DEPARTMENT OF Electronics and Communication Engineering

Syllabus and Scheme of Examination

Syllabus of

Master of Technology

in

DIGITAL ELECTRONICS & COMMUNICATION

Effective from 2017-2018

2017-18

Institution

Vision - Pursuing Excellence, Empowering people, Partnering in Community Development.

Mission - To develop NMAM Institute of Technology, Nitte, as Center of Excellence by imparting Quality Education to generate Competent, Skilled and Humane Manpower to face emerging Scientific, Technological, Managerial and Social Challenges with Credibility, Integrity, Ethics and Social Concern.

Department

Vision Statement: Empowering people, Partnering in Community Development by achieving expertise requiring the knowledge of state of the art technology in the field of Electronics & Communication

Mission Statement: To impart specialized education in the field of Electronics & Communication that contributes to the socio-economic development of the region and to generate technical manpower with high degree of credibility, integrity and ethical standards by providing vibrant learning environment

Programme Educational Objectives

The post graduates of Digital electronics & Communication Programme will be able to

1. Pursue successful careers in industry, academia and entrepreneurial ventures in the domain of DigitalElectronics and Communication
2. Innovate, design and evaluate system suitable for real timescenario
3. Engage in development activity and add value to socio-economic development of the region
4. Exercise excellent leadership qualities with integrity in a credible ethical and professional manner in the fast evolving global scenario.

Programme Outcomes

The post graduates of Digital electronics & Communication Programme will have ability to

1. Apply knowledge of mathematics science and engineering to model analyse and solve engineering problems
2. Ability to design and conduct experiments in the domain of Communication, Signal processing and embedded system using appropriate procedures to meet the professional needs.
3. Ability to fun effectively as a team member & team leader in multidisciplinary group
4. Knowledge of profession and ethicalresponsibilities
5. Ability to communicate effectively in oral written and visual forms
6. Awareness of impactof engineering solutions in societal and global context
7. Ability to engage in continues learning
8. Awarenessof recent trends in specialised field
9. Developentrepreneurship qualities by imbibing creativity discipline and strong work ethics.

NMAM INSTITUTE OF TECHNOLOGY, NITTE

SCHEME OF TEACHING AND EXAMINATION FOR M. TECH. _ DIGITAL ELECTRONICS AND COMMUNICATION

(AUTONOMOUS SCHEME)

Revised at the BOS meeting on 15-05-2017

I SEMESTER

Sub. Code	Name of the Subject	Contact hours/week	Duration of Sem. End	Marks for	Total

		L/T/P/S	Exam in hours	CIE	SEE	Credits
17DEC101	Embedded System Design	3/2/0/4	3	50	50	5
17DEC102	Statistical Signal processing	4/2/0/0	3	50	50	5
17DEC103	Advanced Digital Communication	4/2/0/0	3	50	50	5
17DEC11X	Elective - I	4/0/0/0	3	50	50	4
17DEC12X	Elective -II	4/0/0/0	3	50	50	4
17DEC104	Research Experience through Practice-I	0/0/4/0	0	100	--	2
	TOTAL		15	350	250	25

ELECTIVE –I		ELECTIVE-II	
17DEC111	Advanced Computer Architecture	17DEC121	Cryptographic Systems
17DEC112	Linear Algebra	17DEC122	Detection and Estimation
17DEC113	Optical Communication and Networking	17DEC123	Digital Signal Compression
17DEC114	Speech and Audio Processing	17DEC124	Unified Communication

M.TECH. DIGITAL ELECTRONICS AND COMMUNICATION
(AUTONOMOUS SCHEME)

II SEMESTER

		Teaching hours/week	Duration	Marks for	

Sub. Code	Name of the Subject	L/T/P/S	of Sem. End Exam in hours	CIE	SEE	Total Credits
17DEC201	Error Control Coding	4/2/0/0	3	50	50	5
17DEC202	RF & Microwave Circuit Design	3/2/0/4	3	50	50	5
17DEC203	Advanced Wireless Communication	4/2/0/0	3	50	50	5
17DEC21X	Elective - III	4/0/0/0	3	50	50	4
17DEC22X	Elective -IV	4/0/0/0	3	50	50	4
17DEC204	Research Experience through Practice-II	0/0/4/0	0	100	--	2
TOTAL			15	350	250	25

ELECTIVE –III		ELECTIVE - IV	
17DEC211	Spread Spectrum Communication	17DEC221	Multi-rate Systems and Filter Bank
17DEC212	Image and Video Processing	17DEC222	MIMO Systems
17DEC213	Pattern and Voice Recognition	15DEC223	Software Defined Radio
17DEC214	Cloud Computing	17DEC224	Wireless and Mobile networks
17DEC215		17DEC225	

List of Audit courses currently offered:

M.TECH. DIGITAL ELECTRONICS AND COMMUNICATION (AUTONOMOUS SCHEME)

III SEMESTER

Revised at the BOS meeting on _ _ _ _ _ _ _ _ _ _ _ _ _ _ _

Sub. Code	Name of the Subject	Duration	Marks for		Total Credits
		Practical/Field Work/Assignment	CIE	SEE	
17DEC 301	Industrial Training	Full time 8 weeks	50 (report)	--	8
	Mini-Project		50 (presentation)		
17DEC 302	Seminar on special topics	----	100	--	2
17DEC303	Project-Part I	Full time 10 weeks	100 (report)		10
			100(presentation)	--	
	TOTAL		400		20

IV SEMESTER

Sub. Code	Name of the Subject	Duration Practical Field work	Duration of Exam in Hrs.	Marks for CIE	SEE	Total Credits
17DEC 401	Project - Part II	Full time 20 weeks		200 [PPE*-I – 100 PPE-II – 100]	200	30
			TOTAL	400		30
	GRAND TOTAL From 1st to 4th semester: 100 credits (2000 marks)					

PPE – Project Progress Evaluation

DETAILED COURSE CONTENTS

EMBEDDED SYSTEM DESIGN

Subject Code	**17DEC101**	**Credits**	**5**
Hours/Week	**4+0+1+0**	**CIE**	**50 Marks**
Total Hours	**52**	**SEE**	**50 Marks**

Course Outcomes:

At the end of the course the student should be able to:

1. Get an insight to the fundamentals and know the general structure of an Embedded System.
2. Understand the Hardware/Software Co-Design involved in an Embedded System.
3. Identify problems and design challenges involved in an Embedded System and program using Embedded C.
4. Understand how RTOS is involved in Embedded System Design.
5. Learn IDE and understand the new trends in embedded industry.

