M. Tech. DEGREE

COMMUNICATION SYSTEMS

SYLLABUS

FOR

CREDIT BASED CURRICULUM

(2009 -2010)

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

NATIONAL INSTITUTE OF TECHNOLOGY

TIRUCHIRAPPALLI – 620 015, INDIA.

CURRICULUM

I-SEMESTER

CODE	COURSE OF STUDY	L- T- P- C
EC601	Probability and Stochastic Processes	3 – 0 – 0 – 3
EC603	Advanced Digital Signal Processing	3 – 0 – 0 – 3
EC605	High Speed Communication Networks	3 – 0 - 0 – 3
EC607	Microwave Circuits	3 – 0 - 0 – 3
	Elective – 1	3 – 0 - 0 – 3
	Elective – 2	3 – 0 - 0 – 3
EC609	Microwave and MIC Laboratory	0 – 0 - 3 – 2
		18 - 0 - 3 – 20

II-SEMESTER

EC602	Advanced Digital Communication	3 - 0 - 0 – 3
EC604	Broadband Wireless Technologies	3 -0 - 0 – 3
EC606	Optical Communication Systems	3 - 0 - 0 –3
	Elective – 3	3 - 0 - 0 – 3
	Elective – 4	3 - 0 - 0 – 3
	Elective – 5	3 - 0 - 0 –3
EC608	Fiber Optics and Communication Laboratory	0 - 0 - 3 – 2
EC610	Signal Processing Laboratory	0 - 0 - 3 – 2
		18 –0 –6 –22

III-SEMESTER

EC647	Project - Phase I	**0 - 0– 24 – 12**

IV-SEMESTER

EC648	Project - Phase II	**0 - 0 –24 – 12**

ELECTIVES

I-SEMESTER

EC611	Ad Hoc Networks	3 – 0 - 0 – 3
EC615	Digital Image Processing	3 – 0 – 0 – 3
EC659	Modeling and Synthesis with Verilog HDL	3 - 0 - 0 – 3
EC661	Digital Signal Processing structures for VLSI	3 - 0 - 0 – 3

II- SEMESTER

EC612	Architecture of DSPs	3 – 0 – 0 – 3
EC614	Spectral Analysis of Signals	3 – 0 – 0 – 3
EC616	RF MEMS	3 – 0 – 0 – 3
EC618	Smart Antennas	3 – 0 – 0 – 3
EC656	Designing with ASICs	3 - 0 - 0 – 3
EC662	FPGA – based System Design	3 – 0 – 0 – 3

ADDITIONAL ELECTIVES APPROVED BY BoS

EC620	Detection and Estimation	3 - 0 - 0 – 3
EC622	Wavelet Signal Processing	3 - 0 - 0 – 3
EC624	WDM Optical Networks	3 – 0 – 0 – 3
EC626	Advanced Techniques for Wireless Reception	3 – 0 – 0 – 3
EC628	Error Control Coding	3 - 0 - 0 – 3
EC630	Digital Communication Receivers	3 - 0 - 0 – 3
EC632	Analysis and Design of Planar Transmission Lines	3 - 0 - 0 – 3
EC676	Mixed - Signal Circuit Design	3 – 0 – 0 – 3

EC601 Probability and Stochastic Processes (3-0-0) 3

Vector space, Inner product space, norm, Hilbert spaces. Projection theorem. Separable Hilbert spaces and orthonormal bases. Linear functionals. Riesz representation theorem.

Probability spaces. Random variables and random vectors. Distributions and densities. Statistical independence. Expectations, moments and characteristic functions. Infinite sequences of random variables. Convergence concepts. Laws of large numbers.

Radon-Nikodym theorem. Conditional expectations given a σ-field and a random vector. Jensen's inequality.

Stochastic processes. Separability and measurability. Continuity concepts. Gaussian processes and Wiener processes. Second order processes. Covariance functions and their properties. Linear operations and second order calculus. Orthogonal expansions.

