APJ Abdul Kalam Technological University

Cluster 4: Kottayam

M. Tech Program in Electronics & Communication Engineering

(Advanced Communication & Information Systems)

Scheme of Instruction & Syllabus: 2015 Admissions

Compiled By

Rajiv Gandhi Institute of Technology, Kottayam

July 2015

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY
CLUSTER 4: Kottayam

M.Tech in Electronics and Communication Engineering

(Advanced Communication and Information Systems)

Credit requirements : 65 credits depending on the stream of specialization
Normal Duration : Regular: 4 semesters; External Registration: 6 semesters
Maximum duration : Regular: 6 semesters; External Registration: 7 semesters
Courses: Core Courses : Either 4 or 3 credits for; Elective courses: All of 3 credits

ELIGIBILITY: B.Tech/B.E in Electronics and Communication Engg. and allied branches with strong focus in electronics engineering

Allotment of credits and examination scheme:-

Semester 1 (Credits: 21)

Exam Slot	Course No:	Name	L- T - P	Int. Marks	End Semester Exam		Credits
					Marks	(hrs)	
A	04EC 6101	Linear Algebra for Communication Engineering	4-0-0	40	60	3	4
B	04EC 6103	Probability and Random Processes	3-0-0	40	60	3	3
C	04EC 6105	Queuing Theory and Communication Networks	3-0-0	40	60	3	3
D	04EC 6107	Estimation and Detection Theory	3-0-0	40	60	3	3
E	04EC 6XXX	Elective - I	3-0-0	40	60	3	3
	04GN 6001	Research Methodology	0-2-0	100	0	0	2
	04EC 6191	Seminar - I	0-0-2	100	0	0	2
	04EC 6193	Communication systems Lab	0-0-2	100	0	0	1
		Total	22				21

**See List of Electives-I for slot E*

List of Elective - I Courses

Exam Slot	Course No.	Course Name
E	04 EC 6109	Advanced optical communication systems
E	04 EC 6111	RF MEMS
E	04 EC 6113	Image and Video processing
E	04 EC 6115	Information and Coding Theory

Semester 2 (Credits: 19)

Exam Slot	Course No:	Name	L- T - P	Int. Marks	End Semester Exam		Credits
					Marks	(hrs)	
A	04 EC 6102	Advanced Digital Communication Techniques	3-0-0	40	60	3	3
B	04 EC 6104	Antenna Theory: Analysis and Design	3-0-0	40	60	3	3
C	04 EC 6106	Wireless Communications	3-0-0	40	60	3	3
D	04 EC 6XXX	Elective - II	3-0-0	40	60	3	3
E	04 EC 6XXX	Elective - III	3-0-0	40	60	3	3
	04 EC 6192	Mini Project	0-0-4	100	0	0	2
	04 EC 6194	Communication Systems and Networking Lab	0-0-2	100	0	0	1
		Total	22				18

**See List of Electives -II for slot D* *^See List of Electives -III for slot E*

List of Elective - II Courses

Exam Slot	Course Code	Course Name
D	04 EC 6108	Multicarrier Communication Systems
D	04 EC 6112	Principles of Secure Communication
D	04 EC 6114	Speech Technology
D	04 EC 6212	Mobile Computing

List of Elective - III Courses

Exam Slot	Course Code	Course Name
E	04 EC 6116	MIMO Communication Systems
E	04 EC 6118	Spread Spectrum and CDMA Systems
E	04 EC 6122	Optimization Techniques
E	04 EC 6124	Multirate Systems and Wavelets

Summer Break

Exam Slot	Course No:	Name	L- T - P	Internal Marks	End Semester Exam		Credits
					Marks	Duration (hrs)	
NA	04 EC 7190	Industrial Training	0-0-4	NA	NA	NA	Pass /Fail
		Total	4				0

Semester 3 (Credits: 14)

Exam Slot	Course No:	Name	L- T - P	Internal Marks	End Semester Exam		Credits
					Marks	Duration (hrs)	
A	04 EC 71XX	Elective - IV	3-0-0	40	60	3	3
B	04 EC 71XX	Elective - V	3-0-0	40	60	3	3
	04 EC 7191	Seminar - II	0-0-2	100	0	0	2
	04 EC 7193	Project (Phase - I)	0-0-12	50	0	0	6
		Total	20				14

**See List of Electives-IV for slot A* *^See List of Electives-V for slot B*

List of Elective - IV Courses

Exam Slot	Course Code	Course Name
A	04 EC 7101	Signal Compression
A	04 EC 7103	Network Administration
A	04 EC 7105	FPGA based System Design
A	04 EC 7207	Pattern Recognition

List of Elective - V Courses

Exam Slot	Course Code	Course Name
B	04 EC 7109	Soft Computing
B	04 EC 7111	Adaptive Filters and systems
B	04 EC 7113	RecentTrends in Communication Engineering
B	04 EC 7115	Modern Satellite Communication

Semester 4 (Credits: 12)

Exam Slot	Course No:	Name	L- T - P	Internal Marks	External Evaluation Marks		Credits
NA	04 EC 7194	Project (Phase -II)	0-0-21	70	30	NA	12
		Total	21				12

Total: 65

SEMESTER 1

COURSE CODE	COURSE NAME	L-T-P:C	YEAR
04 EC 6101	LINEAR ALGEBRA FOR COMMUNICATION ENGINEERING	4-0-0:4	2015

Pre-requisites: Nil

Course Objectives:

- To gain an understanding of the linear system of equations
- To get introduce d to the fundamentals of vector spaces
- To impart the basics of linear transformation , inner product spaces and , orthogonalization
- To provide the knowledge to apply linear algebra in communication engineering

Syllabus

Introduction to linear system, matrices, vector spaces, Triangular factors and row exchanges (LU), Linear Transformation, Orthogonality, Hilbert spaces, orthogonal complements, projection theorem, orthogonal projections, Eigen values, eigen vectors, diagonalization, symmetric matrices, Least-square solution of inconsistent system, singular value decomposition, selected topics in communication Engg.

Course Outcome:

Students who successfully complete this course would have the ability to solve the problems related to linear systems and matrices- Apply the knowledge of linear transformation, orthogonal projections and orthonormalization to engineering applications-to obtain the Least-square solution of inconsistent system -to apply singular value decomposition in typical applications.

Text Books:

1. K. Hoffman, R. Kunz, “Linear Algebra”, Prentice Hall India
2. G. Strang, “Linear algebra and its applications”, Thomson Publishers.

References:

1. D. C. Lay, “Linear algebra and its applications”, Pearson Education
2. Gareth Williams, “Linear algebra with applications”, Narosa
3. Michael W. Frazier, “An Introduction to wavelets through linear algebra”, Springer

COURSE PLAN

COURSE CODE:	COURSE TITLE	CREDITS	
04 EC 6101	Linear Algebra For Communication Engineering	4-0-0:4	
MODULES		Contact Hours	Sem. Exam Marks (%)
MODULE 1: Matrices: Introduction to linear system, matrices, vectors, Gaussian elimination, matrix notation, partitioned matrices, multiplication of partitioned matrices, inverse of partitioned matrices		8	15
MODULE 2: Triangular factors and row exchanges (LU), Row exchanges and permutation matrices, inverses (Gauss-Jordan method)		6	15
INTERNAL TEST 1 (MODULE 1 & 2)			
MODULE 3: Vector space, subspace, linear independence, span, basis, dimension, Spanning set theorem, null space, column space, row space-(Matrix), Basis and dimension of null space, column space, row space-(Matrix), Rank nullity theorem, co-ordinate system, change of basis–(finite space)		10	15
MODULE 4: Linear transformation, Kernel and range of linear transformation, matrix representation of linear transform, inverse transform, Inner product spaces: **:** Inner product space, norm, Cauchy-Schwarz inequality, Triangular inequality, self adjoint and normal operators		10	15
INTERNAL TEST 2 (MODULE 3 & 4)			
MODULE 5: Orthogonality, Hilbert spaces, orthogonal complements, projection theorem, orthogonal projections, Orthonormal basis, Gram-Schmidt orthogonalization.		8	20
MODULE 6: Eigen values, eigen vectors, diagonalization, symmetric matrices, Quadratic forms, classification of quadratic forms, Least-square solution of inconsistent system, singular value decomposition, Application of SVD in OFDM communication system. Application of Gram-Schmidt orthogonalization in signal space representation of digital modulation schemes.		14	20
END SEMESTER EXAM			

COURSE CODE	COURSE NAME	L-T-P:C	YEAR
04 EC 6103	PROBABILITY AND RANDOM PROCESSES	3 -0-0: 3	2015

Pre-requisites: Nil

Course Objectives:

- To introduce the fundamentals of probability theory and random processes;
- To study limit theorems and stochastic processes;
- To learn the applications of probability and random processes in communication systems;

Syllabus:

Introduction to Probability Theory; Discrete and continuous random variables; Limit theorems; Stochastic process; Conditional probability distributions; Classification of random process; Poisson process and Markov process.

Course Outcome:

Students who successfully complete this course will have a basic idea about probability theory and random processes. They can also learn about limit theorems, stochastic processes and applications of probability and random processes in communication systems.

Text Books:

1. V. Sundarapandian, "Probability, statistics and Queueing theory", PHI.
2. Athanasios Papoulis, S. UnnikrishnanPillai, "Probability, Random Variables and Stochastic Processes", TMH.

References:

1. T. Veerarajan, "Probability, Statistics and random processes", McGraw-Hill.
2. S. M. Ross, "Stochastic Process", John Wiley and sons.
3. Henry Stark, John W. Woods, "Probability and random processes with application to signal processing", Pearson.

COURSE PLAN

COURSE CODE:	COURSE TITLE	CREDITS	
04 EC 6103	PROBABILITYAND RANDOM PROCESSES	3-0-0:3	
MODULES		Contact Hours	Sem. Exam Marks (%)
MODULE 1: **Introduction to Probability Theory:** Sample space and events, conditional probabilities, independent events, the law of total probability and Baye's theorem.		8	15
MODULE 2: **Random variables :** Discrete and continuous random variables, distributions, expectation of a random variable, moment generating function, joint probability distributions, marginal probability distributions and random vectors.		6	15
INTERNAL TEST 1 (MODULE 1 & 2)			
MODULE 3: **Limit theorems**: Markov and Chebyshev inequalities, weak and strong law of large numbers, convergence concepts and central limit theorem.		7	15
MODULE 4: **Stochastic process** (definition only), conditional probability distributions (continuous and discrete cases), computing mean and variances by conditioning.		7	15
INTERNAL TEST 2 (MODULE 3 & 4)			
MODULE 5: **Random Process:** classification of random process, special classes of random process, SSS and WSS, auto and cross–correlation, ergodicity, Mean ergodic process, power spectral density, unit impulse response system, response of a LTI system to WSS input, noise in communication system-white Gaussian noise, filters.		7	20
MODULE 6: **Selected topics:** Poisson process-Properties, Markov process and Markov chain, Chapman-Kolmogorov theorem, classification of states of a Markov chain, Birth-death process, Wiener process.		7	20
END SEMESTER EXAM			

COURSE CODE	COURSE NAME	L-T-P:C	YEAR
04 EC 6105	QUEUING THEORY AND COMMUNICATION NETWORKS	3-0-0:3	2015

Pre-requisites: Nil

Course Objectives:

To give the Student:-

- A foundation in the fundamentals of Communication Networks;
- An understanding of network terminology;
- An understanding of network architectures from a design and performance perspective;
    - why networks are structured the way they are
    - issues facing the designers of next-generation data networks
- An understanding of Queuing theory in the communication network perspective.

Syllabus:
Network algorithms and their performance - Layered network architecture - Link Layer protocols - high-speed packet switching - queuing theory - Local Area Networks - Wide Area Networking issues - routing - flow control

Course Outcome:

Students who successfully complete this course will have demonstrated the knowledge and ability to

- Identify the different types of network topologies and protocols
- Enumerate the layers of the OSI model and TCP/IP. Explain the function(s) of eachlayer
- Understand and building the skills of subnetting and routing mechanisms.
- Familiarity with the basic protocols of computer networks, and how they can be used to assist in network design and implementation

Text Books:

1. Alberto Leon Garcia and IndraWidjaja, “Communication Networks: Fundamental Concepts and Key Architectures”.
2. DimitriBertsekas and Robert Gallager, “Data Networks”

References:

1. “Computer Networks: A System Approach”, L. L. Peterson, B. S. Davie, 4/e, Elsevier, 2007
2. “High Performance Communication Networks” Jean Walrand, PravinVaraiya, 2/e, Morgan Kaufman Publishers, 2000.
3. “Data Communications & Networking” A. BehrouzForouzan, Tata McGraw-Hill, 2006,

COURSE PLAN

COURSE CODE:	COURSE TITLE	CREDITS	
04 EC 6105	QUEUING THEORY AND COMMUNICATION NETWORKS	**3-0-0:3**	
MODULES		**Contact Hours**	**Sem. Exam Marks (%)**
MODULE 1: **Applications and Layered architecture:** Networks and Services, Approaches to Network Design, Factors in Communication Network evolution, OSI Reference Model, TCP/IP architecture, Application Protocols.		6	15
MODULE 2: **Telephone Networks and Local Area Networks:** Transmission systems and telephone networks, Multiplexing, SONET, WDM, Telephone Signalling, Overload Control, applications, LAN Standards - Ethernet, Token Ring, FDDI, W-LAN		8	15
INTERNAL TEST 1 (MODULE 1 & 2)			
MODULE 3: **Medium Access Control:** Random Access: ALOHA, Slotted ALOHA, CSMA and CSMA-CD, Scheduling Approaches to MAC: Reservation systems, Polling, Token Passing and Comparison of approaches, Channelization		7	15
MODULE 4: **Packet Switching:** Datagrams and Virtual Circuits, Routing in Packet Networks, Shortest Path Algorithms, ATM Networks, Traffic Management and QoS, Congestion Control		7	15
INTERNAL TEST 2 (MODULE 3 & 4)			
MODULE 5: **TCP/IP Architecture:** Internet Protocols, Addressing, CIDR, Address Resolution, Subnetting, IPv6, UDP, TCP, DHCP and Mobile IP, RIP, OSPF, BGP		7	20
MODULE 6: **Delay models in data networks:** Queuing models: Little's Theorem, M/M/1 queuing system, M/M/m, M/M/∞, M/M/m/m and other Markov systems, M/G/1 system, Network of transmission lines, Network of Queues.		7	20
END SEMESTER EXAM			

COURSE CODE	COURSE NAME	L-T-P: C	YEAR
04 EC 6107	ESTIMATION AND DETECTION THEORY	3 – 0 - 0: 3	2015

Pre-requisites: Nil

Course Objectives:

- To impart the fundamentals of estimation and detection theory;
- To learn various types of estimators and their performance bounds;
- To introduce the various decision rules in detection theory;

Syllabus:

Estimation theory and it's mathematical formulation; Linear models and least Squares; Extension to vector parameter and application examples; Detection theory and it's mathematical formulation; Detection of deterministic and random signals in noise; Bayesian approach in detection.

Course Outcome:

Students who successfully complete this course will understand the fundamentals of estimation and detection theory. This helps the students to mathematically model the communication systems. Also, the knowledge of various types of estimators and decision rules obtained from the course enables them to design and implement better communication receivers.

Text Books:

1. Steven Kay, "Fundamentals of Statistical Signal Processing" Vol I: Estimation Theory, Prentice Hall.
2. Steven Kay, "Fundamentals of Statistical Signal Processing" Vol II: Detection Theory, Prentice Hall.

References:

1. H. L. Van Trees, "Detection, Estimation, and Modulation Theory", Vol. I, John Wiley & Sons, 1968
2. Statistical Digital Signal Processing and Modelling" by Monson H. Hayes, John Wiley & Sons Publications, 2002.

COURSE PLAN

COURSE CODE:	COURSE TITLE	CREDITS	
04 EC 6107	ESTIMATION AND DETECTION THEORY	3-0-0:3	
MODULES		**Contact Hours**	**Sem. Exam Marks (%)**
MODULE 1: Estimation Theory**,** Parameter Estimation, Mathematical formulation, Minimum Variance Unbiased Estimation(MVUE), methods of finding MVU estimators, Cramer-Rao Lower Bound (CRLB), CRLB for signals in White Gaussian Noise, extension to vector parameter, application examples.		7	15
MODULE 2: Linear models, General MVUE, sufficient statistics, Best Linear Unbiased Estimation (BLUE), Maximum likelihood estimation (MLE), extension to vector parameter, application examples.		7	15
INTERNAL TEST 1 (MODULE 1 & 2)			
MODULE 3: Least Squares, Method of Moments, Bayesian estimators, Kalman filters, extension to vector parameter, application examples.		7	15
MODULE 4: Detection theory, Mathematical formulation, Hypothesis Testing, Neyman Pearson Theorem, Bayes criterion, minimum probability of error criterion, likelihood ratio test, application examples.		7	15
INTERNAL TEST 2 (MODULE 3 & 4)			
MODULE 5: Detection of deterministic and random signals in noise, Composite Hypothesis Testing, generalized likelihood ratio test, application examples.		7	20
MODULE 6: Bayesian approach in detection, detection of deterministic and random signals with unknown parameters, application examples.		7	20
END SEMESTER EXAM			

COURSE CODE	COURSE NAME	L-T-P:C	YEAR
04 EC 6109	ADVANCED OPTICAL COMMUNICATION SYSTEMS	3 – 0 - 0: 3	2015

Pre-requisites: Nil

Course Objectives:

To give the Student:-

- A basis in the essentials of optical fiber, amplifier, transmitters and receivers;
- A practical guide to design a Light wave system architecture using power budget and rise time budget;
- An overview to Soliton Systems;

Syllabus:

Light wave system components: Optical fibers, wave propagation, Optical transmitters, Optical receivers, Light wave system architecture, Optical amplifiers, Soliton Systems, Fibersolitons, nonlinear Schrodinger equation, bright soliton, dark solitons, soliton based communications, information transmission with solitons, soliton interaction, loss managed soliton, dispersion managed solitons, impact of amplifier noise, high speed soliton system.

Course Outcome:

Students finishing this course will have the ability to recognise the uses of optical fiber, transmitters and receivers; Use the power budget and rise time budget to design a light wave system; understand the use of different optical amplifiers for different purpose; Use the solitons in an apt manner.

Text Books:

1. Govind P. Agrawal, “Fiber Optic Communication System”, John Wiley and Sons, 2003

References:

1. J Diggonet, “Rare Earth Doped Fiber Lasers and Amplifiers”
2. Hasegawa, “Solitons in Optical Communications”
3. Govind P. Agrawal, “Nonlinear Optics”, Academic press 2nd Ed.

COURSE PLAN

COURSE CODE:	COURSE TITLE	CREDITS	
04 EC 6109	ADVANCED OPTICAL COMMUNICATION SYSTEMS	3-0-0:3	
MODULES		Contact Hours	Sem. Exam Marks (%)
MODULE 1: Light wave system components: Optical fibers, step-index fiber, graded-index fibers, wave propagation, fiber modes, single mode and multi-mode fibers, dispersion in fibers, group velocity dispersion, material dispersion, waveguide dispersion, higher-order dispersion, polarization-mode dispersion.		7	15
MODULE 2: Optical transmitters: LED, LED spectrum, modulation response, LED structure, semiconductor LASER, optical gain, LASER structure, characteristics, transmitter design		7	15
INTERNAL TEST 1 (MODULE 1 & 2)			
MODULE 3: Optical receivers: Common photo detectors, p-n photodiodes, p-i-n photodiodes, Avalanche photodiode, receiver design, receiver noise, Receivers sensitivity, bit error rate, minimum received power.		7	15
MODULE 4: Light wave system architecture: Design, loss limited and dispersion limited, power budget and rise time budget, long haul systems, performance limiting factors, terrestrial light wave system, under sea light wave systems.		7	15
INTERNAL TEST 2 (MODULE 3 & 4)			
MODULE 5: Optical amplifiers:Gain spectrum, amplifier noise, amplifier specifications, semiconductor optical amplifiers, amplifier design characteristics, pulse amplifier, system application, Raman amplifiers, EDFA, gain spectrum, amplifier noise, multichannel amplification, distributed gain amplifier, dispersion management, pre-compensation schemes, post compensation technique, dispersion compensation fibers.		7	20
MODULE 6: Soliton Systems: Fibersolitons, nonlinear Schrodinger equation, bright soliton, dark solitons, soliton based communications, information transmission with solitons, soliton interaction, loss managed soliton, dispersion managed solitons, impact of amplifier noise, high speed soliton system.		7	20
END SEMESTER EXAM			

COURSE CODE	COURSE NAME	L-T-P:C	YEAR
04 EC 6111	RF MEMS	3 – 0 - 0: 3	2015

Pre-requisites: Nil

Course Objectives:

To give the Student:-

- A foundation of RF MEMS;
- Applications of MEMS in RF circuit design.

Syllabus:

RF MEMS relays and switches; MEMS inductors; MEMS capacitor; Micromachined RF filters; Micromachined Transmission lines; Micromachined antennas.

Course Outcome:

- At the end of the course students should be able to analyze different MEMS technologies.
- They are also expected to be familiar with the micro machined designs for the design of reconfigurable antennas and different RF circuits.

Text Books:

1. Vijay K. Varadanetal, RF MEMS and their Applications, Wiley-India, 2011.

References:

1. “RF MEMS: Theory, Design, and Technology”, Gabriel M. Rebeiz, Wiley, 2003.

COURSE PLAN

COURSE CODE:	COURSE TITLE	CREDITS	
04 EC 6111	RF MEMS	3-0-0:3	
MODULES		**Contact Hours**	**Sem. Exam Marks (%)**
MODULE 1: **RF MEMS relays and switches:** Switch parameters, actuation mechanisms, Bistable relays and micro actuators, dynamics of switching operation.		8	15
MODULE 2: **MEMS inductors:** Micromachined inductor, effect of inductor layout, Modeling and design issues of planar inductor.		6	15
INTERNAL TEST 1 (MODULE 1 & 2)			
MODULE 3: **MEMS capacitors**: Gap tuning and area tuning capacitors, dielectric tunable capacitors.		5	15
MODULE 4:**Micromachined RF filters:** Modeling of mechanical filters, electrostatic comb drive, micromechanical filters using comb drives, Electrostatic coupled beam structures, MEMS phase shifters, types, limitations		8	15
INTERNAL TEST 2 (MODULE 3 & 4)			
MODULE 5:**Micromachined Transmission lines:** Switched delay lines, micromachined transmission lines, coplanar lines, micromachined directional coupler and mixer.		5	20
MODULE 6: **Micromachined antennas:** Microstrip antennas – design parameters, Micromachining to improve performance, reconfigurable antennas		10	20
END SEMESTER EXAM			

COURSE CODE	COURSE NAME	L-T-P:C	YEAR
04 EC 6113	IMAGE AND VIDEO PROCESSING	3 – 0 – 0: 3	2015

Pre-requisites: Nil

Course Objectives:

To give student:-

- To familiarize with the various image processing techniques.
- To understand various video processing methods.

Syllabus:

Image processing techniques – enhancement – restoration – segmentation - object recognition - image compression - morphological image processing and video processing.

Course Outcome

- To know the image fundamentals and mathematical transforms necessary for image processing.
- To apply various image processing algorithms.
- To estimate motion in 2D and 3D in Video processing.

References

1. K. Jain, “Fundamentals Of Digital Image Processing”, Prentice Hall Of India, 1989.
2. R. C. Gonzalez, R. E. Woods, “Digital Image Processing”, Pearson Education.
3. M. Tekalp, “Digital Video Processing”, Prentice-Hall.
4. Bovik, “Handbook of Image & Video Processing”, Academic Press, 2000
5. W. K. Pratt, “Digital Image Processing”, Prentice Hall
6. Rosenfeld, A. C. Kak, “Digital Image Processing”, vols. 1 and 2, Prentice Hall.

COURSE PLAN

COURSE CODE:	COURSE TITLE	CREDITS	
04 EC 6113	IMAGE AND VIDEO PROCESSING	3-0-0:3	
MODULES		**Contact Hours**	**Sem. Exam Marks (%)**
MODULE 1: Introduction to Digital image processing & Applications: Elements of visual perception, Mach band effect, sampling, quantization, Basic relationship between pixels, color image fundamentals-RIB-HIS models.		5	15
MODULE 2: Image transforms: Two dimensional transforms, orthogonal and unitary transforms, separable unitary transforms, basis images, DFT, DCT, WHT, KLT and SVD.		5	15
INTERNAL TEST 1 (MODULE 1 & 2)			
MODULE 3: Image enhancement and restoration: Image enhancement:Point operations, Spatial operations and Transform operations, Histogram-based processing. Image restoration: Degradation models, PSF, Restoration using inverse filtering, Wiener filtering.		6	15
MODULE 4: Image segmentation: Edge detection and Boundary representation: Thresholding: Bi-level thresholding, Adaptive thresholding, Region growing, Splitting and merging, Edge detection and linking, Hough transform.Boundary representation: Chain codes, Polygonal approximation, Boundary segments, Boundary descriptors, Regional descriptors, Relational descriptors		8	15
INTERNAL TEST 2 (MODULE 3 & 4)			
MODULE 5: Object recognition and Morphological processing Object recognition: Pattern and pattern classes, Recognition based on decision theoretic methods, Matching, Optimum statistical classifiers. Morphological image processing: Erosion and dilation, Opening or closing, HIT or MISS transformation, Basic morphological algorithms.		8	20
MODULE 6: Video processing Time Varying Image Formation Models. Spatio-temporal sampling, 2D motion estimation-Optical flow methods, Block based methods 3D motion estimation- Methods using point correspondence, Optical flow and Direct methods,Image Compression- Lossless compression-DPCM and Transform coding, Vector quantization, Subband coding, Video compression-Interframe compression methods.		10	20

COURSE CODE	COURSE NAME	L-T-P:C	YEAR
04 EC 6115	INFORMATION AND CODING THEORY	3 – 0 - 0: 3	2015

Pre-requisites: Nil

Course Objectives:

To give the Student:-

- A sound background in concepts of Information theory and channel coding.
- An introduction to traditional binary and non-binary channel coding algorithms.
- A foundation on the, extensively used, latest capacity approaching codes

Syllabus:

Fundamental concepts and overview of information theory and channel coding; Shannon's Theorems; Source coding; Channel capacity; Channel coding; Linear Block codes; convolutional codes; Finite fields; Cyclic codes; BCH and RS codes; Turbo Codes; LDPC codes.

Course Outcome:

Students who successfully complete this course will have a sound background in binary and non-binary error-correcting codes, covering different classes of channel codes- block codes and convolutional codes; Study the construction of various algebraic codes in the finite fields; Appreciate the use of iterative probabilistic decoding algorithms; Motivated to take up research works and projects on the design of efficient communication systems using proper channel codes in standard channel models.

Text Books:

1. S. Lin, D. J. Costello Jr,. "Error Control Coding: Fundamentals and Applications," Prentice-Hall, 2004
2. Joy A. Thomas, Thomas M. Cover "Elements of Information Theory"2nd edition John Wiley & Sons.

References:

1. R.E. Blahut, "Theory and Practice of Error Control Coding", MGH 1983
2. S. Ling, C. Xing. "Coding Theory: A First Course," Cambridge University Press, 2004
3. R. Togneri, C. J. S. de-Silva. "Fundamentals of Information Theory and Coding Design" CRC Press, 2006
4. Justesen, J. Hoeholdt, T., "A course in error-correcting codes", European Math. Soc., 2004.
5. Proakis J. G., Salehi M., "Communication Systems Engineering", Prentice-Hall, 2002.
6. Lint Van J. H., "Introduction to Coding Theory", Springer Verlag, 1999.

COURSE PLAN

COURSE CODE:	COURSE TITLE	CREDITS	
04 EC 6115	INFORMATION AND CODING THEORY	3-0-0:3	
MODULES		Contact Hours	Sem. Exam Marks (%)
MODULE 1: Introduction to Communication systems and Information theory: Information and Entropy, Joint, conditional and relative entropy, Mutual Information. Lossless source coding- Uniquely decodable codes- Instantaneous codes- Kraft's inequality - Optimal codes- Shannon's Source Coding Theorem. Huffman code, Optimality of Huffman code, Shannon-Fano-Elias Code, Arithmetic coding.		6	15
MODULE 2: Module 2: Channel capacity and coding theorem: Channel capacity, Capacity computation for simple channels-BSC, BEC, 4-ary channel, general symmetric channel. Shannon's Channel Coding Theorem and its converse, Shannon Limit, Shannon-Hartley Law. Channel Capacity of a Continuous Channel (Gaussian),Channel Capacity in Fading Environments, channel models		7	15
INTERNAL TEST 1 (MODULE 1 & 2)			
MODULE 3: Channel Coding: Linear Block codes- Properties- Minimum Distance, Generator and parity check matrices, Encoding, code rate analysis. Error detection and correction- Standard Array and Syndrome decoding, Hamming codes.		6	15
MODULE 4: Cyclic codes And Convolutional codes: Introduction to finite fields-Group, Ring, Field, Primitive Polynomials, Minimal Polynomials and CyclotomicCosets ,Subfields. Cyclic Codes-Generator polynomial, encoding and decoding procedure, Generator and Parity check matrices, Error detection & correction. Convolutional Codes: Encoding of convolutional codes, state, tree and trellis diagram, Viterbi algorithm, convolutional codes in mobile communications		9	15
INTERNAL TEST 2 (MODULE 3 & 4)			
MODULE 5: BCH and RS codes: Bose-Chaudhuri–Hocquenghem (BCH) Codes- The BCH Bound, Construction of binary and non-binary BCH codes of fixed length Reed–Solomon (RS) Codes-Distance properties, error correction capability, Decoding Reed–Solomon Codes- Euclid's Algorithm, Berlekamp–Massey's		7	20

Algorithm		
MODULE 6: Capacity Approaching codes: Turbo Codes - The Turbo Encoder, The Turbo Decoder- Log Like-lihood Ratios (LLRs) , Maximum A Posteriori (MAP) Decoding. LDPC codes-LDPC encoding, Tanner graph, LDPC decoding-Hard decision decoding-Bit flipping algorithm, Soft decision decoding-Belief propagation algorithm in probability domain.	7	20
END SEMESTER EXAM		

COURSE CODE	COURSE NAME	L-T-P:C	YEAR
04 GN 6001	RESEARCH METHODOLOGY	0 -2-0:2	2015

Pre-requisites: Nil

Course Objectives:

- To get introduced to research philosophy and processes in general.
- To formulate the research problem and prepare research plan
- To apply various numerical /quantitative techniques for data analysis
- To communicate the research findings effectively

Syllabus

Introduction to the Concepts of Research Methodology, Research Proposals, Research Design, Data Collection and Analysis, Quantitative Techniques and Mathematical Modeling, Report Writing

Course Outcome:

Students who successfully complete this course would learn the fundamental concepts of Research Methodology, apply the basic aspects of the Research methodology to formulate a research problem and its plan. They would also be able to deploy numerical/.quantiative techniques for data analysis. They would be equipped with good technical writing and presentation skills.

Text Books:

1. Research Methodology: Methods and Techniques', by Dr. C. R. Kothari, New Age International Publisher, 2004

2 Research Methodology: A Step by Step Guide for Beginners' by Ranjit Kumar, SAGE Publications Ltd; Third Edition

Reference Books:

1. Research Methodology: An Introduction for Science & Engineering Students', by Stuart Melville and Wayne Goddard, Juta and Company Ltd, 2004
2. Research Methodology: An Introduction' by Wayne Goddard and Stuart Melville, Juta and Company Ltd, 2004
3. Research Methodology, G.C. Ramamurthy, Dream Tech Press, New Delhi
4. Management Research Methodology' by K. N. Krishnaswamy et al, Person Education

COURSE PLAN

COURSE CODE:	COURSE TITLE	CREDITS	
04 GN 6001	RESEARCH METHODOLOGY	0-2-0:2	
MODULES		Contact Hours	Sem. Exam Marks (%)
MODULE 1: Introduction to Research Methodology, Concepts of Research, Meaning and Objectives of Research, Research Process, Types of Research, Type of research: Descriptive vs. Analytical, Applied vs. Fundamental, Quantitative vs. Qualitative, and Conceptual vs. Empirical		5	15
MODULE 2: Criteria of Good Research, Research Problem, Selection of a problem, Techniques involved in definition of a problem, Research Proposals – Types, contents, Ethical aspects, IPR issues like patenting, copyrights.		4	15
INTERNAL TEST 1 (MODULE 1 & 2)			
MODULE 3: Meaning, Need and Types of research design, Literature Survey and Review, Identifying gap areas from literature review, Research Design Process, Sampling fundamentals, Measurement and scaling techniques, Data Collection – concept, types and methods, Design of Experiments.		5	15
MODULE 4: Probability distributions, Fundamentals of Statistical analysis, Data Analysis with Statistical Packages, Multivariate methods, Concepts of correlation and regression, Fundamentals of time series analysis and spectral analysis		5	15
INTERNAL TEST 2 (MODULE 3 & 4)			
MODULE 5: Principles of Thesis Writing, Guidelines for writing reports & papers, Methods of giving references and appendices, Reproduction of published material, Plagiarism, Citation and acknowledgement		5	20
MODULE 6: Documentation and presentation tools – LATEX, Office Software with basic presentations skills, Use of Internet and advanced search techniques,		4	20
END SEMESTER EXAM			

COURSE CODE	COURSE NAME	L-T-P:C	YEAR
04 EC 6191	SEMINAR	0-0-2	2015

Each student shall present a seminar on any topic of interest related to the core / elective courses offered in the first semester of the M. Tech. Programme. He / she shall select the topic based on the References: from international journals of repute, preferably IEEE journals. They should get the paper approved by the Programme Co-ordinator / Faculty member in charge of the seminar and shall it in the class. Every student shall participate in the seminar. The students should undertake a detailed study on the topic and submit a report at the end of the semester. Marks will be awarded based on the topic, presentation, participation in the seminar and the report submitted.

COURSE CODE	COURSE NAME	L-T-P:C	YEAR
04 EC 6193	COMMUNICATION SYSTEMS LAB	0-0-2: 1	2015

Pre-requisites: Nil

Course Objectives:

- To familiarize the basic communication experiments using CCS and DSP Kit.
- Experiments for familiarizing basic probability functions.
- To analyze the Parameter estimators.
- To familiarize Different Digital Coding Schemes.

Syllabus

To introduce the basic concepts of TMS 320C67XX DSP Kit and to give an exposure to Digital coding schemes.

PART- I (Experiments are to be conducted using DSP KitTMS320C67XX DSK)

- Generation of Sine wave
- Amplitude Modulation and Demodulation
- DSBSC Amplitude Modulation and Coherent Detection
- SSB Amplitude Modulation and Coherent Detection
- Frequency Modulation and Demodulation
- Pseudo-Random Binary Sequence Generation(Scrambling and Descrambling)
- Generation of PAM signal and Eye Diagram
- QAM
- Near-End Echo Canceller
- Far-End Echo Canceller
- BPSK Modulation and Demodulation
- Convolution coding and decoding

PART II (Experiments are to be conducted using Numerical Computational environments- MATLAB, GNU OCTAVE etc.)

- Fundamentals of Random variables and random processes.
- PDF and CDF of common Probability Distribution Function.
- Verification of GRAM-SCHMITT orthogonalisation procedure.
- Deterministic parameter estimators- LSE, BLUE, MLE.
- Random parameter Estimators-Bayesian, MMSE & MAP estimators.
- Source codes-Shannon-Fano Codes, Huffman Codes & Arithmetic codes.
- Channel Coding: Linear Block codes, cyclic codes, BCH codes and RS codes

Minimum of 10 experiments from above topics shall be completed. Additional topics in concurrence with the syllabus of elective subjects may be offered.

Course Outcome

Students who successfully complete this course will understand the basic communication experiments. This helps the students to mathematically model the communication systems. Also, the students get a clear idea regarding the different digital coding schemes.

SEMESTER II

COURSE CODE	COURSE NAME	L-T-P:C	YEAR
04 EC 6102	ADVANCED DIGITAL COMMUNICATION TECHNIQUES	3-0-0:3	2015

Pre-requisites: Nil

Course Objectives:

- To understand the concepts communication of noise channels.
- Effect of synchronization in communication.
- Concepts of band limited channels.

Syllabus:

Review of Random variables, Multi-variate Gaussian distributions, Characterization of Communication Signals and Systems, Multi dimensional signaling, Optimum receivers for AWGN channels Matched filter receiver, Comparison of digital signaling methods, Carrier Recovery and Symbol Synchronization in Signal Demodulation, Carrier Phase Estimation, Characterization for band limited channels, Equalization Techniques, Maximum Likelihood timing estimation, Adaptive Equalization ,LMS algorithm, adaptive decision feedback equalizer.

Course Outcome:

The student will be able to analyze various aspects of digital communication Techniques

Text Books:

1. J.G. Proakis, M. Salehi, “Digital Communication”, MGH 5th edition, 2008.

References:

1. J.G. Proakis, M. Salehi, “Fundamentals of Communication systems”, Pearson, 2005.
2. John B. Anderson, “Digital Transmission Engineering”, Wiley India Reprint,2012.
3. Edward. A. Lee and David. G. Messerschmitt, “Digital Communication”, Allied Publishers (second edition).
4. J Marvin.K.Simon, Sami. M. Hinedi and William. C. Lindsey, “Digital Communication Techniques”, PHI.
5. William Feller, “An introduction to Probability Theory and its applications”, Wiley 2000.
6. Sheldon.M.Ross, “Introduction to Probability Models”, Elsevier, 9th edition, 2007.

COURSE PLAN

COURSE CODE:	COURSE TITLE	CREDITS	
04 EC 6102	ADVANCED DIGITAL COMMUNICATION TECHNIQUES	3-0-0:3	
MODULES		Contact Hours	Sem. Exam Marks (%)
MODULE 1: Review of Random variables, probability distribution and density functions,Moment generating function, Characteristic Function,Upper bounds on tail probability- Chebyshevinequality,Chernoff bound, Gaussian, Chi square,Rayleigh, Rician, Nakagami and Multi variate Gaussian distributions		10	15
MODULE 2: PDFs and moments, Central limit Theorem,Characterization of Communication Signals and Systems,Signal space representation,Representation of digitally modulated signals,Multidimensionalsignaling.		8	15
INTERNAL TEST 1 (MODULE 1 & 2)			
MODULE 3: Optimum receivers for AWGN channels,Waveform and vector AWGN channel models- Optimal detection, Correlation receiver, Matched filter receiver,Optimal detection and error probabilities for Band limited and Power limited signaling,Comparison of digital signaling methods		9	15
MODULE 4: Carrier Recovery and Symbol Synchronization in Signal Demodulation, Signal parameter estimation, Carrier Phase Estimation, Maximum Likelihood phase estimation Phase locked loop Effect of additive noise on the phase estimate; Symbol Timing Estimation.		10	15
INTERNAL TEST 2 (MODULE 3 & 4)			
MODULE 5: Characterization for band limited channels, Signal design - Optimum pulse shaping, Nyquist criterion for zero ISI, Partial response signaling, Optimum receiver for channels with ISI and AWGN; Equalization Techniques, Linear Equalization Decision feedback equalization, Turbo equalization		10	20
MODULE 6: Maximum Likelihood timing estimation- Non Decision Directed Timing Estimation, Joint Estimation of Carrier phase and Symbol Timing Adaptive Equalization - adaptive linear equalizer Zero forcing algorithm, LMS algorithm, adaptive decision feedback equalizer.		9	20
END SEMESTER EXAM			

COURSE CODE	COURSE NAME	L-T-P:C	YEAR
04 EC 6104	ANTENNA THEORY: ANALYSIS AND DESIGN	3-0-0:3	2015

Pre-requisites: Nil

Course Objectives:

To give the Student:-

- A foundation in the fundamentals of Antenna Design;
- Practice in the formulation of antennas and antenna arrays;
- An introduction to antenna synthesis and microstrip antennas;

Syllabus

Fundamental concepts and overview in radiation; Basic equations in the design of various antennas; Design of antenna arrays; Basic concepts in antenna synthesis; Design of Microstrip antennas; Analysis of various antennas.

Course Outcome:

Students who successfully complete this course will have demonstrated an ability to understand the fundamental concepts of antenna design; Apply the basic equation to determine the radiation pattern of many antennas and antenna arrays; Use of various laws in antenna synthesis; Use the equations to solve microstrip antenna problems.

Text Books:

1. C. A. Balanis, "Antenna Theory and Design", 3rd Ed., John Wiley &Sons., 2005.
2. W. L. Stutzman, and G. A. Thiele, "Antenna Theory and Design", 2nd Ed., John Wiley &Sons., 1998.

References:

1. R. S. Elliot, "Antenna Theory and Design", Revised edition, Wiley-IEEE Press., 2003.
2. R. E. Collin, "Antennas and Radio Wave Propagation", McGraw-Hill., 1985
3. F. B. Gross, "Smart Antennas for Wireless Communications", McGraw-Hill., 2005.

COURSE PLAN

COURSE CODE:	COURSE TITLE	CREDITS	
04 EC 6104	Antenna Theory: Analysis and Design	3-0-0:3	
MODULES		Contact Hours	Sem. Exam Marks (%)
Module 1: Concept of Radiation, Physical concept of radiation, Radiation pattern, near-and far-field regions, reciprocity, directivity and gain, effective aperture, polarization, input impedance, efficiency.Friis transmission equation, radiation integrals and auxiliary potential functions.		7	15
Module 2: Dipole and Aperture Antennas, Infinitesimal dipole, finite-length dipole, linear elements near conductors, dipoles for mobile communication, small circular loop.Aperture and Reflector Antennas-Huygens' principle, radiation from rectangular and circular apertures, design considerations.		7	15
INTERNAL TEST 1 (MODULE 1 & 2)			
Module 3: HF Antennas, Babinet's principle, Log, frequency independent antennas, broadcast antennas.Terrestrial and base station antennas for wireless applications.-Satellite terrestrial antennas, base station antennas, mobile terminal antennas, smart antennas, Adaptive and spatial filtering antennas.		7	15
Module 4: Antenna Arrays, Array Antennas-Directivity of uniformly excited equally spaced linear arrays, Array pattern evaluation including mutual coupling. Phased arrays and array feeding techniques, Scan principles, Feed networks and array technology.		7	15
INTERNAL TEST 2 (MODULE 3 & 4)			
Module 5: Antenna Synthesis, Antenna Synthesis: The Antenna Synthesis problem- Formulation of the Synthesis Problem, Synthesis Principles.Line source shaped beam synthesis methods - The Fourier Transform Method, The Woodward–Lawson Sampling Method.		7	20
Module 6: Microstrip Antennas, Microstrip Antennas-Basic characteristics of microstrip antennas, feeding methods, methods of analysis, design of rectangular and circular patch antennas.CEM for Antennas- Introduction to CEM, Method of moments, Pocklington's Integral Equation, Source Modeling.		7	20
END SEMESTER EXAM			

COURSE CODE	COURSE NAME	L-T-P:C	YEAR
04 EC 6106	WIRELESS COMMUNICATIONS	3-0-0:3	2015

Pre-requisites: Nil

Course Objectives:

To give the Student:-

- A foundation in the fundamentals of wireless communication;
- An introduction to capacity of wireless channels and various channel coding methods;
- An introduction to multiple antenna techniques and multiple access techniques;

Syllabus:

Fundamental concepts and overview in Wireless Communication; Shannon's equations for capacity calculation; Basic equations in channel coding ; Multiple antenna techniques to improve the received SNR and Capacity; Equalization and Multi-carrier modulation; Multiple Access Techniques.

Course Outcome:

Students who successfully complete this course will have demonstrated an ability to understand the fundamental concepts of Wireless Communication; Apply the Shannon's equation to determine the capacity of various channels; Use of Channel coding methods to detect and remove the errors in communication; Use various multiple antenna and multiple access techniques.

Text Books:

Andrea Goldsmith, "Wireless Communications", Cambridge University Press

References:

T.S. Rappaport, "Wireless Communication, Principles & Practice", Pre
ntice Hall of India.

COURSE PLAN

COURSE CODE:	COURSE TITLE	CREDITS	
04 EC 6106	WIRELESS COMMUNICATIONS	3-0-0:3	
MODULES		**Contact Hours**	**Sem. Exam Marks (%)**
MODULE 1: Overview of wireless communication: Radio wave propagation, Transmit and receive signal models, Free space path loss, ray tracing. Simplified path loss model, Empirical path loss model: Okumura model - Hata model - Walfisch model - piecewise linear model- indoor propagation models Shadow fading - combined path loss and shadowing - Cell coverage area.		8	15
MODULE 2: Capacity of wireless channel: Capacity of AWGN Channel - Capacity of flat fading channel - Capacity of frequency selective fading channels Diversity: Receiver diversity: system model - selection combining - threshold combining - maximal ratio combining - equal gain combing, Transmitter diversity: channel known at transmitter - Alamouti scheme		7	15
INTERNAL TEST 1 (MODULE 1 & 2)			
MODULE 3: Channel coding: Overview of code design - Linear block codes - Cyclic Codes. Convolution codes: Trellis diagram - maximum likelihood decoding - Viterbi Algorithm - Concatenated codes - Turbo codes - Low density parity check codes.		7	15
MODULE 4: Multiple Antenna Communication: Narrow band MIMO Model - Parallel decomposition of MIMO - MIMO channel capacity: static and fading channel. MIMO diversity gain - Diversity/Multiplexing trade-offs - Space time modulation and coding - Frequency selective MIMO channels.		7	15
INTERNAL TEST 2 (MODULE 3 & 4)			
MODULE 5: Equalization and Multi carrier modulation: Equalizer noise enhancement, equalizer types, folded spectrum and ISI-free transmission, linear equalizer.Multi carrier modulation: Data transmission using multiple carriers, Multi carrier modulation with overlapping sub channels, Mitigation of subcarrier fading.		6	20
MODULE 6: Multiple Access Schemes: Frequency Division Multiple Access, Time Division Multiple Access, Spread Spectrum Multiple Access, Space Division Multiple Access. Overview of GSM, GPRS, EDGE,UMTS, CDMA 2000, HSDPA and LTE		7	20
END SEMESTER EXAM			

ELECTIVE II

COURSE CODE	COURSE NAME	L-T-P:C	YEAR
04 EC 6108	MULTICARRIER COMMUNICATION SYSTEMS	3-0-0:3	2015

Pre-requisites: Nil

Course Objectives:

- To provide an overview of OFDM and wireless channel characteristics;
- To understand the basic concepts of synchronization and channel impairment in OFDM;

Syllabus

Multi carrier and OFDM system fundamentals; Impairments of wireless channels to OFDM signals; Timing and Frequency Offset estimation; Channel Estimation in OFDM systems; MIMO channel estimation; Performance in AWGN channel.

Course Outcome:

Students who successfully complete this course can understand the basics of OFDM and wireless channel characteristics. They can also learn the concepts of synchronization and channel impairment in OFDM**.**

Text Books:

1. Y. Li. G. Stuber, "OFDM for Wireless Communication", Springer, 2006.
2. R. Prasad, "OFDM for Wireless Communication", Artech House, 2006.

References:

1. Ahmad R.S. Bahai, B.R. Saltzberg, M. Ergen, " Multi carrier Digital Communications- Theory and Applications of OFDM", Second Edition, Springer

COURSE PLAN

COURSE CODE:	COURSE TITLE	CREDITS	
04 EC 6108	MULTICARRIER COMMUNICATION SYSTEMS	3-0-0:3	
MODULES		**Contact Hours**	**Sem. Exam Marks (%)**
MODULE 1: Multi carrier and OFDM system fundamentals, OFDM system model, Single carrier communication, Comparison with other multi carrier modulation scheme, Channel capacity		7	15
MODULE 2: FFT implementation, Power spectrum, Impairments of wireless channels to OFDM signals, Synchronization in OFDM , Timing and Frequency Offset in OFDM, Synchronization & system architecture		7	15
INTERNAL TEST 1 (MODULE 1 & 2)			
MODULE 3: Timing and Frequency Offset estimation, Pilot and Non pilot basedmethods, Joint Time & Frequency Offset estimation.		7	15
MODULE 4: Channel Estimation in OFDM systems, Differential and Coherent detection, Pilot symbol aided estimation, Block type and Comb type pilot arrangement		7	15
INTERNAL TEST 2 (MODULE 3 & 4)			
MODULE 5: Decision directed channel estimation, MMSE estimation using time and frequency domain, correlation, MIMO channel estimation- basic concepts, Concepts of Time and Frequency domain equalization		7	20
MODULE 6: Clipping in Multi carrier systems, Power amplifier non linearity, Error probability analysis, Performance in AWGN channel, PAPR properties of OFDM signals, PAPR reduction techniques with signal distortion, Techniques for distortion less PAPR reduction, Selective mapping and Optimization techniques.		7	20
END SEMESTER EXAM			

COURSE CODE	COURSE NAME	L-T-P:C	YEAR
04 EC 6112	PRINCIPLES OF SECURE COMMUNICATION	3-0-0:3	2015

Pre-requisites: Nil

Course Objectives:

To give the Student:-

- Develop a basic understanding of generic security issues such as authentication, integrity and confidentiality.
- Develop an understanding of different types of cryptographic techniques
- Gain familiarity with authentication techniques.
- Develop an understanding of security issues in web and how these are addressed.

Syllabus

Finite Fields and number theory, Symmetric ciphers, Classic Encryption Techniques, Public Key Encryption, Message Authentication, Network Security, Web Security, System Security, Malicious Software.

Course Outcome:

The course deals with the underlying principles of cryptography and network security. It develops the mathematical tools required to understand the topic of cryptography. Starting from the classical ciphers to modern day ciphers, the course provides an extensive coverage of the techniques and methods needed for the proper functioning of the ciphers. The course defines one way functions and trap-door functions and presents the construction and cryptanalysis of public key ciphers, namely RSA.

Text Books:

1. William Stallings, “Cryptography and Network Security”, 3rd edition, Pearson Education

References:

1. Douglas A. Stinson, “Cryptography, Theory and Practice”, 2nd edition, Chapman & Hall, CRC Press Company, Washington
2. Lawrence C. Washington, “Elliptic Curves”, Chapman & Hall, CRC Press
3. David S. Dummit, Richard M. Foote, “Abstract Algebra”, John Wiley & Sons
4. Evangelos Kranakis, “Primality and Cryptography”, John Wiley & Sons
5. Rainer A. Ruppel, “Analysis and Design of Stream Ciphers”, Springer Verlag

COURSE PLAN

COURSE CODE:	COURSE TITLE	CREDITS	
04 EC 6112	PRINCIPLES OF SECURE COMMUNICATION	3-0-0:3	
MODULES		Contact Hours	Sem. Exam Marks (%)
MODULE 1: Finite Fields and Number theory: Groups, Rings and fields- Modular Arithmetic - Euclidean and Extended Euclidean Algorithms – Galois Field, Polynomial Arithmetic Prime Numbers-Fermats and Eulers Theorem, Testing for Primality, Chinese Remainder Theorem, Discrete Logarithms.		7	15
MODULE 2: Symmetric Ciphers: Classical Encryption Techniques: Substitution, Transposition, Rotor Machines, Steganography, Random Number, Properties and generation techniques. Block ciphers: Basic Principles, Fiestel Structure, DES, Strength and cryptanalysis techniques, Triple DES, AES		7	15
INTERNAL TEST 1 (MODULE 1 & 2)			
MODULE 3: Public Key Encryption: Principles of public key cryptosystems, RSA Key Management, Diffie-Hellman Key Exchange. Elliptic curves- Basic theory, Elliptic curve Arithmetic, Elliptic Curve Cryptography		7	15
MODULE 4: Message Authentication: Authentication functions, message authentication codes, Hash functions and their security Message Digest 5 , secure hash algorithms, HMAC Digital Signatures, protocols, standards		7	15
INTERNAL TEST 2 (MODULE 3 & 4)			
MODULE 5: Network Security: Authentication Applications: Kerbos, X.509, Pretty Good Privacy. IP Security: Overview, Architecture, Authentication Header, Encapsulation and combination of security. Web Security: Secure Socket Layer, Transport Layer Security. Secure Electronic Transaction.		7	20
MODULE 6: System Security: Intruders: detection and password management Malicious software: Virus, malware, Trojan horse, related threats, counter measures. Firewalls: Design principles, trusted systems		7	20
END SEMESTER EXAM			

COURSE CODE	COURSE NAME	L-T-P:C	YEAR
04 EC 6114	SPEECH TECHNOLOGY	3 – 0 – 0: 3	2015

Pre-requisites: Nil

Course Objectives:

- To familiarize with the concept of speech production mechanism
- To understand various speech analysis methods
- To familiarize with various applications of speech processing such as speech enhancement, speech recognition, speech synthesis and speech coding

Syllabus:

Speech production mechanism - vocal tract model - speech analysis - speech recognition - speech synthesis - speech enhancement and speech coding.

Course Outcome:

- To do speech analysis for feature extraction
- To synthesize and enhance speech samples in various conditions.
- To apply various speech processing algorithm for real time applications.

Text books:

1. Douglas O'Shaugnessy,"Speech Communication,Human and Machine",IEEE Press, 2000.

References:

1. 2. L. Rabiner, B. H. Juang and B. Yegnanarayana, "Fundamentals of Speech Recognition", Pearson India, 2009.
2. 3. T.F Quatieri, "Discrete-Time Speech Signal Processing- Principles and Practice", Pearson, 2002. L.R. Rabiner and R. W. Schafer, "Theory and Applications of Digital Speech Processing", Pearson, 2010. 5.
3. J R Deller, J H L Hansen, J G Proakis, "Discrete-time Processing of Speech Signals, IEEE, Wiley.

COURSE PLAN

COURSE CODE:	COURSE TITLE	CREDITS	
04 EC 6114	SPEECH TECHNOLOGY	3-0-0:3	
MODULES		Contact Hours	Sem. Exam Marks (%)
MODULE 1: Speech Production and Acoustic Phonetics. Introduction to speech signal processing: Overview of speech signal processing applications, Human speech production mechanism, Articulatory phonetics, Acoustic Phonetics		4	15
MODULE 2: Acoustic theory of speech production. Acoustics of excitation source, Acoustics of the vocal tract, Acoustics of a uniform lossless tube, Resonance in non uniform tubes, Vowel modeling, Consonant modeling.		5	15
INTERNAL TEST 1 (MODULE 1 & 2)			
MODULE 3: Module3: Co-articulation Effects of different articulators, Invariant features, Effects of co-articulation on duration, Model for co articulation, prosody, Spectrographic analysis of speech.		5	15
MODULE 4: Module 4: Speech Analysis Time and frequency domain analysis, Review of DSP techniques-z-transform, Discrete Fourier transform. Short-time analysis of speech, Linear prediction analysis, Cepstral analysis, Contrasting linear prediction analysis and cepstral analysis, Vector quantization(VQ) methods.		8	15
INTERNAL TEST 2 (MODULE 3 & 4)			
MODULE 5: Speech Recognition Speech recognition, Bayes rule, Segmental feature extraction, Mel Frequency Cepstral Coefficient(MFCC), Dynamic Time Warping(DTW), Gaussian mixture models (GMM), Hidden Markov model(HMM), Approaches for speech, Speaker and language recognition.		10	20
MODULE 6: Speech Coding, Speech Synthesis and Enhancement Speech coding, Time-domain waveform coding, Linear predictive coding, CELP coding. Principles of speech synthesis, Fundamentals of speech enhancement .		10	20
END SEMESTER EXAM			

COURSE CODE	COURSE NAME	L-T-P:C	YEAR
04 EC 6212	MOBILE COMPUTING	3-0-0:3	2015

Pre-requisites: Nil

Course Objectives:

To give the Student:-

- To learn about the concepts and principles of mobile computing;
- To explore both theoretical and practical issues of mobile computing;
- To develop skills of finding solutions and building software for mobile computing applications.

Syllabus:

Mobile Computing (MC): Motivations, concepts and challenges**,** Wireless communication concepts, GSM**:** Mobile services, Mobile IP, Hoarding Techniques, Transactional models, Communications asymmetry, Pull-based mechanisms.

Course Outcome:

Grasp the concepts and features of mobile computing technologies and applications. The student have a good understanding of how the underlying wireless and mobile communication networks work, their technical features, and what kinds of applications they can support. He could identify the important issues of developing mobile computing systems and applications.

Text Books:

1. Jochen Schiller, "Mobile Communications",*Addison-Wesley*.,2nd edition, 2004

References:

1. Stojmenovic and Cacute, "Handbook of Wireless Networks and Mobile Computing", *Wiley*, 2002, ISBN 0471419028.
2. Reza Behravanfar, "Mobile Computing Principles: Designing and Developing Mobile Applications with UML and XML", ISBN: 0521817331, Cambridge University Press, October 2004,
3. Adelstein, Frank, Gupta, Sandeep KS, Richard III, Golden,Schwiebert, Loren, "Fundamentals of Mobile and Pervasive Computing", ISBN: 0071412379, McGraw-Hill Professional, 2005.
4. Hansmann, Merk, Nicklous, Stober, "Principles of Mobile Computing", *Springer*, 2nd edition, 2003.
5. MartynMallick, "Mobile and Wireless Design Essentials", Wiley *DreamTech*, 2003.

COURSE PLAN

COURSE CODE:	COURSE TITLE	CREDITS	
04 EC 6212	MOBILE COMPUTING	3-0-0:3	
MODULES		Contact Hours	Sem. Exam Marks (%)
MODULE 1: Mobile Computing (MC): Motivations, concepts, challenges, and applications of mobile computing; relationship with distributed computing, Internet computing, ubiquitous/pervasive computing. Mobile computing models and architectures. .		8	15
MODULE 2: Wireless communication concepts; classification of wireless networks: Cellular networks (1G, 2G, 3G, 4G), WLAN, WPAN, WMAN, Satellite Networks. SDMA, FDMA, TDMA, CDMA		8	15
INTERNAL TEST 1 (MODULE 1 & 2)			
MODULE 3: GSM: Mobile services, System architecture, Radio interface, Protocols, Localization and calling, Handover, Security, and New data services. Motivation for a specialized MAC (Hidden and exposed terminals, Near and far terminals)		8	15
MODULE 4: Mobile IP (Goals, assumptions, entitiesand terminology, IP packet delivery, agent advertisement and discovery, registration, tunneling and encapsulation, optimizations). Dynamic Host Configuration Protocol (DHCP). Traditional TCP, Indirect TCP, Snooping TCP. Mobile TCP, Fast retransmit/fast recovery, Transmission /time-out freezing, Selective retransmission, Transaction oriented TCP.		8	15
INTERNAL TEST 2 (MODULE 3 & 4)			
MODULE 5: Hoarding techniques, caching invalidation mechanisms, client servercomputing with adaptation, power-aware and context-aware computing Transactional models, query processing, recovery, and quality of service issues.		5	20
MODULE 6: Communications asymmetry, classification of new data delivery mechanisms, push-based mechanisms. Pull-based mechanisms, hybrid mechanisms, selective tuning (indexing) techniques		5	20
END SEMESTER EXAM			

ELECTIVE III

COURSE CODE	COURSE NAME	L-T-P:C	YEAR
04 EC 6116	MIMO COMMUNICATION SYSTEMS	3-0-0:3	2015

Pre-requisites:

Course Objectives:

- To be familiar with the fundamentals of MIMO communication system
- To be familiar with various Diversity and Multiplexing techniques of MIMO
- To gain understanding regarding capacity considerations.
- To introduce the various types of channel coding techniques
- To be exposed to Space Time Codes

Syllabus:

A comprehensive coverage of multiple input multiple output (MIMO) system, channel capacity, Diversity techniques, channel coding techniques.

Course Outcome: Students will be able to design MIMO systems with transmit beam forming, with channel knowledge. Improved signal reception can be made possible in faded channel conditions.

Text Books:

1. David Tse and PramodViswanath, "Fundamentals of Wireless Communication", Cambridge University Press, 2005

References:

1. EzioBiglieri, Robert Calderbank et al "MIMO Wireless Communications", Cambridge University Press, 2007

2. B.Vucetic and J. Yuan, "Space-Time Coding", John Wiley, 2003

3. Hamid Jafarkhani, "Space-Time Coding: Theory and Practice", Cambridge University Press, 2005

4. A. Paulraj, R. Nabar and D. Gore, "Introduction to Space-Time Wireless Communications", Cambridge University Press, 2003

5. E.G. Larsson and P. Stoica, "Space-Time Block Coding for Wireless Communications", Cambridge University Press, 2008

COURSE PLAN

COURSE CODE:	COURSE TITLE	CREDITS	
04 EC 6116	MIMO COMMUNICATION SYSTEMS	3-0-0:3	
MODULES		Contact Hours	Sem. Exam Marks (%)
MODULE 1: **Information Theoretic aspects of MIMO:** Review of SISO communications, MIMO channel models, Classical i.i.d. and Extended channels, Frequency selective and correlated channel models.		8	15
MODULE 2: MIMO Diversity and Spatial Multiplexing: Space Time Diversity Aspects, Sources and types of diversity, Analysis under Rayleigh fading, Diversity and Channel knowledge.		6	15
INTERNAL TEST 1 (MODULE 1 & 2)			
MODULE 3: Capacity of MIMO channels, Ergodic and outage capacity, Capacity bounds, Influence of channel properties on capacity. SVD and Eigen modes of MIMO channel.		8	15
MODULE 4: Alamouti space time code, MIMO Spatial multiplexing and Transmit beam forming approach. Space Time receivers, ML, ZF, MMSE and Sphere decoding, BLAST receivers, Diversity multiplexing trade-off.		8	15
INTERNAL TEST 2 (MODULE 3 & 4)			
MODULE 5: **Space Time Block Codes:** STBC based on real and complex orthogonal designs, Code Design criteria for quasi-static channels (Rank, determinant and Euclidean distance), Orthogonal designs, Generalized Orthogonal designs, Quasi-orthogonal designs, Performance analysis.		6	20
MODULE 6: **Space Time Trellis Codes:** Representation of STTC, Shift register, Generator matrix, State-transition diagram, Trellis diagram, Code construction, Delay diversity as a special case of STTC, Performance analysis		6	20
END SEMESTER EXAM			

COURSE CODE	COURSE NAME	L-T-P:C	YEAR
04 EC 6118	SPREAD SPECTRUM AND CDMA SYSTEMS	3-0-0:3	2015

Pre-requisites: Basic Knowledge in digital communication and Random processes.

Course Objectives:

Give the Student:-

To learn the fundamentals of spread spectrum communication
To study the capacity, coverage and multiuser detection of SS
To study the various standards pertaining to CDMA systems

Syllabus

Introduction to spread spectrum communication, Tracking, Synchronization, Performance of spread spectrum system in jamming environments, Performance of spread spectrum systems with forward error correction, Introduction to fading channels, Characterization of mobile radio channels, Diversity in fading channels. Basics of spread spectrum multiple access in cellular environments, General aspects of CDMA cellular systems.

Course Outcome:

Students who successfully complete this course will have demonstrated an ability to understand the fundamental concepts of spread spectrum and CDMA; apply basic concepts and design a SS system. The student should have an ability design different SS system and analyze properties of each one.

Text Books:

1. R. L. Peterson, R. Ziemer and D. Borth, "Introduction to Spread Spectrum Communications," Prentice Hall, 1995
2. A.J. Viterbi, "CDMA - Principles of Spread Spectrum Communications," Addison-Wesley, 1997.

References:

1. S. Verdu, " Multiuser Detection" , Cambridge University Press- 1998
2. M. K. Simon, J. K. Omura, R. A. Scholts and B. K. Levitt, " Spread Spectrum Communications Handbook", McGraw- Hill, Newyork-1994
3. Cooper and McGillem, "Modern Communications and Spread Spectrum" McGraw- Hill, 1985
4. S. Glisic and B. Vucetic, "Spread Spectrum CDMA Systems for Wireless Communications," Artech House, 1997

COURSE PLAN

COURSE CODE:	COURSE TITLE	CREDITS	
04 EC 6118	SPREAD SPECTRUM AND CDMA SYSTEMS	3-0-0:3	
MODULES		**Contact Hours**	**Sem. Exam Marks (%)**
MODULE 1: Fundamentals of Spread Spectrum Introduction to spread spectrum communication, direct sequence spread spectrum, frequency-hop spread spectrum system. Spreading sequences- maximal-length sequences, gold codes, Walsh orthogonal codes- properties and generation of sequences.		8	15
MODULE 2: Synchronization and Tracking Tracking: Optimum tracking of wideband signals. Delay lock and Tau-dither loops. Code tracking loops for Frequency Hop Systems. Synchronization: Optimum synchronizer. Serial search synchronization techniques. Synchronization using a matched filter. Synchronization by estimating the received spreading code.		8	15
INTERNAL TEST 1 (MODULE 1 & 2)			
MODULE 3: Performance analysis of Spread Spectrum-Performance of spread spectrum system in jamming environments- Barrage noise jamming, partial band jamming, pulsed noise jamming and single tone jamming. Performance of spread spectrum systems with forward error correction: - Block Codes, Convolutional codes, BCH codes, Reed Solomon Codes.		8	15
MODULE 4: Channels and Receivers Introduction to fading channels: - fading channel models: - general fading channel model, WSSUS fading channel, Time selective and frequency selective fading channels. Characterization of mobile radio channels. Diversity in fading channels: - Diversity approaches and combining methods. The RAKE receiver.		8	15
INTERNAL TEST 2 (MODULE 3 & 4)			
MODULE 5: – Basic Spread Spectrum Multiple Access Techniques . Basics of spread spectrum multiple access in cellular environments, reverse Link power control, multiple cell pilot tracking, soft and hard handoffs. Cell coverage issues with hard and soft handoff, spread spectrum multiple access outage, outage with imperfect power control, Erlang capacity of forward and reverse links		5	20
MODULE 6: CDMA Systems- General aspects of CDMA cellular systems, IS-95 standard, Downlink and uplink, Evolution to Third Generation systems WCDMA and CDMA-2000 standards, Principles of Multicarrier communication, MCCDMA and MC-DS-CDMA.		5	20
END SEMESTER EXAM			

COURSE CODE	COURSE NAME	L-T-P:C	YEAR
04 EC 6122	OPTIMIZATION TECHNIQUES	3-0-0:3	2015

Pre-requisites: Nil

Course Objectives:

To give the Student:-

- A foundation in the fundamentals of optimization techniques;
- Awareness about different optimization methods.
- Application level implementation of different methods in the domain of electronics.

Syllabus

Unconstrained optimization**,** Gradient methods, Linear Programming, Simplex algorithms, Nonlinear Constrained Optimization, Convex optimization, Geometric programming, Introduction to Graph Theory and Combinatorial Optimization, Graphcoloring, Scheduling

Course Outcome:

Students who successfully complete this course will have demonstrated an ability to understand the fundamental concepts of optimization; He will have an ability to apply different optimization techniques in the field of electronics.

Text Books:

1. Edwin K. P. Chong, Stanislaw H. ZAK**, "**An Introduction to Optimization ",2nd Ed, John Wiley & Sons

References:

1. Stephen Boyd, LievenVandenberghe, "Convex Optimization", CUP, 2004.
2. R. Fletcher, "Practical methods of Optimization", Wiley, 2000
3. Jonathan L Grosss, Jay Yellen, Chapmamn and Hall, "Graph theory and its application", 2e,CRC pub,
4. Alan Tucker, "Applied Combinatorics", John wiley and Sons
5. Dimitri P. Bertsekas, "Nonlinear programming", Athena Scientific
6. Belegundu, "Optimization Concepts and Applications in Engineering", Prentice Hall, 2000

COURSE PLAN

COURSE CODE:	COURSE TITLE	CREDITS	
04 EC 6122	OPTIMIZATION TECHNIQUES	**3-0-0:3**	
MODULES		**Contact Hours**	**Sem. Exam Marks (%)**
MODULE 1: Unconstrained optimization: Necessary and sufficient conditions for local minima, one dimensional search methods. Gradient methods - steepest descent, Inverse Hessian, Newton's method, conjugate direction method, conjugate gradient algorithm, quasi Newton methods.		8	15
MODULE 2: Linear Programming: Convex polyhedra, standard form of linear programming, Basic solutions.		8	15
INTERNAL TEST 1 (MODULE 1 & 2)			
MODULE 3: Simplex algorithm, Matrix form of the simplex algorithm, Duality, non-simplex methods :Khachiyan method, Karmarkar's method.		8	15
MODULE 4: Nonlinear Constrained Optimization: Equality constraints – Lagrange multipliers, inequality constraints – Kuhn-Tucker conditions. Convex optimization, Geometric programming, Projected gradient methods, Penalty methods		8	15
INTERNAL TEST 2 (MODULE 3 & 4)			
MODULE 5: Introduction to Graph Theory and Combinatorial Optimization: Routing-traveling salesman; Assignment – satisfiabilty, constraint saisfiabilty.		5	20
MODULE 6: Graph coloring; Subsets- set covering, partitioning; Scheduling; Shortest path and Critical path algorithms.		5	20
END SEMESTER EXAM			

COURSE CODE	COURSE NAME	L-T-P:C	YEAR
04 EC 6124	MULTIRATE SYSTEMS AND WAVELETS	3-0-0:3	2015

Pre-requisites: Digital Signal Processing

Course Objectives:

- To impart the fundamental concepts of multirate systems and various types of filterbanks
- To impart the basic concepts in STFT, wavelets and its application in communication engineering

Syllabus

Fundamentals of Multirate Digital Signal Processing, Filter banks- QMF filter banks ,Cosine modulated filter banks, Short time Fourier Transform and Wavelets,Discrete Wavelet transform, Multi-resolution formulation of Wavelet systems and Wavelet applications, Filter banks and the DWT, Wavelet packets,Application of wavelet theory in communication systems.

Course Outcome:

Students who successfully completed this course would be able to design sampling rate alteration devices and the various types of filter banks. They would also be equipped with the knowledge of wavelet transform and its implementation using filter-banks, which would enable them to apply it in typical applications in communication engineering

Text books:

1. P P. Vaidyanathan, “Multirate Systems and Filter Banks”, Pearson Education
2. G.Strang and T Q Nguyen, “Filter banks and Wavelets”, Wellesly Cambridge press

References:

1. R E Crochiere, L E Rabiner, “Multirate Digital Signal Processing”, Prentice Hall.. N J Fliege, “Multirate Digital Signal Processing”, Wiley Inter Science.
2.Frederic J Harris.”Multirate Signal Processing for communication systems”, Pearson Education
3. S K Mitra,”Digital Signal Processing: A computer based approach”, Tata-McGraw Hill
4. C S Burrus, R A Gopinath, H. Guo, “Introduction to Wavelets and Wavelet
Transforms: A primer”, Prentice Hall.
5.K.P.Soman,N.G. Reshmi, K.I.Ramachandran , “Insight into wavelets:Theory and practice”:Prentice Hall

COURSE PLAN

COURSE CODE:	COURSE TITLE	CREDITS	
04 EC 6124	MULTIRATE SYSTEMS AND WAVELETS	3-0-0:3	
MODULES		**Contact Hours**	**Sem. Exam Marks (%)**
MODULE 1: Fundamentals of Multirate Theory: The sampling theorem - sampling at sub-Nyquist rate - Basic Formulations and schemes- Basic Multirate operations-Decimation and Interpolation, Sampling rate alteration by an integer factor - Down sampler - Time and frequency domain characterization of downsampler – Anti-aliasing filter and decimation system – Sampling rate increase by an integer factor. Upsampler –Time and frequency domain characterization of upsampler – Anti-imaging filter and interpolation system – Gain of anti-imaging filter – Changing the sampling rate by rational factors		6	15
MODULE 2: Transposition theorem-Multirate identities - Direct and Transposed FIR structures for interpolation and decimation filters – The Polyphase decomposition - Polyphase implementation of decimation and interpolation filters. Commutator models - Multistage implementation of sampling rate conversion – Filter requirements for multistage designs – Overall and individual filter requirements		5	15
INTERNAL TEST 1 (MODULE 1 & 2)			
MODULE 3: Filter banks: QMF filter banks – Two channel SBC filter banks – Subband coding of speech signals- Standard QMF banks – Filter banks with PR – Conditions for PR –Cosine modulated filter banks with PR - Biorthogonal and Linear phase filter banks with PR - Transmultiplexer filter banks –Uniform M channel filter banks		9	15
MODULE 4: Fourier transform,Short-time(windowed) Fourier transform, Filtering interpretation of STFT – Filter bank implementation - Time frequency resolution tradeoff –Sampling of STFT in time and frequency, Wavelets - The basic functions, Specifications, Admissibility conditions, Continuous wavelet transform (CWT)		5	15
INTERNAL TEST 2 (MODULE 3 & 4)			
MODULE 5: Discrete Wavelet transform – dyadic sampling, Multi-resolution formulation of Wavelet systems, Wavelet decomposition and reconstruction of functions in L2(R), Scaling function and wavelet function – dilation equation - Fast wavelet transform algorithms –Lifting scheme		9	20
MODULE 6: Filter banks and the DWT - Analysis – from fine scale to coarse scale, Synthesis – from coarse scale to fine scale –Synthesis tree. Wavelet packets– Wavelet packet algorithms – Application of wavelet theory in signal denoising,Image and video compression. Application to communication systems– OFDM multicarrier communication, Wavelet packet based MCCS		8	20
END SEMESTER EXAM			

COURSE CODE	COURSE NAME	L-T-P:C	YEAR
04 EC 6192	MINIPROJECT	0-0-4:2	2015

COURSE CODE	COURSE NAME	L-T-P:C	YEAR
04 EC 6194	COMMUNICATION SYSTEMS AND NETWORKING LAB	0-0-2:1	2015

Prerequisites:NIL

Course objectives

The student will be able to

- Design a communication system for band limited channels
- Familiarize with the various passband modulation techniques
- To model and simulate various multipath fading channels
- To perform channel estimation in OFDM frequency selective fading channels
- To gain an insight into the various communication networking techniques
- To model and simulate wireless networks, simple sensor networks and mobile adhoc networks
- **EXPERIMENTS**

1. Communication system Design for Band limited Channels - Signal Design for Zero ISI (Ideal Nyquist channel) and Controlled ISI - Partial Response Signalling.
2. Digital passband Modulation techniques -BER of coherent binary modulation schemes -BPSK, BFSK & BASK
3. Digital passband Modulation techniques -coherent M-ary Modulation techniques-QPSK, QAM, 8-PSK,16-PSK etc.
4. Non coherent orthogonal modulation schemes-Simulation of NC-BFSK, DPSK.
5. ModelingandSimulationofRadioChannelsMultipathFadingChannels-Jake'sModel
6. Frequencynon-selective and
7. OFDM system simulation, BER performancein fading channels
8. Channel estimationin OFDM frequency selective fading channels realization.
9. Synchronization in OFDM
10. Ethernet and Token Ring simulation and Evaluation
11. SchedulingandQueuingDisciplinesinPacketSwitchedNetworks:FIFO,FairQueuing, RED
12. TCP Performanceanalysiswith and without RED.
13. Modellingof Wireless Networks: Physical layerand MAC layer
14. Simple SensorNetworks Simulation and Evaluation
15. Mobile AdhocNetwork Simulation and Evaluation

COURSE OUTCOME

The students would be able to analyse the various aspects pertaining to communication systems and networking.

SEMESTER III

ELECTIVE IV

COURSE CODE	COURSE NAME	L-T-P:C	YEAR
04 EC 7101	SIGNAL COMPRESSION	3-0-0:3	2015

Pre-requisites: nil

Course Objectives:

- To impart the fundamental concepts in lossless compression
- To introduce the principles of lossy coding
- To uncover the principles of vector quantization and differential encoding
- To impart the knowledge on transform coding, sub-band coding, wavelet based compression and audio coding

Syllabus:

Lossless compression, lossy coding, Scalar Quantization, Vector quantization, Differential Encoding, Transform Coding, Sub band coding: Wavelet Based Compression: Audio coding.

Course Outcome:

Students who successfully completed this course would have gained an insight into the fundamental concepts in lossless compression and lossy coding. They would be also be able to design a coder using Vector quantization, Differential Encoding and transform coding. They would be equipped with the knowledge of wavelet based compression which would enable them to apply it in audio coding and image coding.

Text books:

1. KhalidSayood, “Introduction to Data Compression”, 3/e, Elsevier

References:

1. David Salomon, “Data Compression: The Complete Reference”, Springer.

2. Thomas M. Cover, Joy A. Thomas, “Elements of Information Theory," Wiley

3. Ali N. Akansu, Richard A. Haddad, “Multiresolution Signal Decomposition: Transforms, Sub bands and Wavelets”, Academic Press, 1992.

COURSE PLAN

COURSE CODE:	COURSE TITLE	CREDITS	
04 EC 7101	SIGNAL COMPRESSION	3-0-0:3	
MODULES		**Contact Hours**	**Sem. Exam Marks (%)**
MODULE 1: Lossless Compression, Self information, average information, models, uniquely decodable codes, prefix codes, Kraft-McMillan inequality. Huffman coding, extended Huffman coding, non-binary Huffman coding; arithmetic coding – coding a sequence, generating a binary code.		6	15
MODULE 2: Dictionary techniques –LZ77, LZ78, LZW; context-based compression – ppm, Burrows-Wheeler transform Lossy Coding: Distortion criteria, conditional entropy, average mutual information, differential entropy.		8	15
INTERNAL TEST 1 (MODULE 1 & 2)			
MODULE 3: Rate distortion theory; rate distortion theorem, converse of the rate distortion theorem, models. Scalar Quantization: uniform, adaptive, non-uniform, entropy-coded quantization.		6	15
MODULE 4: Vector Quantization, Advantages over scalar quantization, LBG algorithm, tree structured and structured vector quantizers, trellis-coded quantization. Differential Encoding: basic algorithm, prediction in DPCM, adaptive DPCM, delta modulation, speech coding – G.726.		8	15
INTERNAL TEST 2 (MODULE 3 & 4)			
MODULE 5: Transform Coding, Introduction, Karhunen-Loeve transform, discrete cosine transform, discrete Walsh Hadamard transform, Quantization and coding of transform coefficients, JPEG, MDCT.		8	20
MODULE 6: Subband coding: filters, basic subband-coding algorithm. Wavelet Based Compression: multiresolution analysis, image compression, EZWcoder, SPIHT, JPEG 2000. Audio coding:-MPEG audio coding.		6	20
END SEMESTER EXAM			

COURSE CODE	COURSE NAME	L-T-P:C	YEAR
04 EC 7103	NETWORK ADMINISTRATION	3-0-0:3	2015

Pre-requisites: Nil

Course Objectives:

To give the Student:-

- To impart knowledge based on logical addressing and I/O functions
- To develop an idea about various addressing modes in IP
- To provide knowledge regarding different transport layer functions
- To discuss various debugging tools used in IP

Syllabus:

Advanced I/O functions, Socket functions, Broadcasting and Multicasting, Advanced UDP sockets, Advanced SCTP sockets and raw sockets

Course Outcome:

Students who successfully complete this course will learn about the advanced I/O functions, socket functions. Understand the concepts of broadcasting and multicasting. To provide an insight into different types of sockets.

Text books:

1. W. R. Stevens, B. Fenner, A. M. Rudoff, “UNIX Network Programming”, vol. 1, 3/e, Pearson Education.

References :

1. G. R. Wright, W. R. Stevens, “TCP/IP illustrated”, vol. 2, Pearson Education

COURSE PLAN

COURSE CODE:	COURSE TITLE	CREDITS	
04 EC 7103	NETWORK ADMINISTRATION	3-0-0:3	
MODULES		Contact Hours	Sem. Exam Marks (%)
MODULE 1: Advanced I/O functions: IPV4 and IPV6 interoperability, inetdsuper server, advanced I/O functions, UNIX domain protocols, Non-blocking I/O, ioctl operations, routing sockets, data link socket address structure, Reading and writing, sysctd operations, get-ifi-info function, interface name & index functions,		7	15
MODULE 2: Socket functions key management sockets: Reading and writing, dumping the security association database (SADB), creating a static security association (SA), dynamically maintaining SAs.		6	15
INTERNAL TEST 1 (MODULE 1 & 2)			
MODULE 3: Broadcasting:-Broadcast addresses, Unicast verses Broadcast, dg-cli function using broadcasting, race function		6	15
MODULE 4: Multicasting :- Multicasting addresses, multicasting verses broadcasting on a LAN, multicasting on a WAN, source-specified multicast, multicast socket options, mcast_join and related functions, dg_cli function using multicasting, receiving IP multicast infrastructure session announcements, sending and receiving, simple network time protocol.		7	15
INTERNAL TEST 2 (MODULE 3 & 4)			
MODULE 5: Advanced UDP sockets: receiving flags, destination IP addresses, interface index, datagram truncation, UDP verses TCP, adding reliability to UDP application, binding interface addresses, concurrent UDP services, IPV6 packet information, IPV6 path MTU control.		8	20
MODULE 6: Advanced SCTP sockets and raw sockets: auto closing, partial delivery, notification, unordered data, binding a subset of addresses, determining peer and local addresses, association of ID and IP addresses, peeling off and association, controlling timing SCTP verses TCP, Out_of_Banddata : TCP Out_of_Band data, socket:markfunction.Rawsockets:raw sockets creation, raw socket output, raw socket input, ping program, trace route program, ICMP message daemon.		8	20
END SEMESTER EXAM			

COURSE CODE	COURSE NAME	L-T-P:C	YEAR
04 EC 7105	FPGA BASED SYSTEM DESIGN	3-0-0:3	2015

Pre-requisites: Nil

Course Objectives:

To give the Student:-

- To learn the various programmable devices and their architecture
- To learn its technology mapping and routing

Syllabus:

Evolution of Programmable Devices, FPGA Technology, FPGA and Design Process, Technology Mapping for FPGAs, Mapping for FPGAs, Routing of FPGAs

Course Outcome:

Apply the basics of programmable devices, FPGA technology and design process. Students who successfully complete this course will get an idea of mapping and routing FPGAs;

Text books:

1. Stephen D. Brown, Robert J. Francis, Jonathan Rose and Zvonko G. Vranesic, "Field-Programmable Gate Arrays

References:

1. Wayne Wolf, "FPGA-Based System Design", Verlag: Prentice Hall
2. Wayne Wolf, "Modern VLSI Design: System-on-Chip Design", 3/e, Verlag

COURSE PLAN

COURSE CODE:	COURSE TITLE	CREDITS	
04 EC 7105	FPGA BASED SYSTEM DESIGN	3-0-0:3	
MODULES		Contact Hours	Sem. Exam Marks (%)
MODULE 1: Evolution of Programmable Devices Introduction to AND-OR structured Programmable Logic Devices, PROM, PLA, PAL and MPGAs, Combinational and sequential circuit realization using PROM based Programmable Logic Element (PLE), architecture of FPAD, FPLA, FPLS and FPID devices.		8	15
MODULE 2:FPGA Technology FPGA resources - Logic Blocks and Interconnection Resources, Economics and applications of FPGAs, Implementation Process for FPGAs. Programming Technologies, Static RAM Programming, Anti Fuse Programming, EPROM and EEPROM Programming Technology		7	15
INTERNAL TEST 1 (MODULE 1 & 2)			
MODULE 3: : FPGA and Design Process Commercially available FPGAs - Xilinx FPGAs, Altera FPGAs, FPGA . Design Flow Example - Initial Design Entry, Translation to XNF Format, Partitioning, Place and Route, Performance Calculation and Design Verification.		7	15
MODULE 4: Technology Mapping for FPGAs Logic Synthesis - Logic Optimization and Technology Mapping, Lookup Table Technology Mapping - Chortle-crf Technology Mapper, Chortle-d Technology Mapper, Lookup Table Technology Mapping in mis-pga		6	15
INTERNAL TEST 2 (MODULE 3 & 4)			
MODULE 5: Mapping for FPGAs Lookup Table Technology Mapping in Asyl and Hydra Technology Mapper; Multiplexer Technology Mapping - Multiplexer Technology Mapping in mis-pga. Design Flow Example - Initial Design Entry, Translation to XNF Format, Partitioning, Place and Route, Performance Calculation and Design Verification.		7	20
MODULE 6: Routing for FPGAs Routing Terminology; Strategy for routing in FPGAs; Routing for Row-Based FPGAs. Logic Block Architecture: Logic Block Functionality versus Area-Efficiency - Logic Block Selection, Experimental Procedure, Logic Block Area and Routing Model and Results. - Segmented channel routing, 1-channel routing algorithm, K – channel routing algorithm and results.		7	20

COURSE CODE	COURSE NAME	L-T-P:C	YEAR
04 EC 7207	PATTERN RECOGNITION	3-0-0:3	2015

Pre-requisites: Nil

Course Objectives:

- To develop a good understanding of the various pattern recognition/ classification and clustering techniques and algorithms

Syllabus

Bayes' Decision theory Estimation of unknown probability density functions, Linear and Non-linear pattern recognition classification algorithms, Support Vector machines, Dimension reduction techniques, Gaussian mixture models, expectation maximization algorithms, Clustering algorithms

Course Outcome:

Students demonstrate a thorough understanding of fundamental concepts in pattern recognition (Bayesian decision theory, maximum likelihood estimation, bayesian estimation, EM algorithm, SVMs, clustering algorithms).

Text books:

1. SergiosTheodoridis, KonstantinosKoutroumbas, "Pattern Recognition", Academic Press, 2006.
2. Christopher M Bishop, "Pattern Recognition and Machine Learning", Springer 2007

References:

1. Richard O. Duda, Hart P. E., David G. Stork, "Pattern classification" , 2/e, John Wiley & Sons Inc., 2001
2. Earl Gose, Richard Johnsonbaugh, Steve Jost, "Pattern Recognition and Image Analysis", PHI Pvt. Ltd., NewDelhi-1, 1999.
3. Fu K. S., "Syntactic Pattern Recognition and Applications", Prentice Hall, Eaglewood Cliffs, N.J,
4. Andrew R. Webb, "Statistical Pattern Recognition", John Wiley & Sons, 2002.

COURSE PLAN

COURSE CODE:	COURSE TITLE	CREDITS	
04 EC 7207	PATTERN RECOGNITION	3-0-0:3	
MODULES		**Contact Hours**	**Sem. Exam Marks (%)**
MODULE 1: Introduction: features, feature vectors and classifiers, Supervised versus unsupervised pattern recognition, Statistical pattern recognition Bayes' Decision theory, discriminant functions and decision surfaces, Bayesian classification for normal distributions, the nearest neighbour rule. Estimation of unknown probability density functions-Maximum Likelihood Parameter Estimation, Maximum a Posteriori Probability Estimation		9	15
MODULE 2: The perceptron algorithm, Multilayer feed forward neural networks Back propagation algorithm, Radial basis function networks.		8	15
INTERNAL TEST 1 (MODULE 1 & 2)			
MODULE 3: Gaussian mixture models, Expectation maximization ,K-means algorithm		6	15
MODULE 4: Support Vector machines, Separable Classes, Non separable Classes Combining classifiers, Receiver Operating Characteristics (ROC) curve, Class separability measures, The Bayesian information criterion		8	15
INTERNAL TEST 2 (MODULE 3 & 4)			
MODULE 5: Basic concepts of Clustering, Applications of Cluster Analysis, Proximity Measures, Categories of Clustering Algorithms, Sequential Clustering Algorithms and Neural Network Implementations		8	20
MODULE 6: Hierarchical algorithms - Agglomerative algorithms, The Cophenetic Matrix, Divisive algorithms.Basics of Fuzzy Clustering Algorithms		8	20
END SEMESTER EXAM			

ELECTIVE V

COURSE CODE	COURSE NAME	L-T-P:C	YEAR
04 EC 7109	SOFT COMPUTING	3 – 0 – 0: 3	2015

Pre-requisites: Nil

Course Objectives:

To give the Student:-

- A foundation in the fundamentals of fluid mechanics;
- Practice in the analytical formulation of fluid mechanics problems using Newton's Laws of motion and thermodynamics;
- An introduction to experimental methods;

Syllabus

Supervised and unsupervised Learning Neural Networks, Fuzzy sets, Fuzzy Rules and Fuzzy Reasoning, Fuzzy Inference Systems, Derivative-based Optimization, Derivative-free Optimization, Adaptive Neuro-Fuzzy Inference Systems

Course Outcome:

Students who successfully complete this course will be able to understand the fundamental concepts of soft computing, apply the basic principles of neural network, fuzzy logic and neuro fuzzy inference systems to real world problems and apply suitable techniques for optimization problems.

Text Books:

S. N. Sivandan and S. N. Deepa "Priciples of soft computing", Wiley-India, second edition, 2011

References:

1. Satheeshkumar "Neural Networks: A class room approach", Tata McGraw Hill, Second Edition, 2012.

2. Timothy J Ross, "Fuzzy Logic with Engineering Applications", McGraw-Hill, 1997.

3. S. Rajasekaran, G. A. VijayalakshmiPai , "Neural Networks, Fuzzy Logic and Genetic Algorithms: Synthesis and Applications". Prrentice Hall of India,2010

4. J.S.R.Jang, C.T.Sun and E.Mizutani, "Neuro-Fuzzy and Soft Computing", PHI, 2004, Pearson Education 2004

COURSE PLAN

COURSE CODE:	COURSE TITLE	CREDITS	
04 EC 7109	SOFT COMPUTING	3-0-0:3	
MODULES		Contact Hours	Sem. Exam Marks (%)
MODULE 1: Supervised Learning Neural Networks:-Perceptrons-Multilayer perceptrons-Backpropagation- Radial Basis Function Networks.		7	15
MODULE 2: Unsupervised Learning Neural Networks:-Competitive Learning Networks – Kohonen Self-Organizing Networks –Learning Vector Quantization – Hebbian Learning.		7	15
INTERNAL TEST 1 (MODULE 1 & 2)			
MODULE 3: Fuzzy Sets:-Basic Definition and Terminology – Set-theoretic Operations – Member Function Formulation and Parameterization.		6	15
MODULE 4: Fuzzy Rules and Fuzzy Reasoning:-Extension Principle and Fuzzy Relations – Fuzzy If- Then Rules – Fuzzy Reasoning. Fuzzy Inference Systems – Mamdani Fuzzy Models – Sugeno Fuzzy Models – Tsukamoto Fuzzy Models–Input Space Partitioning and Fuzzy Modeling		6	15
INTERNAL TEST 2 (MODULE 3 & 4)			
MODULE 5: Derivative-based Optimization:-Descent Methods – The Method of Steepest Descent –Classical Newton's Method. Step Size Determination – Derivative-free Optimization –Genetic Algorithms. Simulated Annealing – Random Search – Downhill Simplex Search		10	20
MODULE 6: 6Neuro Fuzzy Modeling:-Adaptive Neuro-Fuzzy Inference Systems – Architecture – Hybrid Learning Algorithm. Learning Methods that Cross-fertilize ANFIS and RBFN – Coactive Neuro Fuzzy Modeling. Framework Neuron Functions for Adaptive Networks – Neuro Fuzzy Spectrum.		6	20
END SEMESTER EXAM			

COURSE CODE	COURSE NAME	L-T-P:C	YEAR
04 EC 7111	ADAPTIVE FILTERS AND SYSTEMS	3 – 0 – 0: 3	2015

Pre-requisites: Nil

Course Objectives:

- To provide an insight to the various aspects of adaptive filters and systems;
- To provide an introduction to adaptive filtering algorithms;

Syllabus:

Introduction to adaptive filters; Optimum Filtering; Linear prediction; Gradient-based adaptive filters; The LMS algorithm and variations on the LMS algorithm; Least-Squares Problem; Recursive Least Squares (RLS) algorithms.

Course Outcome:

Students who successfully complete this course will have an insight to the various aspects of adaptive filters and systems; Basic idea about adaptive filtering algorithms.

Text Books:

1. A. H. Sayed, Adaptive Filters, John Wiley & Sons, NJ, 2008.

2. Simon Haykin, Adaptive Filter Theory, Pearson Education India, 2005

References:

1. http://iracema.icsl.ucla.edu/.

COURSE PLAN

COURSE CODE:	COURSE TITLE	CREDITS	
04 EC 7111	ADAPTIVE FILTERS AND SYSTEMS	3-0-0:3	
MODULES		Contact Hours	Sem. Exam Marks (%)
MODULE 1: Introduction to adaptive filters, Review and background, Stochastic processes, Linear Algebra, Basics of estimation and detection theory		7	15
MODULE 2: Optimum Filtering, The normal equations, Minimum mean square error estimation and the orthogonality principle, Linear prediction, Applications and Design Examples.		7	15
INTERNAL TEST 1 (MODULE 1 & 2)			
MODULE 3: Gradient-based adaptive filters, Steepest descent, Newton's Method, Applications and Design Examples.		7	15
MODULE 4: The LMS algorithm, Gradient estimation, Variations on the LMS algorithm, Applications and Design Examples.		7	15
INTERNAL TEST 2 (MODULE 3 & 4)			
MODULE 5: Least-Squares Problem, Weighted Least-Squares, Regularized Least-Squares, Applications and Design Examples.		7	20
MODULE 6: Recursive Least Squares (RLS) algorithms, Exponentially weighted RLS, Applications and Design Examples.		7	20
END SEMESTER EXAM			

COURSE CODE	COURSE NAME	L-T-P:C	YEAR
04 EC 7113	RECENT TRENDS IN COMMUNICATION ENGINEERING	3-0-0:3	2015

Pre-requisites: Basic Wireless communication theory and systems

Course Objectives:

- To impart knowledge about new developments in communication engineering.
- To learn the concepts of software defined and cognitive radios
- To learn the concepts of orthogonal frequency division modulation.
- To learn about Multiple input multiple output systems
- To learn cooperative communication aspects
- To understand the working principles of mobile handset

Syllabus

To familiarize with modern trends in communication like software defined radio, cognitive radio, co-operative communication, OFDM, MIMO and various design considerations of receiver handsets.

Course Outcome:

Students who successfully complete this course will have demonstrate an ability to understand the latest trends in communication technology. This course will develop an ability to effective design, and efficient system performance especially under challenging channel conditions.

Text books:

1.Paul Burns, Software Defined Radio for 3G, Artech House, 2002.

References:

1. JoukoVanakka, Digital Synthesizers and Transmitter for Software Radio, Springer, 2005.
2. PKenington, RF and Baseband Techniques for Software Defined Radio, Artech House, 2005.
3. Kwang-Cheng Chen, Ramjee Prasad , Cognitive Radio Networks, Wiley
4. David Tse and PramodViswanath, “Fundamentals of Wireless Communication”, Cambridge University Press, 2005.
5. Ahmad R.S. Bahai, B.R. Saltzberg, M. Ergen, “ Multi carrier Digital Communications- Theory and Applications of OFDM”, Second Edition, Springer.
6. Y. Li. G. Stuber, “ OFDM for Wireless Communication”, Springer, 2006.
7. R. Prasad, “ OFDM for Wireless Communication”, Artech House, 2006.
8. Tony J Rouphael, RF and DSP for SDR, Elsevier Newnes Press, 2008.
9. Theodore.S.Rappaport, Wireless Communications-Principles and practice, Prentice Hall Communications Engineering and Emerging Technologies Series, Upper Saddle River, New Jersey 07458, 1996.
10. Cooperative Communications and Networking- K. J. Ray Liu, Ahmed K. Sadek, Weifeng Su and Andres Kwasinsk, Cambridge University Press.

11. MartynMallick, Mobile and Wireless Design Essentials, Wiley Dreamtech India pvt ltd., 2003 . 13.Geoff Varall, Roger Belcher,3G Handset & Network Design, WileyDreamtech India pvt ltd., 2003
12. Sajal K Das, Mobile Handset Design, John Wiley & Sons (Asia) Pvt. Ltd. 2010.

COURSE PLAN

COURSE CODE:	COURSE TITLE	CREDITS	
04 EC 7113	RECENT TRENDS IN COMMUNICATION ENGINEERING	3-0-0:3	
MODULES		Contact Hours	Sem. Exam Marks (%)
MODULE 1: Software radio concepts, Design principles, Receiver front end topologies, Noise and Distortion in RF chain, Basic Software Defined Radio Block Diagram- System Level Functioning, Object oriented software radios, Direct digital synthesizers, Pulse shaping and interpolation filters, DDS with tunable DSM, Transmitter and receiver architectures.		8	15
MODULE 2: Cognitive Radios and Dynamic Spectrum Access. Analytical Approach and Algorithms for Dynamic Spectrum Access. Fundamental Limits of Cognitive Radios. Mathematical Models toward Networking Cognitive Radios. Spectrum Sensing to Detect Specific Primary System. Spectrum Sensing for Cognitive Multi-Radio Networks. Spectrum Sharing. Spectrum Pricing. Mobility Management of Heterogeneous Wireless Networks. Regulatory Issues and International Standards.		6	15
INTERNAL TEST 1 (MODULE 1 & 2)			
MODULE 3: Diversity and MIMO: Diversity modelling for Wireless Communications. Types of Diversity – Frequency, Time, Space, BER Performance improvement with diversity, Introduction to MIMO, MIMO Channel Capacity, SVD and Eigen modes of the MIMO Channel, MIMO Spatial Multiplexing – BLAST, MIMO Diversity – Alamouti, OSTBC, MRC.		6	15
MODULE 4: Introduction to OFDM, Multicarrier Modulation and Cyclic Prefix, OFDM through frequency selective fading channels, OFDM Issues – PAPR, Frequency and Timing Offset issues, Fundamentals of MIMO-OFDM.		6	15
INTERNAL TEST 2 (MODULE 3 & 4)			
MODULE 5: Cooperative communications, Cooperation protocols, Cooperative communications with single relay-System model- Amplify and forward (AF) and Decode and Forward (DF) relaying. Distributed space and time relaying systems, Distributed space–frequency coding (DSFC). Energy efficiency in cooperative sensor networks- System model, Cooperative cognitive multiple access (CCMA) protocols.		8	20

MODULE 6: WiMAX, LTE, Spectral Allocations, Impact On Handset Hardware Design, GPRS/EDGE – Handset Hardware Design Issues For Multi slot, Multi band, Multimode Phones Transmitter Architectures, General considerations, Circuit examples, CDMA, UMTS radio architectures. Anatomy of a GSM Mobile Handset- Functional Blocks Inside a GSM Mobile Phone- Hardware Block Diagram of a Mobile Phone- GSM Transmitter and Receiver Module, Connectivity Modules- Battery- Clocking Scheme- Alert Signal Generation- Memory- GSM Receiver Performance.	8	20
END SEMESTER EXAM		

COURSE CODE	COURSE NAME	L-T-P:C	YEAR
04 EC 7115	MODERN SATELLITE COMMUNICATION	3 – 0 – 0: 3	2015

Pre-requisites: Principles of Analog and Digital Communication System

Course Objectives:

To give the Student:-

- An understanding of different concepts used in a satellite communication
- An understanding of various aspects of satellite communication like orbital mechanics, launching techniques, satellite link design, earth station technology and different access system of a satellite
- An understanding of tools necessary for the calculation of basic parameters in a satellite communication system;

Syllabus

Basic principles, Satellite orbits, Radio Frequency requirements and parameters, Antenna design requirements and parameters, Satellite construction (space segment), Satellite links, Earth station (earth segment), Space segment access and utilization, Role and application of satellite communication.

Course Outcome:

Students who successfully complete this course will understand the fundamental concepts and mechanics of satellites in orbit; will demonstrate the ability to apply the link budget equations to design an appropriate satellite communication system; Determine the access system based on requirements and constraints of antenna, weather conditions and available wireless resources.

Text Books: Dennis Roddy, Satellite Communications, 4th Ed., Mc. Graw-Hill International Ed.

References:

Timothy Pratt, Charles W. Bostian, Satellite Communications, John Wiley & Sons.

W. L. Pritchard, J. A. Sciulli, Satellite Communication Systems Engineering, Prentice-Hall, Inc., NJ

COURSE PLAN

COURSE CODE:	COURSE TITLE	CREDITS	
04 EC 7115	MODERN SATELLITE COMMUNICATION	3-0-0:3	
MODULES		Contact Hours	Sem. Exam Marks (%)
MODULE 1: Introduction and Orbital Parameters:- General features, frequency allocation for satellite services, properties of satellite communication systems Introduction to orbits, Kepler's laws, orbital dynamics, orbital characteristics, satellite spacing and orbital capacity, angle of elevation Eclipses, launching and positioning, satellite drift and station keeping, Geostationary Orbit, limits of visibility. Earth eclipse, sun transit outage, launching orbits		7	15
MODULE 2: Radio Wave:-Atmospheric losses, Rain attenuation, Polarization: Antenna Polarization, Cross polarization, Ionosperic and Ice depolarization Antennas: Properties and Parameters of Antennas, Various Antennas and feed systems, Antenna Arrays for Satellite Communication systems		7	15
INTERNAL TEST 1 (MODULE 1 & 2)			
MODULE 3: Space Segment & Earth Station:- Space Segment: Introduction; Attitude and orbit control system; telemetry, tracking and command; power systems, Communication subsystems, antenna subsystem, equipment reliability and space qualification. Earth Station : Introduction, earth station subsystem, Different types of earth stations, MATV, Community Antenna TV System. Transmit-Receive Earth station		7	15
MODULE 4: Satellite Links:- General link design equation, EIRP, Transmission Losses, Link Power Budget Equation. System noise, C/N Ratio uplink design, downlink design, Complete link design, effects of rain.		7	15
INTERNAL TEST 2 (MODULE 3 & 4)			
MODULE 5: Space Segment Access and Utilization:-Space segment access methods: Single access, Pre assigned FDMA, Demand Assigned FDMA, SPADE TDMA, Satellite Switched TDMA ,CDMA		7	20
MODULE 6: Module 6: Applications of Satellite Communication:- DBS, MPEG Compression Standards, FEC, Receiver outdoor and indoor units, Downlink Analysis, Uplink, HDTV, Satellite Mobile Services, VSAT, RADARSAT, GPS, Orbcomm		7	20
END SEMESTER EXAM			

COURSE CODE	COURSE NAME	L-T-P:C	YEAR
04 EC 7191	SEMINAR	0 -0-2: 2	2015

Students have to register for the seminar and select a topic in consultation with any faculty member offering courses for the programme. He / She shall choose the topic based on the references from international journals of repute, preferably IEEE journals. A detailed write-up on the topic of the seminar is to be prepared in the prescribed format given by the Department. The seminar shall be of 30 minutes duration and a committee with the Head of the department as the chairman and two faculty members from the department as members shall evaluate the seminar based on the coverage of the topic, presentation and ability to answer the questions put forward by the committee.

COURSE CODE	COURSE NAME	L-T-P:C	YEAR
04 EC 7193	PROJECT PHASE I	0 -0-12: 6	2015

Project work is to be carried out in the third and fourth semesters. Project work is to be evaluated both in the third and the fourth semesters. Based on these evaluations the grade is finalised in the fourth semester.

In Master's Project Phase-I, the students are expected to select an emerging research area in the field of specialization. After conducting a detailed literature survey, they should compare and analyze research work done and review recent developments in the area and prepare an initial design of the work to be carried out as Master's Project. It is mandatory that the students should refer National and International Journals and conference proceedings while selecting a topic for their Project. He/She should select a recent topic from a reputed International Journal, preferably IEEE/ACM. Emphasis should be given for introduction to the topic, literature survey, and scope of the proposed work along with some preliminary work carried out on the Project topic.

Project evaluation weights shall be as follows:-

Total marks for the Project: 150

In the 3rd Semester:- Marks:50
Project Progress evaluation:
Progress evaluation by the Project Supervisor : 20 Marks
Presentation and evaluation by the committee : 30 Marks

Students should submit a copy of Phase-I project report covering the content discussed above and highlighting the features of work to be carried out in Phase-II of the project. The candidate should present the current status of the Project work and the assessment will be made on the basis of the work and the presentation, by a panel of internal examiners in which one will be the internal guide. The examiners should give their suggestions in writing to the students so that it should be incorporated in the Phase–II of the project.

SEMESTER IV

COURSE CODE	COURSE NAME	L-T-P:C	YEAR
04 EC 7194	PROJECT PHASE II	0 -0-21: 12	2015

In the fourth semester, the student has to continue the Project work and after successfully finishing the work, he / she has to submit a detailed bounded Project report. The work carried out should lead to a publication in a National / International Conference or Journal. The papers received acceptance before the M.Tech evaluation will carry specific weightage.

TOTAL MARKS:100

Project evaluation by the supervisor/s : 30 Marks

Evaluation by the External expert : 30 Marks

Presentation & evaluation by the Committee : 40 Marks