UNIT-I

Typical Embedded System: Core of the Embedded System,Embedded Systems Vs General Computing Systems Memory, Sensors and Actuators, Communication Interface, On Board and External Communication Embedded Firmware, Other System Components.

8 Hrs

UNIT-II

Characteristics and Quality Attributes with Introduction to Hardware software Co-Design:

Characteristics and Quality Attributes ,Fundamental Issues in Hardware Software Co-Design, Computational Models in Embedded Design, Introduction to Unified Modeling Language**,** Hardware Software Trade-offs.

10 Hrs

UNIT-III

Embedded Firmware and Programming Embedded Systems in C: Embedded Firmware Design Approaches, Embedded Firmware Development Languages,and Programming in Embedded C using Function Calls, Pointers, Structures, Register Allocation, Conditional Execution and Loops.

12 Hrs

UNIT-IV

Real-Time Operating System (RTOS) based Embedded System Design:

Operating System Basics, Types of OS, Tasks, Process and Threads, Multiprocessing and Multitasking, Task Scheduling, Threads, Processes and Scheduling: Putting them altogether, Task Communication, Task Synchronization, Device Drivers, How to Choose an RTOS.

12 Hrs

UNIT-V

The Embedded System Development Environment: The Integrated Development Environment (IDE), Types of Files Generated on Cross-compilation, Disassembler/Decompiler, Simulators, Emulators and Debugging, Target Hardware Debugging, Boundary Scan.

Trends in the Embedded Industry: Processor Trends in Embedded Systems, Embedded OS Trends, Development Language Trends, Open Standards, Frameworks and Alliances, Bottlenecks.

10 Hrs

Reference Books:

R1. Shibu K V, **"Introduction to Embedded Systems"**, Tata McGraw Hill Education Private Limited, 2009.

R2. James K Peckol, **"Embedded Systems - A Contemporary Design Tool"**, John Wiley, 2008.

LIST OF EXPERIMENTS FOR EMBEDDED SYSTEM DESIGN LAB I:

1. Write a C code to interface input device (Keyboard), with output devices (seven segment led's and free running LEDs) and display the contents of the key pressed on the output.

2. Design a low pass FIR Filter using Simulink block sets.

2. Verilog/VHDL File Processing (Reading a file and storing data in a file).

3. Verilog/ VHDL LCD Display (Scrolling blinking etc.).

STATISTICAL SIGNAL PROCESSING

Subject Code	**17DEC102**	**Credits**	**5**
Hours/Week	**4+0+2+0**	**CIE**	**50 Marks**
Total Hours	**52**	**SEE**	**50 Marks**

Course Outcomes:

At the end of the course the student should be able to:

1. Compute the statistical relationship between any definite set of discrete signals and design random process using AR, ARMA and MA model.
2. Understand and design signal modeling
3. Understand wiener filter and its applications.
4. Design adaptive filter for noise canceller, line enhancer and other statistical signal processing purpose.
5. Compute power spectrum of random process.

UNIT-I

Discrete Time Random Processes: Random Variables, Random Process, Filtering Random processes, AR, ARMA and MA processes.

10 Hrs

UNIT-II

Signal Modeling: Introduction, Least Square Method, Pade Approximation, Prony's Method – Pole-Zero Modeling, Shank's Method, All-Pole Modeling and Linear Prediction.

11 Hrs

UNIT-III

Weiner Filtering: Introduction, FIR weiner Filter, Linear Prediction and Noise Cancellation using FIR Weiner filter, discrete Kalman filter, Design Problems

10 Hrs

UNIT-IV

Adaptive filter: Introduction, FIR adaptive filter – The steepest Descent Adaptive filter, LMS algorithm, Convergence of LMS algorithm, noise cancellation, Design problems.

12 Hrs

UNIT-V

Spectrum estimation: Introduction, Periodgram, Nonparametric methods – Bartlett's method, Weltch's method and Blackman-Tukey Method. Parametric spectral estimation (Qualitative only)

9 Hrs

Reference Books:

6. Monson H. Hayes, "**Statistical Digital Signal Processing and Modeling**", John Wiley & Sons, Inc.
7. Haykin, **"Adaptive Filter Theory"**, Prentice Hall, 1995.
8. Cooper G.R., Mc Gillen C.D, **"Probability Methods of Signal & Processing"**, HRW INT, (Edition -2), 1986.
9. Steven M. KAY, **"Modern Spectral Estimation"**, Prentice Hall.
10. Oppenheim A.V. , Schafer R.W , **"Discrete Time Signal Processing"**, Prentice Hall.

ADVANCED DIGITAL COMMUNICATION

Subject Code	**17DEC103**	**Credits**	**5**
Hours/Week	**4+0+2+0**	**CIE**	**50 Marks**
Total Hours	**52**	**SEE**	**50 Marks**

Course Outcomes:

At the end of the course the student should be able to:

6. Design of optimal receiver in the presence of Gaussian noise.
7. Understand the need and utilization of link budget analysis.
8. Realize Communication through band limited channels
9. Design of Adaptive Equalizers.
10. Understand Spread Spectrum Communication and also the synchronization techniques.
11. Understand Communication through multipath fading channel and the effect of digital signals through the fading channels.

UNIT-I

Review of Digital Modulation Techniques: QPSK, OQPSK, π/4 - shifted QPSK, MSK, Optimum Receiver for Signals Corrupted by AWGN, Concept of matched filter.

10 Hrs

UNIT-II

Communications Link Analysis: Introduction to System link budget, Error - Performance Degradation, Sources of Signal Loss and Noise, Recieved Signal Power and Noise Power, Link Budget Analysis, Noise Figure, Noise Temperature and System Temperature, Sample link analysis, Satellite Repeaters, System Trade-Offs. **10 Hrs**

UNIT-III

Communication through band limited linear filter channels: Optimum receiver for channels with ISI and AWGN, Linear equalization, Decision-feedback equalization, reduced complexity ML detectors, Iterative equalization and decoding-Turbo equalization.

Adaptive equalization: Adaptive linear equalizer, adaptive decision feedback equalizer, adaptive equalization of Trellis coded signals, Recursive least squares algorithms for adaptive equalization**.** **12 Hrs**

UNIT-IV

Spread Spectrum Signals for Digital Communication: Model of Spread Spectrum Digital Communication System, Direct Sequence Spread Spectrum Signals, Frequency-Hopped Spread Spectrum Signals, CDMA, time-hopping SS**,** Synchronization of SS systems**.**

10 Hrs

UNIT-V

Digital Communication through fading multi-path channels: Characterization of fading multi-path channels, the effect of signal characteristics on the choice of a channel model, frequency-Nonselective, slowly fading channel, diversity techniques for fading multi-path channels, Digital signal over a frequency selective, slowly fading channel, coded wave forms for fading channels.

10 Hrs

Reference Books:

R1. John G. Proakis,**"Digital Communications",** 5th edition, McGraw Hill, 2008.

R2. Andrew J. Viterbi, **"CDMA: Principles of Spread Spectrum Communications"**, Prentice Hall, USA, 1995.

R3. Won Y. Yang, **"Matlab /Simulink for Digital Communication**", Wiley, 2012.

R4. John B. Anderson, **"Digital Transmission Engineering",** Wiley 2nd Edition, 2005.

R5. Krzysztof Wesolowski, "**Introduction to Digital Communication",** Wiley, 2009.

R6. Bernard Sklar, **"Digital Communication: Fundamental & Applications",** Pearson Education, Second Edition, 2001.

List of experiments:

1. 8-PSK Modulation

2. QPSK DSSS
3. MSK Modulation
4. π/4-shiftwd DQPSK generation
5. Analog TDM
6. Study of PLL (PLL characteristics & FSK Demodulation

ADVANCED COMPUTER ARCHITECTURE

Sub Code :17DEC111	**Credits**	**: 04**
Hrs/Week : 4+0+0+0	**CIE**	**: 50 Marks**
Total Hours : 52	**SEE**	**: 50 Marks**

Course Outcomes:

At the end of the course the student should be able to:

11. Analyze the fundamental issues in architecture design and their impact on application performance.
12. Understand advanced issues in design of computer processors, caches, and memory.
13. Analyze performance trade-offs in computer design.
14. Apply knowledge of processor design to improve performance in algorithms and software systems.
15. Acquire experience with tools for statistical analysis of instruction set trade-offs.

UNIT – I

Parallel computer models: The state of computing, Classification of parallel computers, Multiprocessors and multicomputer, Multifactor and SIMD computers.
Program and network properties: Conditions of parallelism, Data and resource Dependences, Hardware and software parallelism, Program partitioning and scheduling, Grain Size and latency, Program flow mechanisms, Control flow versus data flow, Data flow Architecture, Demand driven mechanisms, Comparisons of flow mechanisms. **10 Hrs**

UNIT – II

System Interconnect Architectures: Network properties and routing, Static interconnection Networks, Dynamic interconnection Networks, Multiprocessor system Interconnects, Hierarchical bus systems, Crossbar switch and multiport memory, Multistage and combining network. **10 Hrs**

UNIT – III

Advanced processors: Advanced processor technology, Instruction-set Architectures, CISC Scalar Processors, RISC Scalar Processors, Superscalar Processors, VLIW Architectures,

Vector and Symbolic processors. **10 Hrs**

UNIT – IV

Pipelining: Linear pipeline processor, nonlinear pipeline processor, Instruction pipeline Design, Mechanisms for instruction pipelining, Dynamic instruction scheduling, Branch Handling techniques, branch prediction, Arithmetic Pipeline Design, Computer arithmetic principles, Static Arithmetic pipeline, Multifunctional arithmetic pipelines

Memory Hierarchy Design: Cache basics & cache performance, reducing miss rate and miss penalty, multilevel cache hierarchies, main memory organizations, design of memory hierarchies. **10 Hrs**

UNIT - V

Multiprocessor architectures: Symmetric shared memory architectures, distributed shared memory architectures, models of memory consistency, cache coherence protocols (MSI, MESI, and MOESI), scalable cache coherence, overview of directory based approaches, design challenges of directory protocols, memory based directory protocols, cache based directory protocols, protocol design tradeoffs, and synchronization. Scalable point –point interfaces: Alpha364 and HT protocols, high performance signaling layer.

Enterprise Memory subsystem Architecture: Enterprise RAS Feature set: Machine checks, hot add/remove, domain partitioning, memory mirroring/migration, patrol scrubbing, fault tolerant system. **12 Hrs**

REFERENCE BOOKS:

12. Kai Hwang, **"Advanced Computer Architecture"**, TMH.
13. Hwan and Briggs, **" Computer Architecture and Parallel Processing"**, MGH.VLSI
14. D. A. Patterson and J. L. Hennessey, **"Computer organization and Design"**, Morgan Kaufmann, 2nd Ed.
15. Kai Hwang and Zu, **"Scalable Parallel Computers Architecture",** MGH.
16. M.J Flynn, **"Computer Architecture, Pipelined and Parallel Processor Design"**, Narosa Publishing.
17. D.A.Patterson, J.L.Hennessy, **"Computer Architecture: A quantitative approach"**, Morgan Kauffmann, 2002.

LINEAR ALGEBRA

Subject Code	**17DEC112**	**Credits**	**4**
Hours/Week	**4+0+0+0**	**CIE**	**50 Marks**
Total Hours	**52**	**SEE**	**50 Marks**

Course Outcomes:

At the end of the course the student should be able to

1. Design of optimal receiver in the presence of Gaussian noise.
2. Understand and apply Coding Techniques.
3. Realize Communication through band limited channels
4. Design of Adaptive Equalizers.
5. Understand Spread Spectrum Communication and also the synchronization techniques.
6. Understand Communication through multipath fading channel and the effect of digital signals through the fading channels.

UNIT-I

Linear equations: Field, System of linear equations and its solution sets, Elementary row operations and echelon forms, Matrix operations, Invertible matrices, LU factorization of a matrix.

10 Hrs

UNIT-II

Vector spaces: Vector spaces and subspaces, Null spaces, Column spaces & Linear transformation, Linearly independent sets, Bases, Linear combinations, spanning set theorem, Coordinate systems, Dimension of a vector space, Rank, Change of basis.

10Hrs

UNIT-III

Linear Transformations: Linear transformations, Matrix transformations, algebra of linear transformations, isomorphism, representation of transformations by matrices; linear functional.

6Hrs

Canonical Forms: Characteristic values, Characteristic equation, Minimal polynomial, Characteristic & Minimal polynomials of block matrices, Invariant direct-sum decompositions, primary decomposition theorem, cyclic subspaces, Jordan Canonical form.

6Hrs

UNIT-IV

Inner Product Spaces: Inner products, Examples of inner product spaces, Cauchy- Schwarz inequality, orthogonal sets and projections, Gram-Schmidt process of orthogonalization, QR-factorization, Least-squares problems and solutions.

10Hrs

UNIT-V

Symmetric Matrices and Quadratic Forms: Diagonalization: Characteristic polynomial, Cayley-Hamilton theorem, Eigen values & Eigen vectors, Diagonalization of real symmetric matrix, Quadratic forms, constrained optimization, Singular Value Decomposition.

10Hrs

Reference Books:

R1. Kenneth Hoffman and Ray Kunze, **"Linear Algebra",** 2nd edition, Pearson Education (Asia) Pte. Ltd/ Prentice Hall of India, 2004.

R2. David C. Lay, **"Linear Algebra and its Applications",** 3rd edition, Pearson Education (Asia) Pte. Ltd. 2005.

R3. Schaum's outline series, Seymour Lipschutz& marc Lipson, **"Linear Algebra",** 3rd edition, TATA McGRAW-HILL, 2005.

R4. Gilbert Strang, **"Linear Algebra and its Applications",** 3rd edition, Thomson Learning Asia. , 2003.

R5. Bernard Kolman and David R. Hill, **"Introductory Linear Algebra with Applications",** Pearson

Education (Asia) Pte. Ltd. 7th edition, 2003.

OPTICAL COMMUNICATION & NETWORKING

Subject Code	**17DEC113**	**Credits**	**4**
Hours/Week	**4+0+0+0**	**CIE**	**50 Marks**
Total Hours	**52**	**SEE**	**50 Marks**

Course Outcomes:

At the end of the course the student should be able to:

1. Understand the basics of optical communication system with components.
2. Analyze the propagation model of optical communication system.
3. Conceptualize the optical networking and layers of routing model.
4. Understand the optical design and concepts of routing wavelength assignment, wavelength conversion and statistical dimensioning model.
5. Comprehend the evolution of network management facility and configuration management.

UNIT-I

Introduction: Propagation of signals in optical fiber, different losses, nonlinear effects, solitons, optical sources, detectors.

Optical Components: Couplers, isolators, circulators, multiplexers, filters, gratings, interferometers, amplifiers.

10Hrs

UNIT-II

Modulation — Demodulation: Formats, ideal receivers, Practical detection receivers, Optical preamplifier, Noise considerations, Bit error rates, Coherent detection.

Transmission system engineering: system model, power penalty, Transmitter, Receiver, Different optical amplifiers, Dispersion.

10Hrs

UNIT-III

Optical networks: Client layers of optical layer, SONET/SDH, multiplexing, layers, frame structure, ATM functions, adaptation layers, Quality of service and flow control, ESCON, HIPPI.

10Hrs

UNIT-IV

WDM network elements: Optical line terminal optical line amplifiers, optical cross connectors, WDM network design, cost trade offs, LTD and RWA problems, Routing and wavelength assignment, wavelength conversion, statistical dimensioning model.

10Hrs

UNIT-V

Control and management: network management functions, management frame work, Information model, management protocols, layers within optical layer performance and fault management, impact of transparency, BER measurement, optical trace, Alarm management, configuration management. Suitable number of Assignments / Tutorials can be given based on the syllabus. **12Hrs**

Reference Books:

R1. John M. Senior, "**Optical Fiber Communications"**, Pearson edition, 2000.

R2. Rajiv Ramswami, N. Sivaranjan, **"Optical Networks"**, M. Kauffman Publishers, 2000.

R3. Gerd Keiser, **"Optical Fiber Communication"**, MGH, 1991.

R4. G. P. Agarawal, **"Fiber Optics Communication Systems"**, John Wiley New York ,1997

R5. P.E. Green, **"Optical Networks"**, Prentice Hall, 1994.

SPEECH AND AUDIO PROCESSING

Subject Code	**17DEC114**	**Credits**	**4**
Hours/Week	**4+0+0+0**	**CIE**	**50 Marks**
Total Hours	**52**	**SEE**	**50 Marks**

Course Outcomes:

At the end of the course the student should be able to:

1. Analyze and design algorithms for extracting parameters from the speech signal.
2. Analyze and design algorithms for speech and audio coding.

UNIT-I

Digital models for the speech signal: Process of speech production, Acoustic theory of speech production, Lossless tube models, and Digital models for speech signals.

Time domain models for speech processing: Time dependent processing of speech, Short time energy and average magnitude, Short time average zero crossing rate, Speech versus silence discrimination using energy & zero crossings, Pitch period estimation, Short time autocorrelation function, Short time average magnitude difference function, Pitch period estimation using autocorrelation function, Median smoothing. **10Hrs**

UNIT-II

Digital representations of the speech waveform: Sampling speech signals, Instantaneous quantization, Adaptive quantization, Differential quantization, Delta Modulation, Differential PCM, Comparison of systems, direct digital code conversion.

Short time Fourier analysis: Linear Filtering interpretation, Filter bank summation method, Overlap addition method, Design of digital filter banks, Implementation using FFT, Spectrographic displays, Pitch detection, Analysis by synthesis, Analysis synthesis systems. **10 Hrs**

UNIT-III

Homomorphic speech processing: Homomorphic systems for convolution, Complex cepstrum, Pitch detection, Formant estimation, Homomorphic vocoder. linear predictive analysis, Solution of LPC equations, Prediction error signal, Frequency domain interpretation, Relation between the various speech parameters, Synthesis of speech from linear predictive parameters, Applications.

Speech Enhancement: Spectral subtraction & filtering, Harmonic filtering, parametric re-synthesis, Adaptive noise cancellation.

12Hrs

UNIT-IV

Speech Synthesis: Principles of speech synthesis, Synthesizer methods, Synthesis of intonation, Speech synthesis for different speakers, Speech synthesis in other languages, Evaluation, Practical speech synthesis.

Automatic Speech Recognition: Introduction, Speech recognition vs. Speaker recognition, Signal processing and analysis methods, Pattern comparison techniques, Hidden Markov Models, Artificial Neural Networks. **10Hrs**

UNIT-V

Audio Processing: Auditory perception and psychoacoustics - Masking, frequency and loudness perception, spatial perception, Digital Audio, Audio Coding -High quality, low-bit-rate audio coding standards, MPEG, AC-3, Multichannel audio - Stereo, 3D binaural and Multichannel surround sound. **10Hrs**

Reference Books:

R1. L. R. Rabiner and R. W. Schafer, **"Digital Processing of Speech Signals"**, Pearson Education (Asia) Pte. Ltd. 2004.

R2. D. O'Shaughnessy, **"Speech Communications: Human and Machine"**, Universities Press, 2001.

R3. L. R. Rabiner and B. Juang, **"Fundamentals of Speech Recognition"**, Pearson Education (Asia) Pte. Ltd. 2004.

R4. Z. Li and M.S. Drew, **"Fundamentals of Multimedia"**, Pearson Education (Asia) Pte. Ltd. 2004.

CRYPTOGRAPHIC SYSTEMS

Subject Code	**17DEC121**	**Credits**	**4**
Hours/Week	**4+0+0+0**	**CIE**	**50 Marks**
Total Hours	**52**	**SEE**	**50 Marks**

Course Outcomes:

At the end of the course the student should be able to:

1. Demonstrate competent understanding of cryptographic algorithms and their applications.
2. Get a firm grounding in the analysis and design of robust crypto systems
3. Understand the available cipher systems using analytical approaches.
4. Understand the evaluation and selection process for identifying standards and systems based on application criteria
5. Explain the importance of confidentiality and authentication of network transactions.
6. Adopt her/his line of reasoning to systematic design procedures grounded in informed choices

UNIT-I

Overview: Services, Mechanisms and attack models, Model for network security, Symmetric cipher model, Substitution techniques, Transposition techniques. Rotor machine, Steganography. Block Ciphers and DES, Block cipher design principles, Block cipher modes of operation. Differential and Linear cryptanalysis 3DES, Rijndael system, AES, IDEA. Attack on Block ciphers.

12 Hrs

UNIT-II

Fermat's and Euler's theorem, Big-O notation, Chinese Remainder Theorem, Fields, Group-isomorphism, Discrete logarithm, Pohlig-Hellman algorithm, Pollard's p-1 factorization, pollard rho factorization algorithm. Public Key Cryptography and RSA: Principles of public key cryptosystems, RSA algorithm, Integer Factorization and RSA, Miller-Rabin Test, Massey-Omura, ElGamal crypto systems, Knapsack problem.

10 Hrs

UNIT-III

Other Public Key Crypto Systems and Key Management: Key management, Diffie-Hellman key exchange, DH with multiple participants, Elliptic curve arithmetic, Elliptic curve cryptography, Analog of Massey –Omura, Analog of ElGamal crypto systems. Elliptic curve factorization - pollard's p-1 method,Trapdoor functions.

10 Hrs

UNIT-IV

Message Authentication and Hash Functions: Authentication requirements, Authentication functions, Message authentication codes, Hash functions, Security of hash functions and MAC. Collision resistance hashing.

Digital Signature and Authentication Protocol: Digital signature, Authentication protocols, Digital signature standard, RSA digital signatures, ElGamal digital signatures and DSA, ECDSA.

10 Hrs

UNIT-V

Zero-knowledge proofs, Secret sharing schemes, Identification schemes. Basics of SHA-256, SHA-512 and SHA-n. Introduction to quantum cryptology: Quantum Bit, Quantum Registers and Quantum Algorithm, Shor's Algorithm, Quantum Key-Exchange.Authentication key exchange with SSL/TLS setup.

10Hrs

Reference Books:

R1. Neal Koblitz, **"A Course in Number Theory and Cryptography"**, -2nd Edition, Springer Verlag

R2. Jeffrey Hoffstein,JillPipher,Joseph H. Silverman ,**"An Introduction to Mathematical Cryptography"** -Springer 2008

R3. Behrouz A .Forouzan, DebdeeepMukhopadhyay,"**Cryptography and Network Security",** 2nd Edition, Mc Graw Hill

R4. William Stallings, **"Cryptography and Network Security"**, -4thEdition, Pearson Education PHI.

R5. Douglas R. Stinson **"Cryptography Theory and Practice"**, – 3rd Edition, Chapman & Hall /CRC

R6. KeijoRuohonen, **"Mathematical Cryptology"(**Translation by JussiKangas and Paul Coughlan) -2010

R7. Kefei Chen, **"PROGRESS ON CRYPTOGRAPHY -25 Years of Cryptography in China"** THE KLUWER INTERNATIONAL SERIES

R8. John Hershey, **"Cryptography Demystified"**, McGraw-Hill, 2002.

DIGITAL SIGNAL COMPRESSION

Sub Code : 17DEC122	**Credits : 04**
Hrs/Week : 4+0+0+0	**CIE : 50 Marks**
Total Hours : 52	**SEE : 50 Marks**

Course Outcomes:

At the end of the course the student should be able to:

1. Understand the necessity of the compression technique.
2. Model the system to get the optimum quantization with different quantization methods.
3. Understand the compression algorithms to implement in the real time application
4. Perform the analysis and synthesis of the speech and video using different compression schemes

UNIT – I

Introduction: Compression techniques, Modeling & coding, Distortion criteria, Differential Entropy, Rate Distortion Theory, Vector Spaces, Information theory, Models for sources, Coding – uniquely decodable codes, Prefix codes, Kraft McMillan Inequality

8 Hrs

UNIT – II

Qunatization: Quantization problem, Uniform Quantizer, Adaptive Quantization, Non-uniform Quantization; Entropy coded Quantization, Vector Quantization, LBG algorithm,Tree structured VQ, Structured VQ, Variations of VQ – Gain shape VQ, Mean removed VQ, Classified VQ, Multistage VQ, Adaptive VQ, Trellis coded quantization.

10 Hrs

UNIT – III

Differential Encoding: Basic algorithm, Prediction in DPCM, Adaptive DPCM, Delta Modulation, Speech coding –G.726, Image coding. Transform Coding: Transforms – KLT, DCT, DST, DWHT; Quantization and coding of transform coefficients, Application to Image compression – JPEG, Application to audio compression.

10 Hrs

UNIT – IV

Sub band Coding: Filters, Sub-band coding algorithm, Design of filter banks, Perfect reconstruction using two channel filter banks, M-band QMF filter banks, Poly-phase decomposition, Bit allocation, Speech coding – G.722, Audio coding – MPEG audio, Image compression. Wavelet Based Compression: Wavelets, Multi resolution analysis & scaling function, Implementation using filters, Image compression – EZW, SPIHT, JPEG 2000. Analysis/Synthesis Schemes: Speech compression –LPC-10, CELP, MELP, Image

Compression – Fractal compression. **12 Hrs**

UNIT - V

Video Compression: Motion compensation, Video signal representation, Algorithms for video conferencing & videophones – H.261, H. 263, Asymmetric applications – MPEG 1, MPEG 2, MPEG 4, MPEG 7, Packet video.

Lossless Coding: Huffman coding, Adaptive Huffman coding, Golomb codes, Rice codes, Tunstall codes, Applications of Huffman coding, Arithmetic coding, Algorithm implementation, Applications of Arithmetic coding, Dictionary techniques – LZ77, LZ78, Applications of LZ78 – JBIG, JBIG2, Predictive coding – Prediction with partial match, Burrows Wheeler Transform, Applications – CALIC, JPEGLS, Facsimile coding – T.4, T.6.

12 Hrs

REFERENCE BOOKS:

1. K. Sayood, **"Introduction to Data Compression"**,Harcourt India Pvt. Ltd. & Morgan Kaufmann Publishers, 1996

2. N. Jayant and P. Noll, **"Digital Coding of Waveforms: Principles and Applications to Speech and Video"**, Prentice Hall, USA, 1984.

3. D. Salomon, **"Data Compression: The Complete Reference"**, Springer, 2000.

4. Z. Li and M.S. Drew, **"Fundamentals of Multimedia"**, Pearson Education (Asia) Pte. Ltd.2004.

DETECTION AND ESTIMATION

Subject Code	**17DEC123**	**Credits**	**4**
Hours/Week	**4+0+0+0**	**CIE**	**50 Marks**
Total Hours	**52**	**SEE**	**50 Marks**

Course Outcomes:

At the end of the course the student should be able to:

1. Acquire basics of statistical decision theory used for signal detection and estimation.
2. Examine the detection of deterministic and random signals using statistical models.
3. Comprehend the elements and structure of nonparametric detection.
4. Examine the performance of signal parameters using optimal estimators.
5. Analyze signal estimation in discrete-time domain using filters

UNIT-I

Classical Detection and Estimation Theory: Introduction, simple binary hypothesis tests, M Hypotheses, estimation theory, composite hypotheses, general Gaussian problem, performance bounds and approximations.

10 Hrs

UNIT-II

Representations of Random Processes: Introduction, orthogonal representations, random process characterization, homogenous integral equations and eigen functions, periodic processes, spectral decomposition, vector random processes.

10 Hrs

UNIT-III

Detection of Signals – Estimation of Signal Parameters: Introduction, detection and estimation in white Gaussian noise, detection and estimation in nonwhite Gaussian noise, signals with unwanted parameters, multiple channels and multiple parameter estimation.

12Hrs

UNIT-IV

Estimation of Continuous Waveforms: Introduction, derivation of estimator equations, lower bound on the mean-square estimation error, multidimensional waveform estimation, nonrandom waveform estimation.

10 Hrs

UNIT-V

Linear Estimation: Properties of optimum processors, realizable linear filters, Kalman-Bucy filters, fundamental role of optimum linear filters.

10Hrs

Reference Books:

R1. Harry L. Van Trees, **"Detection, Estimation, and Modulation Theory"**, Part I, John Wiley & Sons, USA, 12001.

R2. M.D. Srinath, P.K. Rajasekaran and R. Viswanathan, **"Introduction to Statistical Signal Processing with Applications"**,Pearson Education (Asia) Pte. Ltd. /Prentice Hall of India, 2003.

R3. Steven M. Kay, **"Fundamentals of Statistical Signal Processing," Volume I: "Estimation Theory"**, Prentice Hall, USA, 1998;

R4. Steven M. Kay, **"Fundamentals of Statistical Signal Processing, "Volume II: "Detection Theory,"** Prentice Hall, USA, 1998.

R5. Louis L Scharf**, "Statistical Signal Processing: Detection, Estimation and Time series Analysis"**, Addison Wesley, 1991

R6. K Sam Shanmugam, Arthur M Breipohl, **"Random Signals: Detection, Estimation and Data Analysis"**, John Wiley & Sons, 1998

Unified Communication

Sub Code : 17DEC124 **Credits : 04**
Hrs/Week : 4+0+0+0 **CIE : 50 Marks**
Total Hours : 52 **SEE : 50 Marks**

Course Outcomes:

At the end of the course the student should be able to:

1. Understand various VOIP and instant messaging protocols
2. Evaluate the Existing Telephony system for enterprise
3. Able to develop and deploy instant messaging solution using communication protocols
4. Design a global unified communication solution for and enterprise
5. Evaluate and Design secure solution for an enterprise unified communication systems

UNIT – I

Introduction to Telephony: Telephony evolution, Voice encoding, Dicing and splicing voice stream, The latency budget, UDP, RTP, RTCP, Multiplexing RTP and RTCP, RTP Mixers and Translators, Layered encoding, Profile for Voice and Video, Voice compression, silence suppression, Sub packet multiplexing, Protocol and codec selection, Voice Protocols and Codecs, Voice Quality, , Securing Voice Communication, Software Powered Voice

10 Hrs

UNIT – II

VOIP Signaling and Call processing: Introduction packet system and Unified communication systems, SIPing voice, SIP architecture, SIP messages, SIP Header and message Behaviors, Session description Protocol, Media gateway control protocol, H.323 Architecture, DNS, DID, Number portability, Call recording, emergency call dialing, Tracking IP phone location, Real-time fax over IP, Instant messaging, Webinar broadcasts, Telepresence

10 Hrs

UNIT – III

Interconnection to Global Networks: Operating Voice across Network address translations, session traversal utilities for NAT, Traversal using relays around NAT, Interactive connectivity establishment, enterprise SBC, Carriers SBC, Voice on Wireless LAN, packet voice on Wi-max and LTE, Radio over VoIP, Instant messaging over web, Unified communication over mobile. Enterprise voice with Microsoft unified communications.

10 Hrs

UNIT – IV

Applying Unified Communication: Evaluation of existing Landscape, assessing the existing communication Infra, evaluating unified communication components Understanding Unified messaging, Instant messaging in enterprise, how instant messaging protocols works, Jabber, concept of instant messaging in Jabber, Jabber messaging models, Jabber messaging

routings, Jabber instant messaging sessions. Integration of speech reorganization with voice and Unified communications

10 Hrs

UNIT - V

Securing unified communication: Voice and UC security threats, scanning UC Network, enumerating a UC network, Toll fraud and service abuse, calling number spoofing, Telephony denial of service, Voice social engineering and Social phishing, UC interception and Modification over network, signaling manipulation, audio and video Manipulation, perverting identity threat, protecting communication with encryption, TLS and MTLS, secure platform architecture, Industry recognized UC security products

12 Hrs

REFERENCE BOOKS:

1. VoIP and Unified Communications: Internet Telephony and the Future Voice Network, William A. Flanagan, John Wiley & Sons, 27-Feb-2012. (Major Reference)
2. Microsoft Voice and Unified Communication, Joe SchurmanPeason education Inc 2009
3. Instant Messaging in Java the Jabber protocols, Lain Shigeoka, Manning publication 2002
4. Unified Communication for Dummies Tony Bradley &Satish Shah , Wiley publishing ,2010
5 Packet Guide to Voice over IP , O'REILLY, O'Reilly Media, Inc, 2013
6 Hacking exposed Unified Communication and VOIP ,Security secret and solutions , Mark Colleir , David Endler , McGrawHill Education 2014

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ERROR CONTROL CODING

Sub Code : 17DEC201 **Credits : 04**
Hrs/Week : 4+0+0+0 **CIE : 50 Marks**
Total Hours : 52 **SEE : 50 Marks**

Course Outcomes:

At the end of the course the student should be able to:

7. Explain the need for error correction in data communication and storage systems. Apply mathematical tools from groups and finite fields in the design of codes and sequences.
8. Design block codes and appreciate the error detecting and correcting capabilities of the same.
9. Design and decode BCH codes for the given specifications.
10. Explain the operation of a convolutional encoder. Apply the Viterbi algorithm to decode a convolutional code.
11. Understand and design concatenated, turbo and burst and random error correcting codes.

UNIT – I

Introduction to Algebra: Groups, Fields, Binary Field Arithmetic, Construction of Galois Field GF (2^m) and its basic properties, Computation using Galois Field GF (2^m) Arithmetic, Rings, Ideals, Vector spaces and Matrices.

Linear Block Codes: Generator and Parity check Matrices, Encoding circuits, Syndrome and Error Detection, Minimum Distance Considerations, Error detecting and Error correcting capabilities, Standard array and Syndrome decoding, Decoding circuits, Hamming Codes, Reed – Muller codes.

10 Hrs

UNIT – II

Cyclic Codes: Introduction, Generator and Parity check Polynomials, Encoding using Multiplication circuits, Systematic Cyclic codes – Encoding using Feedback shift register circuits, Generator matrix for Cyclic codes, Syndrome computation and Error detection, Meggitt decoder, Error trapping decoding, Cyclic Hamming codes, The (23, 12) Golay code, Shortened cyclic codes.

10 Hrs

UNIT – III

BCH Codes: Binary primitive BCH codes, Decoding procedures, Implementation of Galois field Arithmetic, Implementation of Error correction. Non – binary BCH codes: q – ary Linear Block Codes, Primitive BCH codes over GF (q), Reed – Solomon Codes, Decoding of Non – Binary BCH and RS codes: The Berlekamp – Massey Algorithm.

10 Hrs

UNIT – IV

Convolutional Codes: Encoding of Convolutional codes, Structural properties, Distance properties, Viterbi Decoding Algorithm for decoding, Soft – output Viterbi Algorithm, Stack and Fano sequential decoding Algorithms, Majority logic decoding.

10 Hrs

UNIT - V

Concatenated Codes & Turbo Codes: Single level Concatenated codes, Multilevel Concatenated codes, Soft decision Multistage decoding, Concatenated coding schemes with Convolutional Inner codes, Introduction to Turbo coding and their distance properties, Design of Turbo codes.

Burst – Error – Correcting Codes: Burst and Random error correcting codes, Concept of Interleaving, cyclic codes for Burst Error correction – Fire codes, Convolutional codes for Burst Error correction.

12 Hrs

REFERENCE BOOKS:

1. Shu Lin & Daniel J. Costello, Jr. **"Error Control Coding"**, Pearson / Prentice Hall, Second Edition, 2004. (Major Reference)
2. Blahut, R.E. **"Theory and Practice of Error Control Codes"**, Addison Wesley, 1984
3. F.J. Mac Williams and N.J.A. Slone, **"The Theory of Error Correcting Codes"**, North Holland, 1977
4. Peterson, W.W. & Weldon, E.J. **"Error-Correcting Codes"**, MIT Press, Cambridge. Massachusetts, 1972
5 Das, J; Mullick, S.K. &Chaterjee.P.K, **"Principles of Digital Communications"**, Wiley Eastern Ltd. New Delhi, 1986.
6 Satyanarayana P.S., **"Concepts of Information Theory & Coding"**, Dynaram Publications, Bangalore, 2005.

RF AND MICROWAVE CIRCUIT DESIGN

Subject Code	**17DEC202**	**Credits**	**4**
Hours/Week	**4+0+0+0**	**CIE**	**50 Marks**
Total Hours	**52**	**SEE**	**50 Marks**

Course Outcomes:

At the end of the course the student should be able to:

1. Conceptualize the behavior of components at RF/Microwave frequencies.
2. Design Microwave amplifiers, Microwave oscillators, Microwave detectors/mixers and Microwave control circuits.
3. Apply the advanced concepts in Microwaves to analyze Monolithic integrated circuits (MICs), with sinusoidal inputs.
4. Apply microwave processing techniques to complex high frequency circuits and systems.
5. Analyze the design of few RF/Microwave circuits.

UNIT-I

Wave Propagation in Networks: Introduction to RF/Microwave Concepts and applications; RF Electronics Concepts; Fundamental Concepts in Wave Propagation; Circuit Representations of two port RF/MW networks.

10 Hrs

UNIT-II

Passive Circuit Design: The Smith Chart, Application of the Smith Chart in Distributed and lumped element circuit applications, Design of Matching networks.

10 Hrs

UNIT-III

Basic Considerations in Active Networks: Stability Consideration in Active networks, Gain Considerations in Amplifiers, Noise Considerations in Active Networks.

10 Hrs

UNIT-IV

Active Networks: Linear and Nonlinear Design: RF/MW Amplifiers Small Signal Design, Large Signal Design, RF/MW Oscillator Design, RF/MW Frequency Conversion.

12 Hrs

UNIT-V

Rectifier and Detector Design, Mixer Design, RF/MW Control Circuit Design, RF/MW Integrated circuit design. **10 Hrs**

Reference Books:

R1. Matthew M. Radmanesh, **"Radio Frequency and Microwave Electronics Illustrated"**, Pearson Education (Asia) Pte. Ltd. 2004.

R2. Reinhold Ludwig and Pavel Bretchko, **"RF Circuit Design: Theory and Applications"**, 2nd edition, Pearson Education (Asia) Pte. Ltd. 2007.

ADVANCED WIRELESS COMMUNICATION

Subject Code	**17DEC203**	**Credits**	**5**
Hours/Week	**4+2+0+0**	**CIE**	**50 Marks**
Total Hours	**52**	**SEE**	**50 Marks**

Course Outcomes:

At the end of the course the student should be able to:

5. Analyze the Wireless Communication strategies in terms of frequency reuse, Channel assignment scenarios with improving coverage and capacity.
6. Understand diversity techniques and MIMO systems with the advent of space-time coding.
7. Understand CDMA mechanisn in order to establish connectivity between different types of coding analysis, design and implementation methods.
8. Understand the principle and applications of OFDM with the need of channel estimation.
9. Understand the concept and application of UWB as well as impact of UWB channel on system design.

UNIT-I

Cellular Concept: Cellular concept fundamentals, frequency reuse, channel assignment strategies, handoff, trunking and grade of service, improving coverage and capacity.

12 Hrs

UNIT-II

Diversity Techniques: Introduction and Principle of diversity, Types, Combining and switching methods, Rake receiver, Transmit and Receive diversity, Space time coding – Alamouti codes design and properties, BLAST architectures, MIMO systems.

10 Hrs

UNIT-III

CDMA Systems: Introduction to CDMA, Direct Sequence CDMA, Frequency Hop CDMA, Pulse position hopped CDMA, Orthogonal and Quasi-orthogonal expansions of Spread spectrum signals, Reception of Spread Spectrum signals in AWGN channel - Introduction to Block Coding, First-Order Reed–Muller Code, Noncoherent Reception of Encoded DS CDMA Signals, Introduction to Convolutional Coding, Convolutional Coding in DS CDMA Systems, Orthogonal Convolutional Codes, Coding in FH and PPH CDMA Systems, Concatenated Codes in CDMA Systems, Forward Error Control Coding in Spread Spectrum.

10 Hrs

UNIT-IV

OFDM: Introduction, Principle of OFDM,Frequency selective channels, Channel estimation, Peak to average power ratio, Intercarrier interference, Adaptive modulation and capacity, Multiple access, Impairment of wireless channels to OFDM. 10 Hrs

UNIT-V

UWB: Introduction To Ultra-Wideband, Ultra-wideband application classes, Brief history of ultra-wideband, Next generation HDR applications, Matching of UWB to HDR applications, Physical layer characteristics – Multiband, Multiband OFDM.

Ultra-Wideband Channel Modeling: Principles and Background of UWB Multipath Propagation Channel Modeling -Channel Sounding Techniques - UWB Statistical-Based Channel Modeling -Impact of UWB Channel on System Design - Potential Benefits of MIMO**. 10 Hrs**

Reference Books:

R1. T.S.Rappaport, **"Wireless Communications – Principles & Practice"**, Second Edition, PHI, 2002.
R2. Andrea Goldsmith, "**Wireless Communication"**, Cambridge University Press, 2005.
R3. Andreas F. