is computed. Assume errors can be produced in either state where the probability of error in good state will be less than error probability of bad state. Specifically we define conditional error probability as Pr{Eg}=0.0005 and Pr{Eb}=0.1000. Markov chain is defined by transition matrix

   $A = \begin{matrix} 0.98 & 0.02 \\ 0.5 & 0.95 \end{matrix}$

504502 High Speed Communication Networks

Credits: 04

Teaching Scheme: **Examination Scheme:**

Lecture : 04Hr/week **In-Sem : 50 Marks**
End-Sem : 50 Marks

Course Objectives

The Objectives of this course are to:-

- Differentiate high speed networking technologies,architectures and protocols.
- Describe the concept of queuing Modelsandcongestion control.
- Categorize the TCP, ATM congestion and traffic management.
- Design Integrated Services Architecture, Audio and video media transport in networks.

Course Outcomes

Having successfully completed this course, students should be able to:

1. Compose the concepts of high-speed networks and Routing protocols.
2. Describe queuing Models and effect of congestion in Packet Switching Networks.
3. Compare TCP and ATM congestion control protocols.
4. Describe integrated and differentiated services, Audio and video media transport in wired & wireless networks.

Course Contents

Module I : (8 Hrs)

Fundamentals of high speed network architectures and protocols, Link Layer addressing, Inter-networking, Multimedia Communications, Quality of services, Resource Allocation and traffic control, Dynamic Routing protocols.

High Speed Networks: Frame Relay Networks–Asynchronous transfer mode–ATM ProtocolArchitecture, ATM logical Connection, ATM Cell – ATM Service Categories – AAL. High Speed LAN‟s: Fast Ethernet, Gigabit Ethernet, Fiber Channel – Wireless LAN‟s: applications, requirements – Architecture of 802.11

Module II : Congestion and Traffic Management(6 Hrs)

Queuing Analysis–queuing Models–Single Server Queues–Effects of Congestion – Congestion Control – Traffic Management – Congestion Control in Packet Switching Networks – Frame Relay Congestion Control

Module III:TCP Congestion Control (8 Hrs)

TCP Flow Control–TCP Congestion Control–Retransmission–TimerManagement – Exponential RTO back off – KARN‟s Algorithm – Window Management – Performance of TCP over ATM

ATM Congestion Control: Traffic and Congestion control in ATM–Requirements–Attributes–TrafficManagement Frame work, Traffic control – ABR traffic Management - ABR rate control, RM cell formats ABR Capacity allocations – GFR traffic management

Module IV : Integrated and Differentiated Services (6 Hrs)

Integrated Services Architecture–Approach, Components,Services – Queuing Discipline, FQ, PS, BRFQ, GPS, WFQ – Random Early Detection, Differentiated Services.

Audio and video media transport in Packet Networks, Multimedia Transmission in Wired and Wireless Networks, Multimedia Networking, streaming audio and video, Protocols for interactive streaming for both audio and video

Module V : Video Processing (6 Hrs)

Fundamental Concepts in Video – Types of video signals, Analog video, Digital video, Color models in video, Motion Estimation; Video Filtering; Video Compression, Video coding standards.

Reference Books:

1. William Stallings, "High Speed Networks and Internet", Communication Networks", Jean Harcourt
   Asia, Pvt. Ltd., II Edition, 2001
2. IrvanPepelnjk, Jim Guichard and Jeff Apcar, "MPLS and VPN architecture", Cisco Press, Volume 1 and 2, 2003.
3. Tom Sheldon, "Encyclopedia of Networking and telecommunications" TMH, 2001

List of Experiments :

1. Write an article on the latest development in the ATM congestion control.
2. Discuss in detail all the versions of the Architecture of 802.11.as applied to different radio access techniques.
3. Write a note on various queuing models for traffic congestion control highlighting their advantages, disadvantages and applications.
4. Comment on the various Integrated Services Architecture leading to QoS support with proper justification.
5. Design any one high speed communication network to give atleast on parameter related to QoS.

504503 Network Security

Credits:4

Teaching Scheme:

Lecture : 4hrs/week

Examination Scheme:

In-Sem : 50 Marks
End-Sem : 50 Marks

Course Objectives

The Objectives of this course are to:-

- Discriminate network security concept and different security algorithms.
- Categorize security protocols and models.
- Analyze the performance of Network security applications.
- Comply the needs and issues related to social networking and cyber security

Course Outcomes

Having successfully completed this course, students will be able to:

1. Design different cryptography algorithms.
2. Apply standards and laws of security related to different protocols and models.
3. Develop security application by considering authentication Processes.
4. Develop solutions for network and cyber security issues

Course Contents

Module I : (9 Hrs)

Overview of Networking Concepts, Overview of Network Security and Operations, Information Security Concepts, Security Threats and Vulnerabilities, Cryptography, Conventional encryption, cipher-block, location of encryption devices, key distribution. Public key cryptography, RSA algorithm, diffie-hellman algorithms, message authentication, secure hash functions, HMAC, digital signatures, key management. Secrete Key Cryptography, DES, IDEA, AES.

Module II :(9 Hrs)

Secure Software Design, Network Security Concepts, Access Control and Intrusion Detection, Security Technologies and Protocols, Security Architecture and Models, Operating System Security Security Management and Practices, Laws and Standards

Module III : (9 Hrs)

Network Security applications: Authentication applications email Security, PGP, SMIME IP Security, authentication on header, encapsulating security payload, combining security associations, key management. Web Security Requirements, SSL and TSL, SET.

Module IV : (9 Hrs)

Cybersecurity, cyber-physical systems, Cyber-attacks, need of cybersecurity for wired and wireless networks, Cyber security for Smart Grids, Botnets and Cyber security, Cyber security for VoIP, Cyber Physical Systems and their security, Cyber security for online shopping, Incident Handling with Cyber security, Cyber security for Bluetooth Data Communication, Social Networking and Cyber security

Reference Books:

1. 1 William Stallings, " Cryptography and Network Security", 3rd edition, Pearson Education
2. Jochen Schiller, "Mobile Communications", Addison Wesley, 2000.
3. C. Siva Ram Murthy and B. S. Manoj, "Ad Hoc Wireless Networks: Architectures and Protocols", Prentice Hall.
4. Ramjee Prasad and Luis Munoz, "WLANs and WPANs towards 4G wireless", Artech House, 2003.
5. EvangelosKranakis, " Primality and Cryptography", John Wiley & Sons
6. Rainer A. Ruppel, " Analysis and Design of Stream Ciphers", Springer Verlag
7. Douglas A. Stinson, "Cryptography, Theory and Practice", 2nd edition, Chapman & Hall, CRC Press Company, Washington.

List of Experiments:

1. Write a program that reads *n* and *e* from a file and text from another file and writes encrypted text to a third file. File names will be command line parameters. View each group of four characters as a 32-bit integer. Assume that characters in plain text are keyboard characters with ASCII values less than 128. Thus, the 32-bit integer will have a leading bit of 0. Since *n* must have a leading bit of 1 from above, the number will be from 0 to $n - 1$ and hence valid for the algorithm. The values of *n* and *e* can be assumed to be less than 2^{32}. Make sure that the format of your output file is such that your program can be run with *n* and *d* as input and reproduce the original input file

2. Show that the Computational Diffie-Hellman problem has a random self reduction. Let G be a group of prime order q and let g be a generator of G. Define the function $F_{DH}(g^x, g^y) = g^{xy}$. Suppose there is an algorithm A that computes $F_{DH}(X, Y)$ in time T on fraction of the inputs (A outputs ? on all other inputs). Show that there is an algorithm B that computes F_{DH} on all inputs in expected time T/€

504504Research Methodology

Credits: 4

Teaching Scheme: **Examination Scheme:**

Lecture : 4hr/week **In-Sem : 50 Marks**
End-Sem : 50 Marks

The Objectives of this course are:-

- Create research process and basic instrumentation schemes.
- Analyze the statistics of defined problem.
- Calculate performance analysis for modeling and prediction.
- Develop research proposal process.

Course Outcomes

Having successfully completed this course, students will be able to:

1. Describe research process associated with the research methodology and performance analysis using different instruments.
2. Analyze and implement different numerical methods for defined problem.
3. Compose the performance analysis of experimental systems.
4. Defend a research proposal.

Course Contents

Module I : Research Problem (10 Hrs)

Meaning of research problem, Sources of research problem, Criteria / Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem.

Basic instrumentation

Instrumentation schemes, Static and dynamic characteristics of instruments used in experimental set up, Performance under flow or motion conditions, Data collection using a digital computer system, Linear scaling for receiver and fidelity of instrument, Role of DSP is collected data contains noise

Module II : Applied statistics (8 Hrs)

Regression analysis, Parameter estimation, Multivariate statistics, Principal component analysis, Moments and response curve methods, State vector machines and uncertainty analysis

Module III : Modeling and prediction of performance (10 Hrs)

Setting up a computing model to predict performance of experimental system, Multi-scaling and verifying performance of process system, Nonlinear analysis of system and asymptotic analysis, Verifying if assumptions hold true for a given apparatus setup, Plotting family of performance curves to study trends and tendencies, Sensitivity theory and applications.

Module IV : Developing a Research Proposal (8 Hrs)

Format of research proposal, Individual research proposal, Institutional proposal. Proposal of a student – a presentation and assessment by a review committee consisting of Guide and external expert only. Other faculty members may attend and give suggestions relevant to topic of research

Reference Books:

1. "Research methodology: an introduction for science & engineering students", by Stuart Melville and Wayne Goddard
2. "Research Methodology: An Introduction" by Wayne Goddard and Stuart Melville
3. "Research Methodology: A Step by Step Guide for Beginners", by Ranjit Kumar, 2nd Edition
4. "Research Methodology: Methods and Trends", by Dr. C. R. Kothari
5. "Operational Research" by Dr. S.D. Sharma, KedarNath Ram Nath& co.
   Software Engineering by Pressman

Laboratory Assignments/Experiments:

1. Regression analysis of any given problem.
2. Applying PCA for a given problem.
3. For a given system, design a computer model to test the performance of the system. Draw graphs for to study the trends.
4. Develop a research proposal for any system in your mind and present it in front of the committee.

504505 Coding And Modulation Techniques (Elective-I)

Credits: 4

Teaching Scheme:

Lecture : 4Hrs/week

Examination Scheme:

In-Sem : 50 Marks

End-Sem : 50 Marks

Course Objectives

The Objectives of this course are to:-

- Calculate the theoretical analysis of information.
- Differentiate different source and channel coding techniques.
- Analyze effective utilization of spectrum considering different digital modulation Techniques.

Course Outcomes

Having successfully completed this course, students should be able to:

1. Develop information theoretic analysis and design a data compression scheme using suitable source coding technique.
2. Analyze different channel coding techniques.
3. Describe digital modulation, spread spectrum and multiple access techniques.
4. Assess transceivers considering different parameters like channel capacity, interference, Spectrum sharing and antenna weights.

Course Contents

Module I : (8 Hrs)

Definitions, Uniquely Decodable Codes, Instantaneous Codes, Krafts Inequality, McMillan‟s Inequality, Optimal Codes, Binary Huffman Codes, r-ary Huffman codes, Information and Entropy, Properties of Entropy Function, Entropy and Average Word-Length, Shannon-Fano Coding, Shannon‟s First Theorem, Information Channels, Binary Symmetric Channel, System Entropies, System Entropies for Binary Symmetric Channel, Extension of Shannon‟s First Theorem to Information Channels, Mutual Information, Mutual Information for the Binary Symmetric Channel, Hamming Distance, Shannon‟s Second (Fundamental) Theorem, Converse of Shannon‟s Theorems

Module II : (10Hrs)

The Lee Metric, Hadamard Codes, Golay Codes (Binary and Ternary), Reed Muller Codes, and Kerdock Codes. Bounds on Codes: Gilbert Bound, Upper Bound, Linear Programming Bounds, Hamming‟s Sphere – Packing Bound, Gilbert Varshamov Bound, Hadamard Matrices and Codes. Reed-Solomon Codes, Quadratic Residue Codes, Generalized Reed-Muller Codes, Perfect Codes and Uniformly Packed Codes: Lloyd‟s Theorem, Characteristic Polynomial of a Code, Uniformly Packed Codes, Nonexistence Theorems. Galois Rings over Z4, Cyclic Codes over Z4, Goppa Codes. Algebraic Curves, Divisors, Differentials on a Curve, Riemann – Roch Theorem, Codes from Algebraic Curves. Arithmetic Codes: AN Codes, Mandelbaum – Barrows Codes, Convolutional Codes

Module III : (10 Hrs)
Advanced Digital Modulation and Demodulation Techniques, QPSK, Continuous Phase PSK (CPPSK), GMSK, QAM, Trellis Coded Modulation (TCM) Clock and Carrier Recovery Schemes. Frequency hopping multiple access (FHMA) principle and functional block diagram, DSSS, Code division multiple access, Mathematical representation, Effect of multipath propagation on CDMA. CDMA systems, Multi-user detection.

Module IV : (8Hrs)
Orthogonal Frequency Division Multiplexing (OFDM), Principle, Implementation of Transceivers, Frequency selective channels, channel estimation, Inter-carrier interference, multicarrier code division multiple access. Multi-antenna systems, smart antennas, capacity increase, receiver structures, algorithms for adaptation of antenna weights. Multiple input and multiple output systems, channel state information, capacity of non fading channels

Laboratory Assignments/Experiments:

1. Discuss the Reed-Solomon codes with respect to architecture and implementation highlighting the superiority for wireless communication systems

2. Develop the design steps for RADAR signal detection and estimation by various prediction techniques and filters. Comment on the same by simulating the design using MATLAB

504505 Detection And Estimation Theory(Elective-I)

Credits: 4

Teaching Scheme: **Examination Scheme:**

Lecture : 4Hrs/week **In-Sem : 50 Marks**
End-Sem : 50 Marks

Course Objectives:
The Objectives of this course are to:-

- Describe the main concepts and algorithms of detection and estimation theory.
- Categorize the random processes and estimation of continuous waveform.
- Calculate the signal parameter estimation.
- Differentiate different types of optimum filters.

Course Outcomes

Having successfully completed this course, students will be able to:

1. Describe the basics of statistical decision theory used for random signal detection and estimation.
2. Calculate signal parameters by using Bayer's, LMS, MMSE estimators.
3. Analyze signal estimation using optimum filters.

Course Contents

Module I : (9 Hrs)
Classical Detection and Estimation Theory: Introduction: Signals and Systems: Systemtheory, stochastic process and their representation, Gauss – Markov models, likelihood and efficiency. Detection theory: Hypothesis testing, Decision criterion, multiple measurements, multiple and composite hypothesis system, CFAR detection. Detection of signals in noise: detection of known signals in white noise, co- relation receiver, Maximum SNR criterion estimation theory, composite hypotheses, general Gaussian problem, performance bounds and approximations

Module II : (9 Hrs)
Representations of Random Processes: Introduction, orthogonal representations, randomprocess characterization, homogenous integral equations and eigen-functions, periodic processes, spectral decomposition, vector random processes
Estimation of Continuous Waveforms: Introduction, derivation of estimator equations, a lowerbound on the mean-square estimation error, multidimensional waveform estimation, nonrandom waveform estimation

ModuleIII : (9 Hrs)
Detection of Signals – Estimation of Signal Parameters: Estimation theory: Estimation ofparameters, random and non-random, Bayer‟s estimates properties of estimators, linear mean square estimation. Estimation of waveform: Linear MMSE estimation of waveform, estimation of stationary process, Weiner filters, estimation of non- stationary process, detection and estimation in white Gaussian noise, detection and estimation in non-white Gaussian noise, signals with unwanted parameters, multiple channels and multiple parameter estimation

ModuleIV: **(9 Hrs)**

Linear Estimation: Properties of optimum processors, realizable linear filters, Kalman-Bucyfilters, fundamental role of optimum linear filters. Weiner filters, estimation of non- stationary process, Kalman filters. Relation between Weiner filters and Kalman filters, non-linear estimation. Application to RADAR signal processing, estimation of range detection of object, it‟s size etc. Linear prediction and optimum linear filters: Forward and backward linear prediction, properties of linear prediction error filters, AR lattice and ARMA lattice ladder filters, Weiner filters for filtering and prediction

Reference Books:

1. Harry L. Van Trees, “Detection, Estimation, and Modulation Theory,” Part I, John Wiley & Sons, USA, 2001
2. M.D. Srinath, P.K. Rajasekaran and R. Viswanathan, "Introduction to Statistical Signal Processing with Applications,” Pearson Education (Asia) Pte. Ltd. /Prentice Hall of India, 2003
3. Steven M. Kay, "Fundamentals of Statistical Signal Processing," Volume I: "Estimation Theory", Prentice Hall, USA, 1998
4. Steven M. Kay, "Fundamentals of Statistical Signal Processing”, Volume II: "Detection Theory," Prentice Hall, USA, 1998
5. K Sam Shanmugam, Arthur M Breipohl, “Random Signals: Detection, Estimation and Data Analysis”, John Wiley & Sons, 1998

List of Practicals:

Develop the design steps for RADAR signal detection and estimation by various prediction techniques and filters. Comment on the same by simulating the design using MATLAB.

1. Highlight the estimation parameters for detection of random and non-random signals
2. Write a note on application of Markov models in estimation process. Design atleast one of them

504505 Mathematics for Communication Networks(Elective-I)
Credits: 4

Teaching Scheme: **Examination Scheme:**

Lecture : 4hrs/week **In-Sem : 50 Marks**
End-Sem : 50 Marks

Course Objectives

The Objectives of this course are to:-

- Analyze the mathematical model, probability theory.
- Describe the concepts of Linear algebra and algorithm development.
- Design the random variables and processes.

Course Outcomes

Having successfully completed this course, students should be able to:

1. Design a mathematical model for any signal processing application.
2. Analyze the given problem using the concepts of probability theory and random processes.
3. Construct the concepts of Linear algebra, algorithm development involving arrays and matrix operations.
4. Design different signal processing algorithms.

Course Contents

Module I: **(8 Hrs)**

Matrices - Inverse matrix to solve system of linear equations, Rank of a matrix, use of echelonform and canonical form of a matrix to find rank, Concept of Linear dependence / independence, classification of real and complex matrices, matrix inversion techniques, trace, Linear operators, Linear equations, singularity, characteristic vectors, Cayley-Hamilton theorem, quadratic form, matrix differentiation and matrix integration, LDU decomposition.

Module II : **(8 Hrs)**

Some Important Classes of Linear Systems:-Shift Invariant Systems and TopelitzMatrices,Operators and Square Matrices, Self Adjoint Operators and Hermitian Matrices, idempotent matrices and unitary matrices, Gram-Schmidt Orthogonalization

Module III : **(8 Hrs)**

Vector Space -Definition and properties of vector space; Definition and properties of vector sub-space; Algebra of subspaces; basis of a vector space; finite dimensional vector space; Linear independence of vectors

Module IV: **(12 Hrs)**

Random variable- CDF,PDF, Statistical averages, nth moments, central moments, probabilitymodels for discrete and continuous random variables, Binominal‟s, Poisson‟s, Gaussian, Uniform, Rician, 2D-random variables, autocorrelation, covariance, covariance coefficient.

Random processes- Ensemble, Stationary process, WSS, Ergodic process, Markov chain,Markov process, Poisson‟s process, Gaussian process, Weiner process, spectral representation of random signals, transmission of random process through LTI filter, effect of noise on random process, white noise, narrow band noise, SVD decomposition. Filtering Random processes, spectral factorization

Reference Books:

1. K. Hoffman &R.Kunze, Linear Algebra- PHI, 1996
2. S.Andrilli&D.Hecker-Elementary linear Algebra-Else verinc 2003.
3. Paul R. Halmos, Finite-Dimensional Vector Spaces, Springer
4. Matrix Analysis- . R. Horn and C. Johnson, Cambridge U.P
5. Monson Hayes, Statistical Signal Processing, Wiley, 1996
6. A. Popoulis, Pillai-Probability, Random Variables & stochastic processors-TMH, 2004.
7. H.Stark&J.W.Woods-Probability, Random variables &eitimation theory for Engineer PHI-1994.
8. Kishor S. Trivedi - Probability, Random Variables & Random processors- Prentice hall
9. Simon Haykins - Communication system.
10. Taub& Schilling, Taubs Principals of Communication Systems, TMH 3rd edition.
11. Dr. Shaila D. Apte , Advanced Digital Signal Processing, Wiley India

List of experiments:

1. To solve simultaneous equations of 3 variables using matrices.
2. To find the Eigen values and Eigen vectors of a matrix.
3. To calculate and plot the CDF and PDF of a given problem.
4. To find the mean, variance, standard deviation, autocorrelation, covariance and covariance coefficient of a given problem

504505 Neural Networks in Communications(Elective-I)
Credits: 4

Teaching Scheme: **Examination Scheme:**

Lecture : 4hrs/week **In-Sem : 50 Marks**
End-Sem : 50 Marks

Course Objectives

The Objectives of this course are to:-

- Describe the different types of neural networks and Neuro-dynamic programming.
- Develop applications of neural networks in telecommunication.
- Describe the concept of channel equalization and traffic density determination.

Course Outcomes

Having successfully completed this course, students should be able to:

1. Describe the concepts of neural networks, and Neuro-dynamic programming.
2. Design neural network based applications in telecommunication.
3. Differentiate channel equalization and traffic density determination.

Course Contents

Module I: **(9 Hrs)**

Introduction to artificial neural networks, Learning rules, perceptron networks, Feed forward networks, Feedback networks, Radial basis function networks, Associative memory networks, self organizing feature map, Adaptive resonance theory

Module II : **(9 Hrs)**

Probabilistic neural networks, neocognitron, Optical neural networks, Simulated annealing, Support vector machines, Neuro-dynamic programming

Module III : **(9 Hrs)**

Applications in Telecommunications: Efficient design of RF and wireless circuits, Neural networks for switching, ATM traffic control using neural networks, Neural model for adaptive congestion control in ATM networks

Module IV: **(9 Hrs)**

Neural network channel equalization, Static and Dynamic Channel assignment using simulated annealing, Traffic density determination using self organizing feature map.

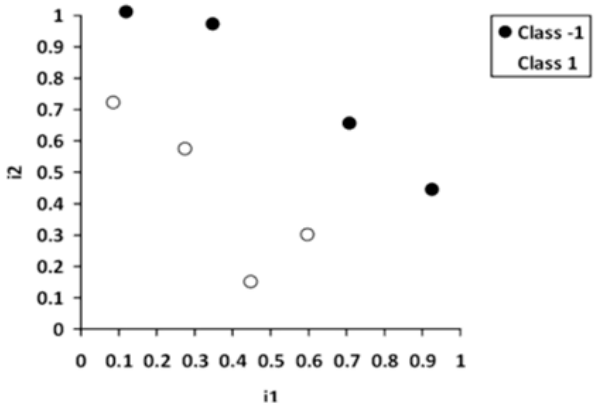
Reference Books:

1. S N Sivanandam, S Sumathi, S N Deepa, “Introduction to Neural Networks Using Matlab 6.0”, Tata McGraw Hill Publication.
2. Fredric Ham and IvicaKostanic, “Principles of Neuro-computing for science and Engineering”, Tata McGraw Hill Publication
3. Simon Haykin, “Neural Networks: Comprehensive foundation”, Prentice Hall Publication.
4. Ben Yuhas and Nerwan Ansari, “Neural Networks in Telecommunications”, Kluwer Academic publishers

List of experiments:

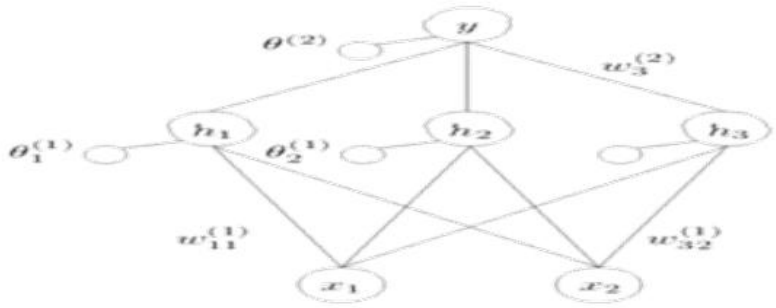
1. Consider the Back propagation algorithm operating on neurons which use the transfer function logsigmoid instead of the usual sigmoid function. That is assume that the output of a single neuron is
   $\sigma = \log\sigma(w^{(T)}x)$. Remember $(\sigma(x))' = \sigma(x).(1- \sigma(x))$
   Given the weight update rules for output layer weights and for hidden layer weights.

2. The chart below shows a set of two dimensional input samples from two classes



   (a) It looks like there exists a perfect classification function for this problem that is linearly separable, and therefore a single perceptron should be able to learn this classification task perfectly. Let us study the learning process, starting with a random perceptron with weights w0= 0.2, w1= 1, and w2= -1, where of course w0is the weight for the constant offset i0= 1. For the inputs, just estimate their coordinates from the chart.
   Now add the perceptron's initial line of division to the chart. How many samples are misclassified? Then pick anarbitrary misclassified sample and describe the computation of the weight update (you can choose η= 1 or any other value; if you like you can experiment a bit to find a value that leads to efficientlearning). Illustrate the perceptron's new line of division in the same chart or a different one, and give the number of misclassified samples. Repeat this process four more times so that you have a total of six lines (or fewer if your perceptron achieves perfect classification earlier). You can do the computations and/or graphs either by hand or by writing a computer program. If you write a program, please attach a printout, and let the program run until the perceptron achieves perfect classification (after how many steps?).
   (b)If your perceptron did not reach perfect classification, determine a set of eights that would achieve perfect classification, and draw the separating line for those weights.
   (c) Now let us assume that less information were available about the samples that are to be classified. Let us say that we only know the value for i1for each sample, which means that our perceptron has only two weights to classify the input as best as possible, i.e., it has weights w0and w1, where w0is once again the weight for the constant offset i0= 1. Draw a diagram that visualizes this one-dimensional classification task, and determine weights for a perceptron that does the task as best as possible (minimum error, i.e., minimum proportion of misclassified samples). Where does it separate the input space, and what is its error?

3. A feed forward neural Network with 13 parameters. You will explore evaluating and learning in this model.



Use your program to find for k= 1…….K

$g_k(w\text{‟}) = [E_D(w\text{‟}+\varepsilon\eta^{(k)}) - E_D(w\text{‟})] / \varepsilon$ where $\varepsilon = 10^{-6}$ and $\eta^{(k)}$) is a vector of zeroes with a one in position k:

$\eta_j^{(k)} = 1$ if j=k

= 0 otherwise

c) Learning the weight vector

Describe and explain a method for using $g_k(w)$ to find a setting of w that predicts the outputs

$t^{(n)}$ from the inputs $x^{(n)}$

If you implement this (optional). Then include code and a solution for w

504505*LATEX

Credits: 1

Teaching Scheme: **Examination Scheme:**

Lecture : 1hrs/week **In-Sem :**
End-Sem :

Course Objectives:
The objectives of this course are to :

- Construct documents usingLaTeX.

Course Outcomes:
On completion of the course, student will be able to

- Create documents/assignments/reports usingLaTeX.

Course Contents

LaTeX /Document Structure, Document classes, Packages, The document environment, Book structure.

**For each Subject under Elective I the student Shall study LATEX for 1 credit.

References:
http://miktex.org/
http://www.winedt.com/

504506 Lab Practice I

Credits: 4

Teaching Scheme:

Practical : 4hrs/week

Examination Scheme:

TW : 50 Marks

Oral/Presentation : 50 Marks

Lab Practice I:

The laboratory work will be based on completion of minimum two assignments/experiments confined to the courses of that semester.

SEMESTER-II

504507 **Traffic Analysis and QoS**

Credits: 4

Teaching Scheme: **Examination Scheme:**

Lecture : 4hrs/week **In-Sem : 50 Marks**

End-Sem : 50 Marks

Course Outcomes

Having successfully completed this course, students should be able to:

- Categorize general concepts and architecture behind standards based network management.
- Describe concepts and terminology associated with TMN.
- Differentiate the operation of high speed networking technologies and protocols of QoS.
- Describe the concept of queuing, traffic management and congestion control.

Course Outcomes

Having successfully completed this course, students will be able to:

1. Compare the different network management models and tools.
2. Describe the concept of TMN and applications related to network management.
3. Choose a network in terms of quality to optimize high-speed network.
4. Describe the congestion control and traffic management techniques.

Course Contents

Module I: **(9 Hrs)**

SNMP and Network Management: Basic foundations: Standards and Models, OrganizationModel, Information Model, Communication Model, Functional Model.

Network Management Tools, Systems and Engineering: System utilities for Management,Network Statistics, Measurement Systems, MIB Engineering, NMS Design, Network Management System

Module II : **(9 Hrs)**

TMN and Applications Management: Telecommunication Management network: ConceptualModel, Standards, Architecture, Service architecture, integrated view, Implementation. Broadband Network Management: Network and Services, ATM Technology and Management, MPLS Network Technology and OAM Management, Optical and MAN Feeder Networks

Module III : **(9 Hrs)**

High Speed Networks: High Speed LAN, Performance Modeling and Estimation: Self SimilarTraffic. **Quality of Service in IP Networks:** Integrated and Differential Services, Protocols for QoSSupport

Module IV: **(9 Hrs)**

Congestion, Performance Issues and Traffic Management: Need for Speed and Quality of Service, Performance Requirement and Metrics, Effects of Congestion, Congestion Control in Data Networks and Internet, Link Level Flow and Error Control, TCP Traffic, Control Traffic and Congestion Control in ATM Networks

Reference Books:

1. Network Management- Principles and Practices - Mani Subramanian, Pearson, Second Edition.
2. High-Speed Networks and Internets- Performance and QoS, William Stallings, Pearson, Second Edition.
3. Computer Networking with Internet Protocols and Technology, William Stallings, Pearson, Second Edition.
4. Traffic Management & Traffic Engineering for the future Internet - Valadas&Ruj

List of experiments:

1. Develop the design steps in the implementation of telecommunication networks.
2. Download a Network Management tool from WWW and install it on an appropriate platform where that tool works (Windows/Linux/Solaris, etc.) on your PC. You can also use an evaluation copy with limited usage time (e.g., 30 days). Some tools are available only in executable binary forms (especially those that run under Windows) while others are available with source code. You should build the tool from source code following developer‟s instructions on your platform (typically Linux). Each tool comes with some documentation about its use and a few examples. Execute at least two such examples and comment on the results provided by the tool

504508 **Broadband Wireless Technologies**

Credits: 4

Teaching Scheme: **Examination Scheme:**

Lecture : 4hrs/week **In-Sem : 50 Marks**

End-Sem : 50 Marks

Course Objectives

The Objectives of this course are to:-

- Analyze the basics of OFDM and MIMO technology.
- Categorize UWB and MAC Protocol.
- Differentiate types of wireless networks and routing protocols.
- Describe the Architectures for EPON and WiMAX.

Course Outcomes

Having successfully completed this course, students should be able to:

1. Analyze different parameters of MIMO system and types of OFDM systems.
2. Discriminate types of UWB and MAC protocols.
3. Describe different routing protocols and QoSin wireless systems.
4. Describe architectures for EPON and WiMAX , their Design & operation Issues.

Course Contents

Module I: **(9 Hrs)**

OFDM & Block Based Transmissions: Block based transmissions, OFDM multiplexingsystems, Single carrier cyclic prefix systems, orthogonal FDMA, interleaved FDMA, single carrier FDMA, CP based CDMA, receiver design. **MIMO Antenna Systems:** MIMO system model, channel capacity, diversity and spatialmultiplexing gain, SIMO & MISO systems, space-time coding, MIMO transceiver design, SVD based Eigen bean forming, MIMO for frequency selective fading channels, cyclic delay diversity

Module II : **(9 Hrs)**

UWB and Medium Access Control: Time hopping UWB, Direct sequence UWB, Multiband, other types UWB, Slotted ALOHA MAC, Carrier sense multiple access with collision avoidance MAC, polling MAC, Reservation MAC, Energy efficient MAC, Multichannel MAC, Directional Antenna MAC, Multihop saturated Throughput of IEEE 802.11 MAC, Multiple Access Control

Module III : **(9 Hrs)**

Multihop Wireless Broadband Networks, Radio Resource Management and QOS: MultihopWireless Broadband networks: Mesh networks, Importance of Routing Protocols, Routing Metrics, Classification of Routing Protocols, MANET routing protocols, Packet scheduling, Admission Control, Traffic Models, QoS in wireless systems, Out\age probability for vbideo services in a multirate DS- CDMA system. **WiMAX and Optical Access Networks:** Point–multipoint WiMAX networks, Mesh mode,Mobility in WiMAX networks, Data link layer Protocols, Multi – point control Protocols, Dynamic BW allocation algorithm (DBA)

Module IV: **(9 Hrs)**

Ethernet Passive Optical Networks (EPONS): Intra–ONU scheduling, QoS enabled DBA,QoS protection and Admission control in EPON, BW management for Multichannel EPONS, Separate/combined time and wavelength assignment

EPON – WiMAX, Hybrid WOBAN, Point – Point FTTx, Broadband Access Networks Integrated Architectures for EPON and WiMAX, Design & operation Issues, WOBAN- a network for future, connectivity, routing, fault tolerance &self healing, fiber topology vs. transmission scheme, Architectural/deployment/operational/cost considerations, open fiber access, transmission technologies, broadband networks & network requirements, scalable broadband access networks, next generation access & backhaul

Reference Books:

1. David Tung Choug Wong, Peng Yong Kong, Ying Chang Liang, Lee Chaing Chua, Jon W. Mark, Wireless Broadband Networks, Wiley Publication
2. AbdallahShami, Martin Maier, ChadiAssi: BiswanathMukharjee- series Editor, Broadband Access Networks Technologies Deployments, Springer
3. Regis J. "Bud" Bates, Broadband Telecommunications Handbook, Mc GRAW – Hill

List of experiments: (At least 2 experiments for the given list)

1. Study a specific case study on the deployment of any advanced broadband wireless technology and illustrate the details of its implementation. Also, describe its productivity gain, future benefits of the technology and the resultant economic growth.

2. Perform a study of new communication services and infer possible scenarios for applying open wireless broadband platform to new value-added scenarios such as broadcasting services, regional services, and disaster recovery.

3. Analyze the governance for open wireless broadband platforms: laws, systems, rules, assignment of radio frequencies, and propose the necessary strategies and policies that could be adopted.

4. Give details of validation of mobile communications technology including Proposal, validation of IP mobile communications protocol technology and study of network design schemes for open wireless platforms

5. Perform study of authentication techniques for realizing MVNOs on wireless networks and ways to integrate them with open standard authentication techniques on the internet.

6. Analyze the validation of non-preemptive handover technology between foreign wireless networks, Validation of seamless handover technology between wireless networks, and study the development of standardized handover technologies for foreign wireless networks

504509 Software Defined and Cognitive Radio

Credits: 4

Teaching Scheme: **Examination Scheme:**

Lecture : 4hrs/week **In-Sem : 50 Marks**
End-Sem : 50 Marks

Course Objectives

The Objectives of this course are to:-

- Describe architecture and requirements of Cognitive Radio for end to end communication.
- Categorize different elements of Software Communication Architecture.
- Design the implementation of algorithms of smart antennas for cognitive radio.

Course Outcomes

Having successfully completed this course, students will be able to:

1. Describe the architecture of Cognitive Radio for end-to-end communication.
2. Develop algorithms of SCA to test different radio sets.
3. Develop smart antenna algorithms.

Course Contents

Module I: **(9 Hrs)**

Cognitive radio concepts & history, Benefits of Cognitive radio, Cognitive radio Forum. Low Cost Cognitive radio Platform, Requirements and system architecture, Convergence between military and commercial systems, The Future of Software Defined Radio

Module II : **(9 Hrs)**

Ideal Cognitive radio architecture, Cognitive radio Based End-to-End Communication, Worldwide frequency band plans

Module III : **(9 Hrs)**

Aim and requirements of the SCA, Architecture Overview, Functional View, Networking Overview, Core Framework, Real Time Operating Systems, Common Object Request Broker Architecture (CORBA), SCA and JTRS compliance

Module IV: **(9 Hrs)**

Radio Frequency design, Baseband Signal Processing, Radios with intelligence, Smart antennas, Adaptive techniques, Phased array antennas, Applying Cognitive radio principles to antenna systems, Smart antenna architectures

Reference Books:

1. Reed, Software Radio, Pearson Education, 2002
2. Kwang– Cheng Chen and Ramjee Prasad, Cognitive Radio Networks, Wiley Pub.
3. Dillinger, Madani, Alonistioti (Eds.): Software Defined Radio, Architectures, Systems and Functions, Wiley 2003
4. Paul Burns , Software Defined Radio for 3G, 2002
5. Tafazolli (Ed.): Technologies for the Wireless Future, Wiley 2005.
6. Bard, Kovarik: Software Defined Radio, the Software Communications Architecture, Wiley 2007.

List of experiments:

1. Design a Smart Antenna or sensor system to evaluate performance and gain an understanding of the operation and application of spatial filtering accomplished by adaptive array antenna systems.
2. Develop software platform that includes functions of sensing, (select adequate communication systems) on the widely-spread operation systems for Cognitive Radio.
3. Describe the various IEEE standards associated with Cognitive Radio

4.Illustrate the different hardware and software platform of a Cognitive Radio

504510 **Advanced Techniques for Wireless Reception(Elective-II)**

Credits: 4

Teaching Scheme: **Examination Scheme:**

Lecture : 4hrs/week **In-Sem : 50 Marks**

End-Sem : 50 Marks

Course Objectives:

Course objectives

The objectives of this course are to

- Describe signal processing for CDMA and TDMA wireless reception.
- Categorize predictive and code aided techniques.
- Discriminate Signal processing techniques.

Course outcomes

Having successful completion of this course, student will be able to

1. Describe signal processing for CDMA and TDMA wireless reception.
2. Compare predictive and code aided techniques based on performance.
3. Describe Signal processing techniques for MIMO, fading channel and OFDM.

Module I: **(9 Hrs)**

Wireless signalling environment. Basic signal processing for wireless reception. Linear receivers for synchronous CDMA. Blind and group-blind multiuser detection methods. Performance issues.

Module II : **(9 Hrs)**

Robust multiuser detection for non Gaussian channels; asymptotic performance, implementation aspects. Adaptive array processing in TDMA systems. Optimum space-time multiuser detection

Module III : **(9 Hrs)**

Turbo multiuser detection for synchronous and turbo coded CDMA. Narrowband interface suppression. Linear and nonlinear predictive techniques. Code aided techniques. Performance comparison

Module IV: **(9 Hrs)**

Signal Processing for wireless reception: Bayesian and sequential Monte Carlo signal processing. Blind adaptive equalization of MIMO channels. Signal processing for fading channels. Coherent detection based on the EM algorithm. Decision-feedback differential detection. Signal processing for coded OFDM systems

Reference Books:

1. X.Wang&H.V.Poor, Wireless Communication Systems, Pearson, 2004.
2. R.Janaswamy, Radio Wave Propagation and Smart Antennas for Wireless Communication, Kluwer, 2001.
3. Mohamed Ibnkahla, Signal Processing for Mobile Communications, CRC Press, 2005.
4. A.V.H. Sheikh, Wireless Communications Theory & Techniques, Kluwer Academic Publications, 2004.
5. A.Paulrajetal, Introduction to Space-time Wireless Communications, Cambridge University Press, 2003

List of experiments:

1. Design the steps of Monte Carlo sampling methods for Bayesian filtering

2. Develop a general variational Bayesian framework for iterative data and parameter estimation for coherent detection is introduced as a generalization of the EM-algorithm

504510 Spread Spectrum and CDMA Systems(Elective-II)

Credits: 4

Teaching Scheme: **Examination Scheme:**

Lecture : 4hrs/week **In-Sem : 50 Marks**
End-Sem : 50 Marks

Course objectives

The objectives of this course are to

- Describe Binary Shift Register Sequences and synchronization techniques for Spread Spectrum Systems.
- Calculate performance of Spread Spectrum Systems.
- Describe Code Division Multiple Access Digital Cellular Systems.
- Describe the concepts of WCDMA.

Course outcomes

Having successful completion of this course, student will be able to

1. Discriminate Binary Shift Register Sequences and synchronization techniques for Spread Spectrum Systems.
2. Compare performance of Spread Spectrum Systems using different coding techniques.
3. Discriminate CDMA and WCDMA cellular systems.

Course Contents

Module I: **(9 Hrs)**

Binary Shift Register Sequences for Spread Spectrum Systems: Definitions, mathematical background and sequence generator fundamentals, Maximal length sequences, Gold codes, and nonlinear code generatorsInitial Synchronization of the Receiver Spreading Code: Problem definition and the optimum synchronizer, Serial search synchronization techniques, generalized analysis of average synchronization time, Synchronization using a matched filter Synchronization by estimating the received spreading code, Tracking loop pull-in.

Module II : **(9 Hrs)**

Performance of Spread Spectrum Systems in Jamming Environments, with forward Error Correction: Spread spectrum communication system model, Performance of spread spectrum systems without coding, Elementary block coding concepts, Elementary convolutional coding concepts , Results for specific error correction codes, Interleaving , Coding bounds, Introduction to Fading Channels, Statistical model of fading, Characterization of the mobile radio channel , Requirement for diversity in fading channels

Module III : **(9 Hrs)**

Code Division Multiple Access Digital Cellular Systems: Cellular radio concept, CDMA digital cellular systems, Specific examples of CDMA digital cellular systems, North American DS-CDM digital cellular system (IS-95), Cooper and Nettleton DPSK-FHMA system , Bell Labs multilevel FSK frequency hop system, SFH900 system, GSM-SFH digital cellular system , Hybrid SFH TDMA/CDMA system for PCS applications

Module IV: **(9 Hrs)**

Diversity and the RAKE receiver, Physical and logical channels in IS-95; Medium access in cdma2000 and its extensions, Physical and logical channels in WCDMA; Medium access in WCDMA; Packet access, Radio resource management: Power control and soft handoff, Radio resource management in IS-95, cdma2000 and WCDMA; HSDPA, Network planning for CDMA - IS-95 and WCDMA systems, miscellaneous topics in spread spectrum - GPS (positioning), jamming, and military systems

Reference Books:

1. R. L. Peterson, R. E. Ziemer, and D. E.Borth, Introduction to Spread Spectrum Communications, Prentice Hall, 1995. (ISBN 0-02-431623-7)
2. Vijay K. Garg, Wireless Network Evolution: 2G to 3G, Prentice Hall, 2002, ISBN: 0-13-028077-1
3. J. S. Lee and L. E. Miller, CDMA Systems Engineering Handbook, Artech House, 1998. (ISBN 0-89006-990-5)
4. J. Viterbi, CDMA: Principles of Spread Spectrum Communication, Addison-Wesley, 1995.
5. R. C. Dixon, Spread Spectrum Systems with Commercial Applications, 3rd ed., John Wiley & Sons, 1994.
6. T. S. Rappaport, Wireless Communications: Principles and Practice (2nd Edition), Prentice Hall, 2001.
7. H. Holma and A. Toskala, WCDMA for UMTS, John Wiley and Sons, 2000

List of experiments:

1. Discuss the mathematical analysis on the average bit error rate for multi-users in a single channel of the spread spectrum, Code Division Multiple Access (SS-CDMA) mobile radio system. Present expressions of BER performance of CDMA systems for a wide range of interference conditions for both synchronous case and asynchronous case, including Gaussian approximations (GA), Improved Gaussian Approximation (IGA), and Simple Improved Gaussian Approximation (SIGA).
2. Discuss the key idea of the multiuser detection in the CDMA systems for high speed data transmission and develop the multiuser CDMA system model.
3. Comment on the use of spread spectrum technology is the North American Code Division Multiple Access (CDMA) Digital Cellular (IS-95) standard.
4. Reason out the following with proper examples
    - Tight synchronization is required to use orthogonal codes, which then break in a multipath channel anyway
    - Quasi-orthogonal codes cause self-interference, which dominates the performance in most CDMA systems
    - Near-far problem is a serious hindrance, requiring fast and accurate power control (that uses up bits we could otherwise send information with)
    - For all this, the required bandwidth is now J times largerthan it was before, so there doesn‟t appear to be a capacity gain
    - How did Qualcomm convince people to use this stuff

5. Highlight the features of RAKE Receiver and discuss the practical implementation of the same

504510 Optical Networks(Elective-II)

Credits: 4

Teaching Scheme: **Examination Scheme:**

Lecture : 4hrs/week **In-Sem : 50 Marks**
End-Sem : 50 Marks

Course objectives

The objectives of this course are to

- Describe switching techniques, components and physical properties of optical networks.
- Describe transmission system parameters and protocols applied in optical internets.
- Differentiate architectures of SONET, SDH and Optical Transport Networks.
- Compose network topologies and protection schemes of Optical Networks.

Course outcomes

Having successful completion of this course, student will be able to

1. Compare switching techniques, components and physical properties of optical networks.
2. Assess transmission system parameters and protocols applied in optical internets.
3. Compare architectures of SONET, SDH and Optical Transport Networks.
4. Describe network topologies and protection schemes of Optical Networks.

Course Contents

Module I: **(9 Hrs)**

Introduction to Optical Networks: Telecommunications Networks Architecture, Services,circuit switching and packet switching, Optical Networks: Multiplexing Techniques, Second generation Optical Networks, Optical Packet Switching, Transmission Basics: Wavelength, frequencies, and channel spacing, Wavelength standards, Optical power and loss, Network Evolution, Nonlinear Effects: Self-phase Modulation, Cross-phase Modulation, Four Wave mixing, Solitons

Components: Couplers, Isolators and Circulators, Multiplexers and Filters, Optical Amplifiers,Transmitters, Detectors, Switches, Wavelength Converters.

Module II : **(9 Hrs)**

Transmission System Engineering: System Model, Power Penalty, Transmitter, Receiver,Optical Amplifiers, Crosstalk, Dispersion, Wavelength Stabilization, Overall Design Considerations.

Optical Internets: Migration to IP optical networking, IP and Optical backbone, IP Routingtable, MPLS and optical cross connect table, Protocol stack Alternatives, Internetworking SS7 and Legacy Transport, Internet transport network protocol stack

Module III : **(9 Hrs)**

SONET, SDH and Optical Transport Networks (OTNs): SONET and SDH: SONETmultiplexing hierarchy, Frame structure, Functional Component, problem detection, concatenation.

Architecture of Optical Transport Networks (OTNs): Digital wrapper, in-band and out-of-band control signalling, Importance of Multiplexing and multiplexing hierarchies, SONET multiplexing hierarchies, SDH multiplexing hierarchies, New Optical Transport, OTN layered Model, Generic Framing Procedure (GFP)

Module IV: **(9 Hrs)**

WDM, Network topologies, MPLS and Optical Networks: WDM: WDM operation, DenseWavelength Division Multiplexing (DWDM), Erbium-doped Fiber (EDF), WDM amplifiers, Add-Drop Multiplexers, Wavelength Continuity Property, Higher dispersion for DWDM, Tunable DWDM Lasers.

Network topologies and protection schemes: Robust networks, Line and path protectionswitching, Types of topology, Point to point topology, bi-directional line-switched ring (BLSR), meshed topology, Passive optical networks, Metro optical networks

MPLS and Optical Networks: IS label switching, Forwarding equivalence class (FEC), Typesof MPLS nodes, Label distribution and binding, label swapping and traffic forwarding, MPLS support of Virtual Private Networks (VPN), MPLS traffic engineering, Multi protocol Lambda switching (MPIS)

Reference Books:

1. Optical Networks – Practical Perspective, 3rd Edition, Rajiv Ramaswami and Kumar Sivarajan, Morgan - Kaufmann Publishers.
2. Optical Networks, Third Generation Transport Systems, Uyless Black, Pearson Edition

List of experiments:

1. Examine new elastic optical networking paradigm describing the drivers, building blocks, architecture, and enabling technologies for this new paradigm, as well as early standardization efforts
2. Explore the new paradigm for the access network with the introduction of OFDMA into a Passive Optical Network (PON) architecture
3. Give an overview of Optical network architectures and protocols design for wireless backhauling
4. Describe Next Generation Passive Optical Networks (NGPONs) and Next Generation Access Networks (NGANs)
5. Analyze Long-Reach Passive Optical networks for Metropolitan network consolidation and its impacts
6. How is the problem of routing and wavelength assignment (RWA) handled for increasing the efficiency of wavelength-routed all-optical network?

504510 RF MEMS(Elective-II)
Credits: 4

Teaching Scheme: **Examination Scheme:**

Lecture : 4hrs/week **In-Sem : 50 Marks**
End-Sem : 50 Marks

Course objectives

The objectives of this course are to

- Describe mechanical and electromagnetic properties of MEMS structures.
- Categorize switching operations of MEMS inductors and capacitors.
- Describe micromechanical filters and MEMS phase shifters.
- Design RF MEMS Microstrip antennas.

Course outcomes

Having successful completion of this course, student will be able to

1. Describe mechanical and electromagnetic properties of MEMS structures.
2. Compare switching operations of MEMS inductors and Capacitors.
3. Design micromechanical filters and MEMS phase shifters.
4. Construct RF MEMS Microstrip antennas.

Course Contents

Module I: **(9 Hrs)**

General overview of MEMS and RF MEMS. MEMS materials and Fabrication techniques. Analysis of the fundamental mechanical and electromagnetic properties of MEMS structures. RF MEMS relays and switches. Switch parameters. Actuation mechanism. Bistable relays and micro actuators.

Module II : **(9 Hrs)**

Dynamics of switching operations. MEMS inductors and Capacitors. Micromachined inductor. Effect of inductor layout. Modeling and design issues of planar inductor. Gap tuning and area tuning capacitors. Dielectric tunable capacitors. Micrmachined RF filters

Module III : **(9 Hrs)**

Modeling of mechanical filters. Electrostatic comb drive. Micromechanical filters using comb drives. Electrostatic coupled beam structures. MEMS phase shifters. Types. Limitations. Switched delay lines

Module IV: **(9 Hrs)**

Micromachined transmission lines. Coplanar lines. Micromachined directional coupler and mixer. Micromachined antennas. Microstrip antennas – design parameters. Micromachining to improve performance. Reconfigurable antennas. One Detailed application of RF MEMS

Reference Books:

1. Gabriel M Rebeiz, "RF MEMS – Theory, Design and Technology".
2. Vijay varadan, Zoelzer, "RF MEMS and their Application".
3. Hector J.de.los Santos, "RF MEMS circuit Design for Wireless Communication".
4. V.K.Varadhan& Jose, "RF MEMS and their Application".
5. Stephen Lveyszyn, "Advanced RF MEMS"

List of experiments:

1. Analyze the applications of RF MEMS technology for wireless communication systems.
2. Describe the various design issues in reconfigurable RF-MEMS Meta materials Filters
3. The antenna is a lossless end-fire array of 10 isotropic point sources spaced and operating with increased directivity. The normalized field pattern is

   Since antenna is lossless, Gain = Directivity. Calculate

(a) Gain G.
(b) Gain from approximate equation
(c) What is the difference value between result (a) and (b)?

504510 *Software Tools

Credits: 1

Teaching Scheme: **Examination Scheme:**

Lecture : 1hrs/week **In-Sem :**
End-Sem :

Course Objectives:
The objectives of this course are to :

- Design applications using open source software.

Course Outcomes:
On completion of the course, student will be able to

- Developapplications using open source software**.**

Course Contents

Introduction to software tools such as Octave, MATLAB, LAB VIEW, RTLinux, VxWorks, µCOS-II, Tiny OS, ANDROID, Xilinx, Microwind, Tanner, TCAD Tools, NS-II, NS-III, OMNET++, OPNET, AWR Microwave office, CAD Feko, IE-3D.

*For each Subject under Elective II the student Shall study open source/evaluation versions of at least two software tools mentioned above and should present term paper

504511 Lab Practice II

Credits: 4

Teaching Scheme: **Examination Scheme:**

Lecture : 4hrs/week **TW : 50 Marks**

Oral/Presentation: 50 Marks

Lab Practice II:

The laboratory work will be based on completion of minimum two assignments/experiments confined to the courses of that semester

504512 Seminar I

Credits: 4

Teaching Scheme: **Examination Scheme:**

Lecture : 4hrs/week **TW : 50 Marks**

Oral/Presentation: 50 Marks

Seminar-I Shouldbe on the topic of student's own choice approved by an authority. The student shall submit the duly certified seminar report in standard format, for satisfactory completion of the work by the concerned Guide and head of the department/institute.

Second Year

Semester I

604501 **4G LTE Cellular Systems**

Credits: 4

Teaching Scheme: **Examination Scheme:**

Lecture : 4hrs/week **In-Sem : 50 Marks**
End-Sem : 50 Marks

Course Objectives

The Objectives of this course are to:-

- Categorize the current wireless cellular standards of LTE and LTE -advanced.
- Analyze the effective utilization of spectrum and RF requirements for LTE.
- Discriminate the LTE Air Interface, OFDMA, MIMO, SDR and CoMP technology.
- Describe the relay deployment and overview of WiMAX.

Course Outcomes

Having successfully completed this course, students will be able to:

1. Describe the different standards of LTE and LTE –advanced such as SAE, EPC and EUTRAN.
2. Analyze the transmission and reception techniques for LTE for effective utilization of Spectrum.
3. Discriminate 4G technology.
4. Differentiate relay schemes and compare LTE with WiMAX.

Course Contents

Module I: **(9 Hrs)**

STANDARDIZATION OF LTE :3rd GenerationPartnership Project **(3GPP);**The 3G Evolution to 4G; Long Term Evolution **(LTE)** and System Architecture Evolution**(SAE)**, LTE and LTE-Advanced; **LTE-Advanced E-UTRAN architecture**; **Protocol stack**: NAS (Non-Access Stratum),RRC (Radio Resource Control), PDCP (Packet Data Convergence Protocol),RLC (Radio Link Control), MAC (Medium Access Control); **Evolved PacketStratum**: Mobility Management Entity (MME),Serving Gateway (S-GW), Packet Data Network Gateway (PDN-GW).

Module II : **(9 Hrs)**

Spectrum and RF Characteristics :Carrier aggregation: LTE and LTE-Advanced carrier aggregation scenario; Control channels; Multiple access scheme; Transceiver architecture;**. Spectrum sharing**; **Research challenges**: Transceiver design; Increased FFT size,Resource management; **Retransmission control**; **OVERVIEW OF RF REQUIREMENTS FOR LTE**

Module III : **(9 Hrs)**

KEY 4G TECHNOLOGIES: **OFDMA; SOFTWARE DEFINED RADIO, Enhanced MIMO**, **HANDOVER AND MOBILITY**, **Enhanced MIMO**: Single-User MIMO (SU-MIMO): MIMO adaptive switching scheme. LTE-Advanced main MIMO modes.; Multi-User MIMO (MU-MIMO); Cooperative MIMO; Single-site MIMO: Advanced precoding concept. Downlink MIMO transmission; Uplink MIMO transmission

Module IV: **(9 Hrs)**

CoMP Transmission &reception:CoMP architecture: Centralized architecture, Distributed architecture,. Mixed architectures;.**TheCoMP schemes**: Downlink, Uplink**,Relays: Relay basic scheme**, Relay deployment scenarios; **Types** ; **Duplexing schemes**: Integration into RAN, Add-ons; **BACKHAUL DESIGN FOR INBAND RELAYING, LTE Vs WIMAX :WiMAX Overview** : WiMAX Standards Evolution, **WiMAX Deployment**; Technology Comparison between LTE and WiMAX

Reference Books:

1. Erik Dahlman, Stefan Parkvall , John Skold, "4G: LTE Advanced for Mobile Boradband ",2nd edition
2. Erik Dahlman, Stefan Parkvall , John Skold, "4G ,LTE Advanced Pro and The Road to 5 G",3rdediton
3. Christopher Cox,Wiley, "An introduction to LTE: LTE Advanced, SAE and 4G Mobile communication

604502 Modern Communication Receiver Design & Technology

Credits: 4

Teaching Scheme: **Examination Scheme:**

Lecture : 4 hrs/week **In-Sem : 50 Marks**
End-Sem : 50 Marks

Course Objectives

The Objectives of this course are to:-

- Design consideration of super heterodyne receiver
- Differentiate the different types of dynamic range of communication receiver.
- Describe the operation of mixers and frequency synthesizer.
- Categorize the different components of IF receiver.

Course Outcomes

Having successfully completed this course, students will be able to:

1. Analyze and design the communication receiver.
2. Choose the dynamic range of communication receiver based on performance parameters.
3. Categorize different types of mixers and frequency synthesizer.
4. Choose blocks in design of IF receivers.

Course Contents

Module I: **(9 Hrs)**

Superheterodyne Receiver: Implementing Double Conversions, Implementing Multiple Conversions ,Implementing Direct Conversions , Special Conversions and Their Implementation ,Drift-Canceling Loops and the Barlow-Wadley Receiver , High Probability of Intercept (HPOI) and the Ideal Receiver **System Design Considerations for Modern Receivers** :Introduction , Understanding Intermodulation Distortion Products ,Predicting Receiver System Spurious Performance: Design Tools for Predicting Intermodulation Distortion , Product Charts and Their Use-The Intermodulation Distortion Web Analysis Tool , System Analysis for a General Coverage CommunicationReceiver-.

Module II : **(9 Hrs)**

Dynamic Range : Five Types of Dynamic Range , Single-ToneDynamic Range ,Two-Tone Dynamic Range ,Determining Noise Figure Requirements ,Sensitivity ,Design Considerations for the Front End-Composite Noise Figure , Understanding the Third-Order Intercept Point Spurious-Free Dynamic Range (IP3SFDR), Simulating and Measuring Composite Linear Dynamic Range for an HPOI Receiver **High-Performance Receiver** Designing a Front End for an HF transceiver ,Practical Preselector Design: Automatically Switched Half-Octave Filter Banks, Switching Mechanisms of Front-End Filters for Best Dynamic RangePerformance , Automatically Switched Half-Octave Filters Design

Module III : **(9 Hrs)**

Mixers : Mixer Topologies , The Single-Balanced Mixer ,The Double-Balanced Mixer and Its Performance Characteristics , Terminating Mixers and the Diplexer , AM Noise Suppression and Phase Noise Impacts on Transferring Signals in Mixers, Conversion Loss and Noise Figure of Diode Mixers , Two-Tone Intermodulation Performance in Mixers , Compression Point (-1 dB) in Mixers ,Desensitization Level and Isolation , Commutative Mixers, FET, and H-Mode Mixers , Integrated Circuit Mixers-Gilbert Cell Mixers Image-Reject Mixer, Image Recovery Mixers , Mixer Technology

Frequency Synthesizers Definitions **,**Leeson Oscillator Noise Model , Leng-Term and Short-Terrn Frequency Stability ,Residual Phase Noise and Absolute Phase Noise , Phase Noise and Jitter Concepts , Defining Coherency in Synthesizers , Open Loop Systems: Mixing VFOs with Crystal Oscillators , Synthesizer Forms and Classifications: Brute Force, Direct and Indirect, and Non brute Force, Direct and Indirect

Module IV: **(9 Hrs)**

Intermediate Frequency (IF) Receivers: Switched and Cascaded IF Filters , Implementing a High-Performance IF in the Star-l0 Receiver , Logarithmic , Using Logarithmic Amplifiers in Low-Cost High-Performance ASK, Data Receivers , Variable Passband Filters and Analog IFs 3,Noise Blankers, The Variable Pulse Noise Blanker and the Star-l0 Receiver Noise Blanker , The Notch Filter and the Bandpass Tuning Mechanism **Automatie Gain Control (AGC)** Linear Control Systems-Feedback Systems and Their Significance, Achieving High Dynamic Range with AGC, Deriving and Applying AGC in Receivers, Understanding and Using Logarithmic Detectors ,Square-Law Detectors ,True-RMS Detectors ,Attack and Release Time, Hanged AGC, and the Star-l0 AGC System Audio-Derived AGC , The PIN Diode Attenuator Used for AGC ,Digital AGC **Product Detectors and Beat Frequency Oscillators (BFO)** land Q Demodulation Process: The Concept of Demodulation ,Other Demodulation Techniques ,The Star-l0 Receiver Product Detector , Audio and Baseband Amplifier Design Considerations

Reference Books:

1. Cornell Drentea, "Modern Communication Receiver Design & Technology"
2. Robert Dixon ,"Radio Receiver Design"
3. Ulrich Rohde, Jerry Whitaker, Andrew Bateman"Communications Receivers: DPS, Software Radios, and Design", 3rd Edition
4. Kevin McClaning, Tom Vito"Radio Receiver Design"
   Richard A. Poisel," Electronic Warfare Receivers and Receiving Systems

Elective-III

Select one subjects from Group-I, and one subject from Group-II from the following list as Elective-III.

Group		Subject	Credit
I	1	Value Education, Human Rights and Legislative Procedures	3
	2	Environmental Studies	3
	3	Renewable Energy Studies	3
	4	Disaster Management	3
	5	Knowledge Management	3
	6	Foreign Language	3
	7	Economics for Engineers	3
	8	Engineering Risk – Benefit Analysis	3
II	1	Optimization Techniques	2
	2	Fuzzy Mathematics	2
	3	Design and Analysis of Algorithms	2
	4	CUDA	2

604503A Value Education, Human Rights and Legislative Procedures

Credits: 3 (Elective – III)

Teaching Scheme: **Examination Scheme:**

Lecture : 3hrs/week **In-Sem : 50 Marks**
End-Sem : 50 Marks

Course Contents

Module I: Values and Self Development-Social values and individual attitudes, Work ethics, Indian vision of humanism, Moral and non moral valuation, Standards and principles, Value judgments. Importance of cultivation of values, Sense of duty, Devotion, Self reliance, Confidence, Concentration, Truthfulness, Cleanliness, Honesty, Humanity, Power of faith, National unity, Patriotism, Love for nature, Discipline

Module II : Personality and Behavior Development- Soul and scientific attitude, God and scientific attitude, Positive thinking, Integrity and discipline, Punctuality, Love and kindness, Avoiding fault finding, Free from anger, Dignity of labor, Universal brotherhood and religious tolerance, True friendship, Happiness vs. suffering love for truth, Aware of self destructive habits, Association and cooperation, Doing best, Saving nature

Module III : Human Rights- Jurisprudence of human rights nature and definition, Universal protection of human rights, Regional protection of human rights, National level protection of human rights, Human rights and vulnerable groups. Legislative Procedures- Indian constitution, Philosophy, fundamental rights and duties, Legislature, Executive and Judiciary, Constitution and function of parliament, Composition of council of states and house of people, Speaker, Passing of bills, Vigilance, Lokpal and functionaries

Reference Books:

1. Chakraborty, S.K., Values and Ethics for Organizations Theory and Practice, Oxford University Press, New Delhi, 2001.
2. Kapoor, S.K., Human rights under International Law and Indian Law, Prentice Hall of India, New Delhi, 2002.
3. Basu, D.D., Indian Constitution, Oxford University Press, New Delhi, 2002.
4. Frankena, W.K., Ethics, Prentice Hall of India, New Delhi, 1990.
5. Meron Theodor, Human Rights and International Law Legal Policy Issues, Vol. 1 and 2, Ox ford University Press, New Delhi, 2000

604503 A Environmental Studies (Elective – III)

Credits: 3

Teaching Scheme:

Lecture : 3hrs/week

Examination Scheme:

In-Sem : 50 Marks

End-Sem : 50 Marks

Course Contents

Module I: Introduction and Natural Resources: Multidisciplinary nature and public awareness, Renewable and nonrenewal resources and associated problems, Forest resources, Water resources, Mineral resources, Food resources, Energy resources, Land resources, Conservation of natural resources and human role. Ecosystems: Concept, Structure and function, Producers composers and decomposers, Energy flow, Ecological succession, Food chains webs and ecological pyramids, Characteristics structures and functions of ecosystems such as Forest, Grassland, Desert, Aquatic ecosystems

Module II : Environmental Pollution- Definition, Causes, effects and control of air pollution, water pollution, soil pollution, marine pollution, noise pollution, thermal pollution, nuclear hazards, human role in prevention of pollution, Solid waste management, Disaster management, floods, earthquake, cyclone and landslides

Module III : Social issues and Environment- Unsustainable to sustainable development, Urban problems related to energy, Water conservation and watershed management, Resettlement and re-habitation, Ethics, Climate change, Global warming, Acid rain, Ozone layer depletion, Nuclear accidents, holocaust, Waste land reclamation, Consumerism and waste products, Environment protection act, Wildlife protection act, Forest conservation act, Environmental issues in legislation, population explosion and family welfare program, Environment and human health, HIV, Women and child welfare, Role of information technology in environment and human health

Reference Books:

1. Agarwal, K.C., Environmental Biology, Nidi Publication Ltd., Bikaner, 2001.
2. BharuchaErach, Biodiversity of India, Mapin Publishing Pvt. Ltd., Ahmadabad, 2002.
3. Bukhootsow, B., Energy Policy and Planning, Prentice Hall of India, New Delhi, 2003.
4. Cunningham, W.P., et al. , Environmental Encyclopedia, Jaico Publishing House, Mumbai, 2003.

604103A Renewable Energy Studies

Elective-III A **Credits:3**

Teaching Scheme: **Examination Scheme:**

Lectures:3Hrs/Week **Theory: 50 Marks (In Semester)**

50 Marks (In Semester)

Module I : Solar Energy : **(8 Hrs.)**

Photovoltaic Systems: Introduction to the Major Photovoltaic System Types, Current–Voltage Curves for Loads, Grid-Connected Systems: Interfacing with the Utility, DC and AC Rated Power, The "Peak-Hours" Approach to Estimating PV Performance, Capacity Factors for PV Grid Connected Systems, PV Powered Water Pumping, PV systems – off grid systems and scope for inclusive growth of rural India.

Module II :Wind Energy : **(8 Hrs.)**

Wind Energy: wind speed and power relation, power extracted from wind, wind distribution and wind speed predictions. Wind power systems: system components, Types of Turbine, Choice of generators, electrical load matching, power control, Effect of wind speed variations, tower height and its effect, Variable speed operation, maximum power operation, control systems, Design consideration of wind farms and control

Module III :Other Energy Sources : **(8 Hrs.)**

Biomass – various resources, energy contents, technological advancements, conversion of biomass in other form of energy – solid, liquid and gases. Gasifiers, Biomass fired boilers, Co-firing, Generation from municipal solid waste, Issues in harnessing these sources. Mini and micro hydel plants scheme layout economics. Tidal and wave energy, Geothermal and Ocean-thermal energy conversion (OTEC) systems – schemes, feasibility and viability. Fuel cell- types and operating characteristics, efficiency, energy output of fuel cell

References

1. Renewable energy technologies - R. Ramesh, Narosa Publication.
2. Energy Technology – S. Rao, Parulkar
3. Non-conventional Energy Systems – Mittal, Wheelers Publication.
4. Clark W. Gellings, "The Smart Grid: Enabling Energy Efficiency and Demand Response",CRC Press
5. Renewable Energy Technologies – Chetan Singh Solanki, PHI Learning Pvt. Ltd.

604503A Disaster Management(Elective – III)

Credits: 3

Teaching Scheme: **Examination Scheme:**

Lecture : 3hrs/week **In-Sem : 50 Marks**
End-Sem : 50 Marks

Course Contents

Module I: Introduction: Concepts and definitions: disaster, hazard, vulnerability, risk, capacity, impact, prevention, mitigation). Disasters classification; natural disasters (floods, draught, cyclones, volcanoes, earthquakes, tsunami, landslides, coastal erosion, soil erosion, forest fires etc.); manmade disasters (industrial pollution, artificial flooding in urban areas, nuclear radiation, chemical spills etc); hazard and vulnerability profile of India, mountain and coastal areas, ecological fragility

Module II : Disaster Impacts :Disaster impacts (environmental, physical, social, ecological, economical, political, etc.); health, psycho-social issues; demographic aspects (gender, age, special needs); hazard locations; global and national disaster trends; climate-change and urban disasters

Module III : Disaster Risk Reduction (DRR) : Disaster management cycle – its phases; prevention, mitigation, preparedness, relief and recovery; structural and non-structural measures; risk analysis, vulnerability and capacity assessment; early warning systems, Post-disaster environmental response (water, sanitation, food safety, waste management, disease control); Roles and responsibilities of government, community, local institutions, NGOs and other stakeholders; Policies and legislation for disaster risk reduction, DRR programmes in India and the activities of National Disaster Management Authority

Reference Books:

1. http://ndma.gov.in/ (Home page of National Disaster Management Authority).
2. http://www.ndmindia.nic.in/ (National Disaster management in India, Ministry of Home Affairs).
1. PradeepSahni, 2004, Disaster Risk Reduction in South Asia, Prentice Hall.
2. Singh B.K., 2008, Handbook of Disaster Management: techniques & Guidelines, Rajat Publication.
3. Ghosh G.K., 2006, Disaster Management ,APH Publishing Corporation.

604503A Knowledge Management(Elective – III)
Credits: 3

Teaching Scheme: **Examination Scheme:**

Lecture : 3hrs/week **In-Sem : 50 Marks**
End-Sem : 50 Marks

Course Contents

Module I: Introduction: Definition, evolution, need, drivers, scope, approaches in Organizations, strategies in organizations, components and functions, understanding knowledge; Learning organization: five components of learning organization, knowledge sources, and documentation. Essentials of Knowledge Management; knowledge creation process, knowledge management techniques, systems and tools

Module II : Organizational knowledge management; architecture and implementation strategies, building the knowledge corporation and implementing knowledge management in organization. Knowledge management system life cycle, managing knowledge workers, knowledge audit, and knowledge management practices in organizations, few case studies

Module III : Futuristic KM: Knowledge Engineering, Theory of Computation, Data Structure

Reference Books:

1. Knowledge Management – a resource book – A Thohothathri Raman, Excel, 2004.
2. Knowledge Management- Elias M. AwadHasan M. Ghazri, Pearson Education
3. The KM Toolkit – Orchestrating IT, Strategy & Knowledge Platforms, AmritTiwana, Pearson, PHI, II Edn.
4. The Fifth Discipline Field Book – Strategies & Tools For Building A learning oganizationPeterSenge et al. Nicholas Brealey 1994
5. Knowledge Management – Sudhir Warier, Vikas publications
6. Leading with Knowledge, MadanmohanRao, TataMc-Graw Hill.

604503 A Foreign Language(Elective – III)
Credits: 3

Teaching Scheme:

Lecture : 3hrs/week

Examination Scheme:

In-Sem : 50 Marks
End-Sem : 50 Marks

Course Contents

Module I: Pronunciation guidelines; Single vowels, Accentuated vowels, Vowels and consonants combinations, Consonants; Numbers 1-10 Articles and Genders; Gender in French, Plural articles, Some usual expressions. Pronouns and Verbs; The verb groups, The pronouns, Present tense, Some color Adjectives and Plural ; Adjectives, Some adjectives, Our first sentences, More Numbers

Module II : Sentences Structures; Some Prepositions, Normal Sentences, Negative Sentences, Interrogative Sentences, Exercises The Family; Vocabulary ,Conversation, Notes on Pronunciation, Notes on Vocabulary, Grammar, Liaisons Guideline. D'oùviens-tu (Where do you come from); Vocabulary, Conversation, Notes on Vocabulary, Liaisons Guidelines . Comparer (Comparing); Vocabulary, Conversation, Notes on Vocabulary, Grammar Liaisons Guidelines, Ordinal Numbers

Module III : Le temps (Time); Vocabulary, Grammar, Time on the clock Additional French Vocabulary; Vocabulary related to - The Family, Vocabulary related to - Where do you come from? French Expressions and Idioms; Day-to-day Life, At Work, The car, Sports, Specia Events Other French Flavours; Nos cousins d'Amérique - Québec et Accadie, Au pays de la bière et des frites, Mettez-vous à l'heure Suisse, Vé, peuchère, le françaisbien de chez nous

Reference Books: http://www.jump-gate.com/languages/french/index.html

604503A Engineering Economics (Elective – III)

Credits: 3

Teaching Scheme:

Lecture : 3hrs/week

Examination Scheme:

In-Sem : 50 Marks

End-Sem : 50 Marks

Course Contents

Module I: Introduction to the subject: Micro and Macro Economics, Relationship between Science, Engineering,Technology and Economic Development. Production Possibility Curve, Nature of Economic Law, **TimeValue of Money:** concepts and application. Capital budgeting; Traditional and modern methods,Payback period method, IRR, ARR, NPV, PI (with the help of case studies)

Module II : Meaning of Production and factors of production, Law of variable proportions and returns to scale. Internal and external economies and diseconomies of scale. Concepts of cost of production, different types of costs; accounting cost, sunk cost, marginal cost, Opportunity cost. Break even analysis, Make or Buy decision (case study). Relevance of Depreciation towards industry. Meaning of market, types of market, perfect competition, Monopoly, Monopolistic, Oligopoly. (Main features). Supply and law of supply, Role of demand and supply in price determination.

Module III : Indian Economy, nature and characteristics. Basic concepts; fiscal and monetary policy, LPG, Inflation, Sensex, GATT, WTO and IMF. Difference between Central bank and Commercial banks

Text Books:

1. Jain T.R., Economics for Engineers, VK Publication
2. Singh Seema, Economics for Engineers, IK International

Reference Books:

1. Chopra P. N., Principle of Economics, Kalyani Publishers
2. Dewett K. K., Modern economic theory, S. Chand
3. H. L. Ahuja., Modern economic theory, S. Chand
4. DuttRudar&Sundhram K. P. M., Indian Economy
5. Mishra S. K., Modern Micro Economics, Pragati Publications
6. Pandey I.M., Financial Management; Vikas Publishing House
7. Gupta Shashi K., Management Accounting, Kalyani Publication

604503 A **Engineering Risk – Benefit Analysis(Elective – III)**

Credits: 3

Teaching Scheme: **Examination Scheme:**

Lecture : 3 hrs/week **In-Sem : 50 Marks**

End-Sem : 50 Marks

Course Contents

Module I: Introduction- Knowledge and Ignorance, Information Uncertainty in Engineering Systems, Introduction and overview of class; definition of Engineering risk; overview of Engineering risk analysis. Risk Methods: Risk Terminology, Risk Assessment, Risk Management and Control, Risk Acceptance, Risk Communication, Identifying and structuring the Engineering risk problem; developing a deterministic or parametric model System Definition and Structure: System Definition Models, Hierarchical Definitions of Systems, and System Complexity

Module II : Reliability Assessment: Analytical Reliability Assessment, Empirical Reliability Analysis Using Life Data, Reliability Analysis of Systems

Module III : Reliability and probabilistic risk assessment (RPRA), decision analysis (DA), and cost-benefit analysis (CBA). All of these pertain to decision making in the presence of significant uncertainty. In ERBA, the issues of interest are: The risks associated with large engineering projects such as nuclear power reactors, the International Space Station, and critical infrastructures; the development of new products; the design of processes and operations with environmental externalities; and infrastructure renewal projects

Reference Books:

1. Risk Analysis in Engineering and Economics, B. M. Ayyub, Chapman-Hall/CRC Press, 2003.
2. Hoyland, Arnljot, and Rausand, Marvin. *System Reliability Theory*. Hoboken, NJ: Wiley-Interscience, 1994. ISBN: 9780471471332.
3. Clemen, Robert, " Making Hard Decisions: An Introduction to Decision Analysis (Business Statistics) " PHI publications

604503B **Optimization Techniques(Elective – III)**

Credits: 2

Teaching Scheme: **Examination Scheme:**

Lecture : 2hrs/week **In-Sem : 50 Marks**

End-Sem : 50 Marks

Course Contents

Module I: First and second order conditions for local interior optima (concavity and uniqueness), Sufficient conditions for unique global optima; Constrained optimization with Lagrange multipliers; Sufficient conditions for optima with equality and inequality constraints.

Module II : Recognizing and solving convex optimization problems. Convex sets, functions, and optimization problems. Least-squares, linear, and quadratic optimization. Geometric and semidefinite programming. Vector optimization. Duality theory. Convex relaxations. Approximation, fitting, and statistical estimation. Geometric problems. Control and trajectory planning.

Reference Books:

1. Stephen Boyd and LievenVandenberghe, *Convex Optimization*, Cambridge University Press.
2. A. Ben-Tal, A. Nemirovski, *Lectures on Modern Convex Optimization: Analysis,Algorithms, and Engineering Applications*, SIAM.
3. D. P. Bertsekas, A. Nedic, A. E. Ozdaglar, *Convex Analysis and Optimization*,Athena Scientific.
4. D. P. Bertsekas, *Nonlinear Programming*, Athena Scientific.
5. Y. Nesterov, *Introductory Lectures on Convex Optimization: A Basic Course*, Springer.
6. J.Borwein and A. S. Lewis, *Convex Analysis and Nonlinear Optimization:Theory and Examples*,Springer

604503B **Fuzzy Mathematics(Elective – III)**

Credits: 2

Teaching Scheme: **Examination Scheme:**

Lecture : 2hrs/week **In-Sem : 50 Marks**

End-Sem : 50 Marks

Course Contents

Module I: Definition of a Fuzzy set; Elements of Fuzzy logic. Relations including, Operations, reflexivity, symmetry and transitivity; Pattern Classification based on fuzzy relations.

Module II : Fuzzy Models: Mamdani , Sugeno, Tsukamoto

Reference Books:

1. Neuro-Fuzzy and Soft Computing by S.R.Jung, Sun, Mizutani

604503B Design and Analysis of Algorithm(Elective – III)

Credits: 2

Teaching Scheme: **Examination Scheme:**

Lecture : 2hrs/week **In-Sem : 50 Marks**
End-Sem : 50 Marks

Course Contents

Module I: Introduction- Fundamental characteristics of an algorithm. Basic algorithm analysis – Asymptotic analysis of complexity bounds– best, average and worst-case behaviour, standard notations for expressing algorithmic complexity. Empirical measurements of performance, time and space trade-offs in algorithms.

Module II : Properties of big-Oh notation – Recurrence equations – Solving recurrence equations – Analysis of linear search. Divide and Conquer: General Method – Binary Search – Finding Maximum and Minimum – Merge Sort – Greedy Algorithms: General Method – Container Loading – Knapsack

Reference Books:

1. Algorithm Design – Jon Kleinberg and Eva Tardos
2. Introduction to Algorithms – T.H. Cormanet. Al

604503B **CUDA** **(Elective – III)**

Credits: 2

Teaching Scheme: **Examination Scheme:**

Lecture : 2hrs/week **In-Sem : 50 Marks**

End-Sem : 50 Marks

Course Contents

Module I: History of GPUs leading to their use and design for HPC- The Age of Parallel Processing, The Rise of GPU Computing ,CUDA, Applications of CUDA, Development Environment, Introduction to CUDA C, Kernel call, Passing Parameters, Querying Devices, Using Device Properties.

Module II : Parallel Programming in CUDA C - CUDA Parallel Programming, Splitting Parallel Blocks, Shared Memory and Synchronization, Constant Memory, Texture Memory, CUDA events, Measuring Performance with Events

Reference Books:

1. Programming Massively Parallel Processors: A Hands-on Approach –second edition by Davi Kirk, Wen-mei W. Hwu.
2. CUDA by Example - An Introduction to General-Purpose GPU Programming by Jason Sanders ,Edward Kandrot- Addison Wesley
3. GPU Computing Gems Emerald Edition -Applications of GPU Computing Series by Wen-mei,
4. CUDA Programming: A Developer's Guide to Parallel Computing with GPUs by shane cook

604504 Seminar II

Credits: 4

Teaching Scheme:

Lecture : 4hrs/week

Examination Scheme:

TW : 50 Marks

Oral/Presentation : 50 Marks

Course Contents

Seminar II shall be on the topic relevant to latest trends in the field of concerned branch, preferably on the topic of specialization based on the electives selected by him/her approved by authority. The student shall submit the seminar report in standard format, duly certified for satisfactory completion of the work by the concerned guide and head of the Department/Institute

604505 **Project Stage- I**

Credits: 8

Teaching Scheme:

Lecture : 8hrs/week

Examination Scheme:

TW : 50 Marks

Oral/Presentation : 50 Marks

Course Contents

Project Stage – I

Project Stage – I is an integral part of the project work. In this, the student shall complete the partial work of the project which will consist of problem statement, literature review, project overview, scheme of implementation (Mathematical Model/SRS/UML/ERD/block diagram/ PERT chart, etc.) and Layout & Design of the Set-up. As a part of the progress report of Project work Stage-I, the candidate shall deliver a presentation on the advancement in Technology pertaining to the selected dissertation topic.

The student shall submit the duly certified progress report of Project work Stage-I in standard format for satisfactory completion of the work by the concerned guide and head of the Department/Institute.

Second Year

Semester II

604506 Seminar III

Credits: 5

Teaching Scheme:

Lecture : 5hrs/week

Examination Scheme:

TW : 50 Marks

Oral/Presentation : 50 Marks

Course Contents

Seminar III shall preferably an extension of **seminar II.** The student shall submit the dulycertified seminar report in standard format, for satisfactory completion of the work by the concerned guide and head of the Department/Institute

604507 Project Stage- II

Credits: 20

Teaching Scheme:

Lecture : 20hrs/week

Examination Scheme:

Examination Scheme:

Term Work : 150 Marks

Oral/ Presentation: 50Marks

Course Contents

Project Stage – II

In Project Stage – II, the student shall complete the remaining part of the project which will consist of the fabrication of set up required for the project, work station, conducting experiments and taking results, analysis & validation of results and conclusions The student shall prepare the duly certified final report of project work in standard format for satisfactory completion of the work by the concerned guide and head of the Department/Institute