Stationarity in the strict and wide senses. Ergodicity in the q.m.sense. Widesense stationary processes. Herglotz's and Bochner's theorems. Spectral representation. L^2- stochastic integrals. Spectral decomposition theorem. Low-pass and band-pass processes. White noise and white-noise integrals.

Text Books:

1. *A.Papoulis, S.U.Pillai, "Proabability, Random variables and Stochastic processes" 4th edition Tata-Mc Hill (4/e) ,2001*
2. *R.B.Ash & C.Doleans-Dade, Probability and Measure Theory (2/e), Elsevier, 2005*

Reference Books:

1. *E.Wong & B.Hajek, Stochastic Processes in Engineering systems, Springer, 1985*
2. *R.B.Ash & W.A.Gardner, Topics in stochastic processes, Academic Press, 1975.*
3. *Stakgold, I., Green's Functions and Boundary value Problems (e), Wiley,1998*

EC603 Advanced Digital Signal Processing (3-0-0) 3

Review of sampling theory. Sampling rate conversion by integer and rational factors. Efficient realization and applications of sampling rate conversion.

Wiener filtering. Optimum linear prediction. Levinson- Durbin algorithm. Prediction error filters.

Adaptive filters. FIR adaptive LMS algorithm. Convergence of adaptive algorithms. Fast algorithms. Applications; Noise canceller, echo canceller and equalizer.

Recursive least – squares algorithms. Matrix inversion lemma. Convergence analysis of the RLS algorithm. Adaptive beam forming. Kalman filtering.

Spectrum estimation. Estimation of autocorrelation. Periodogram method. Nonparametric methods. Parametric methods.

Text Books:

1. *J.G.Proakis et al, Advanced Digital Signal Processing, McGraw –Hill,1992*
2. *S.Haykin, Adaptive Filter Theory (3/e), Prentice- Hall,1996*

Reference Books:

1. *D.G.Manolakis et al, Statistical and Adaptive Signal Processing, McGraw-Hill,2005*
2. *Marple, Spectral Analysis,*
3. *M.H.Hays, Statistical Digital Signal Processing and Modeling, John-Wiley.*

EC605 High Speed Communication Networks (3-0-0) 3

Broadband ISDN. Protocol reference model. SDH- basic features. ATM standard. Multistage networks.

Traffic models; delay and loss performance. Cell switching. Cell scale and burst scale queuing.

Protocol layers, their service and models.Internet protocol stack, link layer and local area networks. Network layer and routing.

Transport layer. Congestion control. Application layer protocols. Web and HTTP.FTP and e-mail. Mobile adhoc networking. Routing approaches.

Mobile ad hoc networking. Protocol performance and open issues. Clustering and hierarchial routing. Ad hoc network security.

Text Books:

1. *J.F.Kurose & K.W. Ross, Computer Networking,(3/e), Pearson Education,2005*
2. *A.Pattavina, Switching Theory, Wiley, 1998.*

Reference Books:

1. *S.Basagni, Mobile Ad Hoc Networking, Wiley,2004.*
2. *J.M.Pitts & J.A.Schormans, Introduction to IP and ATM Design and Performance (2/e), Wiley, 2000.*
3. *C.Siva Ram Murthy & B.S.Manoj, Adhoc Wireless Networks (2/e), Pearson Education, 2005.*

EC607 Microwave Circuits (3-0-0) 3

Two-port network characterization. Scattering matrix representation of microwave components.

Planar transmission lines; characteristics, properties ; design parameters and applications. Design of mixers.

MIC filters. Kuroda transformation, K inverter, J inverter. Resonator filters.Realization using microstrip lines and strip lines.

Microwave amplifier design. Power gain equations. Maximum gain design. Low noise design. High power design. Stability considerations.

Microwave oscillator design. One – port and two – port negative resistance oscillators. Oscillator design using large – signal measurements.

Text Books:

1. *I.J.Bhal & P.Bhartia, Microwave Solid state Circuit Design, Wiley, 2003.*
2. *S.Y.Liao, Microwave Amplifier and Oscillator Design, Pearson Education,2003.*

Reference Books:

1. *G.Gonzalez, Microwave Transistors and Amplifiers, Prentice- Hall, Englewoo Cliffs,1984*
2. *Annapoorna Das, Microwave Engineering, Tata McGraw Hill, 2000*
3. *Soohoo, Microwave Electronics, Addison Wesley.*

EC602 Advanced Digital Communication (3-0-0) 3

Baseband data transmission. Nyquist criterion for zero ISI. Correlative level coding. Data detection. Optimum design of transmit and receive filters. Equalization. Linear, adaptive, fractionally spaced and decision feedback equalizers.

Digital modulation schemes. Carrier synchronization methods. Symbol timing estimation methods.

Linear block codes, cyclic codes; encoding and decoding. Non-binary codes. Convolutional codes. Decoding of convolutional codes.

Trellis coded modulation. Lattice type trellis codes. Turbo coding. Interleaver, turbo encoder, MAP decoder, Log MAP decoder. Performance measures.

D S and F H spread spectrum. CDMA system based on FH spread spectrum signals. Synchronization of spread spectrum signals.

Text Books:

1. *J.G.Proakis, Digital Communication (4/e), McGraw- Hill, 2001*
2. *S.Lin & D.J.Costello, Error Control Coding (2/e) Pearson, 2005*

Reference Books:

1. *S.Haykin, Communication Systems (4/e), Wiley,2001.*
2. *R.E.Zimer & R.L.Peterson : Introduction to Digital Communication, PHI, 2001.*
3. *L.Hanzo etal, Turbo Coding, Turbo Equalization & Space-Time Coding Wiley,2002.*

EC604 Broadband Wireless Technologies (3-0-0) 3

The Cellular concept, System design, Capacity improvement in cellular systems, Co channel interference reduction. Intelligent cell concept and applications

Mobile radio propagation, fading, diversity techniques, design parameters at the base station, smart antenna systems, Practical link budget design using path loss models

CDMA- Principle, Network design, Link capacity, Power control, RAKE receiver, Channel modeling. WCDMA-Network planning

MC-CDMA, Orthogonal frequency division multiplexing, OFDM with code division multiplexing, Cellular mobile communication beyond 3G

GSM, IS-95, GPRS, UMTS, WLAN, Bluetooth, beyond 4G

Text Books:

1. *S.G. Glisic, Adaptive CDMA, Wiley, 2003*
2. *A.F.Molisch, Wireless Communications, Wiley, 2005.*

Reference Books:

1. *K.Fazel & S. Kaiser, Multi-carrier and Spread Spectrum Systems, Wiley, 2003*
2. *S.G. Glisic, Advanced Wireless Communications, 4G Technologies, Wiley, 2004.*
3. *W.C.Y.Lee, Mobile Communication Engineering. (2/e), McGraw- Hill,1998.*

EC606 Optical Communication Systems (3-0-0) 3

Fundamentals of coherent systems: Basic concepts. Modulation and demodulation schemes. System performance.

Semiconductor optical amplifiers. EDFA and Raman amplifiers – modeling and analysis. Analysis and digital transmission with high power fiber amplifiers.

Multichannel systems: WDM lightwave systems. TDM and code division multiplexing. Advances in wavelength division multiplexing / demultiplexing technologies.

SONET/SDH, ATM, IP, storage area networks.Wavelength routed networks. Next generation optical Internets.

Soliton systems: Nonlinear effects. Soliton – based communication. High speed and WDM soliton systems.

Text Books:

1. *G.P.Agrawal, Fiber Optic Communication Systems (3/e), Wiley, 2002*
2. *B.P.Pal , Guided Wave Optical Components and Devices, Elsevier , 2006*

Reference Books:

1. *C.S.Murthy & M.Gurusamy, WDM Optical Networks, PHI, 2002*
2. *R.Ramaswami, K.N. Sivarajan, Optical Networks, (2/e), Elsevier, 2002.*
3. *G.P.Agrawal, Non linear Fiber Optics, (3/e), Elsevier, 2001.*

EC611 Ad Hoc Networks (3-0-0) 3

Mobile ad hoc networking; imperatives, challenges and characteristics. Bluetooth networks.

Routing approaches. Proactive and reactive protocols. Clustering and hierarchial routing. Multipath routing. Security aware routing.

Energy efficient communication in ad hoc networks. Measuring energy consumption. Power save protocols. Maximum life time routing.

Secure routing protocols. Intrusion detection. Security considerations in ad hoc sensor networks. Key management.

Characterization of IP traffic. QOS classification. Self similar processes. Statistical analysis of non – real time traffic and real – time services.

Text Books:

1. *S.Basagni & M.Conti, Mobile Ad Hoc Networking, Wiley, 2004*
2. *C.Perkins, Ad Hoc Networking, Addison Wesley, 2000.*

Reference Books:

1. *C.S. Murthy & B.S. Manoj, AdHoc Wireless Networks, Pearson, 2004.*
2. *T.Janevski, Traffic Analysis and Design of Wireless IP Networks, Artech House, 2003.*
3. *Ozan K. Tonguz & Gianluigi, Adhoc Wireless Networks, Wiley, 2006.*

EC615 Digital Image Processing (3-0-0) 3

Elements of Visual perception-Image sensing and Acquisition -Imaging in different bands-Digital Image Representation-Relationship between pixels-Image transformations: 2D-DFT, DCT, DST, Hadamard, Walsh, Hotelling transformation, 2D-Wavelet transformation, Wavelet packets.

Image Enhancements in spatial domain and Frequency domain. Image Restoration techniques. Color Image processing.

Error free compression: Variable length coding, LZW, Bit-plane coding-Bit-plane coding, Lossless predictive coding - Lossy compression: Lossy predictive coding, transform coding, wavelet coding. Image compression standards, CCITT, JPEG, JPEG 2000, Video compression standards.

Summary of morphological operations in Binary and Gray Images. Image segmentation: Point, Line and Edge segmentation. Edge linking and Boundary detection. Segmentation using thresholding, Region based segmentation-segmentation by morphological watersheds-Use of motion in segmentation.

Feature Extraction from the Image: Boundary descriptors, Regional descriptors, Relational descriptors.

Text Books:

1. *Rafael C.Gonzalez, Richard E.Woods, Digital Image processing, Pearson edition, Inc2/e, 2002.*
2. *Anil K.Jain, Fundamentals of Digital Image Processing, PHI,1995*

Reference Books:

1. *J.C. Russ, The Image Processing Handbook, (5/e), CRC, 2006*
2. *R.C.Gonzalez & R.E. Woods; Digital Image Processing with MATLAB, Prentice Hall, 2003*

EC612 Architecture of DSPs (3-0-0) 3

Architecture of TMS 320C54X processors. Addressing modes. Assembly instructions. Pipelining. Interrupts.

Clock generator. Timer. Serial ports. Parallel ports. Host-port interface (HPI). Comparison with TMS320C55X processor architecture and instruction set.

Architecture of TMS 320C67X processor. CPU data paths and control. Addressing modes. Instruction set. Pipeline operation.

Interfacing with serial I/O. A/D, D/A converters. Parallel interfacing. Interfacing with RAM, EEPROMs, FPGAs. Wait state generation. DSP tools: Assembler. Debugger. C compiler. Linker and loader.

VLIW Architecture. Multiprocessor DSPs, SHARC, SIMD, MIMD Architectures and Analog Devices DSPs. Applications: Digital Filter, Adaptive filter, Spectrum analyzer, Echo cancellation, Modem, Voice synthesis and recognition.

Text Books:

1. *B.Venkataramani & M.Bhaskar, Digital Signal Processor, Architecture, Programming and Applications,McGraw- Hill,2003*
2. *S.Srinivasan & Avtar Singh, Digital Signal Processing, Implementations using DSP Microprocessors with Examples from TMS320C54X, Brooks/Cole, 2004.*

Reference Books:

1. *N. Kehtarnavaz & M. Kerama, DSP System Design using the TMS320C6000, Printice Hall, 2001.*
2. *S.M. Kuo & B.H.Lee: Real-Time Digital Signal Processing, Implementations, Applications and Experiments with the TMS320C55X, John Wiley, 2001.*

EC614 Spectral Analysis of Signals (3-0-0) 3

Periodogram and correlogram. Blackman – Tukey, Bartlett, Welch and Daniel methods. Window design considerations.

Parametric methods for rational spectra. Covariance structure of ARMA processes. AR, MA and ARMA signals. Multivariate ARMA signals.

Parametric methods for line spectra. Models of sinusoidal signals in noise. Nonlinear least squares, high order Yule-Walker, min-norm, Pisarenko, MUSIC and ESPRIT methods.

Filter bank methods. Filter-bank interpretation of the periodogram. Refined filter-bank and Capon methods.

Spatial methods. Array model. Nonparametric methods; beam forming and Capon method. Parametric methods; nonlinear least squares, Yule-Walker, min-norm, Pisarenko, MUSIC and ESPRIT methods.

Text Books:

1. *P.Stroica & R.Moses, Spectral Analysis of signals, Pearson,2005*
2. *Marple, Introduction to Spectral Analysis, Prentice Hall.*

Reference Book:

1. *S.M.Key, Fundamentals of Statistical Signal Processing, Prentice Hall PTR, 1998*

EC616 RF MEMS **(3-0-0) 3**

RF MEMS relays and switches. Switch parameters. Actuation mechanisms. Bistable relays and micro actuators. Dynamics of switching operation.

MEMS inductors and capacitors. Micromachined inductor. Effect of inductor layout. Modeling and design issues of planar inductor. Gap tuning and area tuning capacitors. Dielectric tunable capacitors.

Micromachined RF filters. Modeling of mechanical filters. Electrostatic comb drive. Micromechanical filters using comb drives. Electrostatic coupled beam structures.

MEMS phase shifters. Types. Limitations. Switched delay lines. Micromachined transmission lines. Coplanar lines. Micromachined directional coupler and mixer.

Micromachined antennas. Microstrip antennas – design parameters. Micromachining to improve performance. Reconfigurable antennas.

Text Books:

1. *H.J.D.Santos, RF MEMS Circuit Design for Wireless Communications, Artech House , 2002.*
2. *G.M.Rebeiz , RF MEMS Theory , Design and Technology, wiley , 2003.*

Reference Book:

1. *V.K.Varadan etal, RF MEMS and their Applications, Wiley,2003*

EC618 Smart Antennas **(3-0-0) 3**

Spatial processing for wireless systems. Adaptive antennas. Beam forming networks. Digital radio receiver techniques and software radios.

Coherent and non-coherent CDMA spatial processors. Dynamic re-sectoring. Range and capacity extension – multi-cell systems.

Spatio – temporal channel models. Environment and signal parameters. Geometrically based single bounce elliptical model.

Optimal spatial filtering – adaptive algorithms for CDMA. Multitarget decision – directed algorithm.

DOA estimation – conventional and subspace methods. ML estimation techniques. Estimation of the number of sources using eigen decomposition. Direction finding and true ranging PL systems. Elliptic and hyperbolic PL systems. TDOA estimation techniques.

Text Books:

1. *T.S.Rappaport & J.C.Liberti, Smart Antennas for Wireless Communication, Prentice Hall (PTR) , 1999.*
2. *R.Janaswamy, Radio Wave Propagation and Smart Antennas for Wireless Communication, Kluwer, 2001.*

Reference Book:

1. M.J. Bronzel, Smart Antennas, John Wiley, 2004.

EC620 Detection and Estimation (3-0-0) 3

Binary hypothesis testing; Bayes, minimax and Neyman-Pearson tests. Composite hypothesis testing.

Signal detection in discrete time: Models and detector structures. Coherent detection in independent noise. Detection in Gaussian noise. Detection of signals with random parameters. Detection of stochastic signals. Performance evaluation of signal detection procedures.

Bayesian parameter estimation; MMSE, MMAE and MAP estimates. Nonrandom parameter estimation. Exponential families. Completeness theorem. ML estimation. Information inequality. Asymptotic properties of MLEs.

Discrete time Kalman- Bucy filter. Linear estimation. Orthogonality principle. Wiener-Kolmogorov filtering – causal and noncausal filters.

Signal detection in continous time:Detection of deterministic signals in Gaussian noise. Coherent detection in white Gaussian noise.

Text Books:

1. H.V.Poor, An Introduction to Signal Detection and Estimation (2/e) Springer, 1994.
2. H.L.Vantrees, Detection, Estimation and Modulation theory, Part I, Wiley.

Reference Books:

1. M.D.Srinath & P.K.Rajasekaran, Statistical Signal Processing with Applications, Wiley.
2. J.C.Hancock & P.A. Wintz, Signal Detection Theory, Mc-Graw Hill.

EC622 Wavelet Signal Processing (3-0-0) 3

Limitations of standard Fourier analysis. Windowed Fourier transform. Continous wavelet transform. Time-frequency resolution.

Wavelet bases. Balian-Low theorem. Multiresolution analysis. (MRA). Construction of wavelets from MRA. Fast wavelet algorithm.

Compactly supported wavelets. Cascade algorithm. Franklin and spline wavelets. Wavelet packets.
Hilbert space frames. Frame representation. Representation of signals by frames. Iterative reconstruction. Frame algorithm.

Wavelet methods for signal processing. Noise suppression. Representation of noise-corrupted signals using frames. Algorithm for reconstruction from corrupted frame representation. Wavelet methods for image processing. Burt- Adelson and Mallat's pyramidal decomposition schemes. 2D-dyadic wavelet transform.

Text Books:

1. *E.Hernandez & G.Weiss, A First Course on Wavelets, CRC Press, 1996.*
2. *L.Prasad & S.S.Iyengar, Wavelet Analysis with Applications to Image Processing, CRC Press, 1997.*

Reference Books:

1. *A.Teolis, Computational Signal Processing with Wavelets, Birkhauser, 1998*
2. *R.M. Rao & A.S. Bopardikar, Wavelet Transforms, Addition Wesely, 1998.*
3. *J.C. Goswami & A.K. Chan, Fundamentals of Wavelets, John Wiley,1999.*

EC624 WDM Optical Networks (3-0-0) 3

First generation optical networks. SONET/SDH. Computer interconnects. Metropolitan area networks. Layered architecture.

WDM optical network evolution. Enabling technologies. WDM optical network architecture. Wavelength routed networks.

Wavelength routing networks. Optical layer. Node designs. Network design and operations. Routing and wavelength assignment.

Wavelength convertible networks, performance evaluation. Networks with sparse wavelength conversion. Converter placement and allocation problems.

Virtual topology design problem, light path routes, implementation in broadcast and select networks.

Text Books:

1. *C.Sivaramamurthy & M.Gurusamy, WDM optical Networks, PHI, 2002.*
2. *R.Ramaswami& K.N.Sivarajan, Optical Networks (2/e), Elsevie,2002*

Reference Books:

1. *K.M.Sivalingam & S.Subramanium, Optical WDM Networks- Principles & Practice,*
2. *Kluwer Academic Publications, 2000.*
3. *T.E.Stern & K.Bala, Multiwavelength Optical Networks- A Layered Approach, (1/e), Printice Hall PTR, 1999.*
4. *B.Mukherjee, Optical Communication Networks, (1/e), McGraw Hill, 1997.*

EC626 Advanced Techniques for Wireless Reception (3-0-0) 3

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

Robust multiuser detection for non Gaussian channels; asymptotic performance , implementation aspects.

Adaptive array processing in TDMA systems. Optimum space-time multiuser detection. Turbo multiuser detection for synchronous and turbo coded CDMA.

Narrowband interface suppression. Linear and nonlinear predictive techniques. Code- aided techniques. Performance comparison.

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

Text Books:

1. *X.Wang & H.V.Poor, Wireless Communication Systems, Pearson, 2004.*
2. *R.Janaswamy, Radio Wave Propagation and Smart Antennas for Wireless Communication, Kluwer, 2001.*

Reference Books:

1. *Mohamed Ibnkahla, Signal Processing for Mobile Communications, CRC Press, 2005.*
2. *A.V.H. Sheikh, Wireless Communications Theory & Techniques, Kluwer Academic Publications, 2004.*
3. *A.Paulraj etal, Introduction to Space-time Wireless Communications, Cambridge University Press, 2003.*

EC628 Error Control Coding (3-0-0) 3

Review of modern algebra. Galois fields. Linear block codes; encoding and decoding. Cyclic codes. Non-binary codes.

Convolutional codes. Generator sequences. Structural properties. ML decoding. Viterbi decoding. Sequential decoding.

Modulation codes. Trellis coded modulation. Lattice type Trellis codes. Geometrically uniform trellis codes. Decoding of modulation codes.

Turbo codes. Turbo decoder. Interleaver. Turbo decoder. MAP and log MAP decoders. Iterative turbo decoding. Optimum decoding of turbo codes.

Space-time codes. MIMO systems. Space-time codes. MIMO systems. Space-time block codes (STBC) – decoding of STBC.

Text Books:

1. *S.Lin & D.J.Costello, Error Control Coding (2/e), Pearson, 2005.*
2. *B.Vucentic & J.Yuan, Turbo codes, Kluwer, 2000*

Reference Books:

1. *C.B.Schlegel & L.C.Perez, Trellis and Turbo Coding Wiley,2004.*
2. *B.Vucetic & J.yuan, Space-Time Coding, Wiley, 2003.*
3. *R.Johannaesson & K.S.Zigangirov, Fundamentals of Convolutional Coding, Universities Press, 2001.*

EC630 Digital Communication Receivers (3-0-0) 3

Baseband PAM. Clock recovery circuits. Error tracking and spectral – line generating synchronizers. Squaring and Mueller and Muller synchronizers.

Channel models. Receivers for PAM. Optimum ML receivers. Synchronized detection. Digital matched filter.

ML synchronization algorithms – DD and NDA. Timing parameter and carrier phase estimation – DD and NDA.

Performance analysis of carrier and symbol synchronizers. Feedback and feedforward synchronizers. Cycle slipping Acquisition of carrier phase and symbol timing.

Fading channels. Statistical characterization. Flat and frequency selective fading channels. Optimal receivers for data detection and synchronization parameter estimation. Realizable receiver structures for synchronized detection.

Text Books:

1. *H.Meyer etal, Digital Communication Receivers, Wiley, 1998.*
2. *U.Mengali & A.N.D'Andrea, Synchronization Techniques for Digital Receivers, Kluwer , 1997.*

Reference Books:

1. *N.Benuveruto & G.Cherubini, Algorithms for Communication Systems and their Applications, Wiley, 2002.*
2. *H.Meyr & G.Ascheid, Synchronization in Digital Communications, John Wiley, 1990.*

EC632 Analysis and Design of Planar Transmission Lines (3-0-0) 3

Parameters of planar transmission line variants. Static and dynamic analysis methods for microstripline, coplanar waveguide, coplanar strips, striplines and slot line.
Spectral domain methods. Formulation of quasistatic and dynamic spectral domain analyses. Galekin's method.

Hybrid mode analysis. Formulation. Application in planar transmission lines. Characteristic equation. Evaluation of parameters.

Coplanar lines , quasi-static and full wave analysis. Design equations. Comparison with microstrip and slot lines.

General analysis of coupled lines. Design considerations for microstrip lines and coplanar waveguides.

Text Books:

1. *T.Itoh, Numerical Techniques for Microwave and Millimeter Wave Passive Structures, John Wiley & Sons,1989.*
2. *C.Nguyen, Analysis Methods for RF, Microwave and Planar Transmission Line Structures, Wiley, 2000*

Reference Book:

1. *C. Nquyen, Analysis Methods for RF, Microwave, and Millimeter-Wave Planar Transmission Line Structures, Wiley Interscience, 2000*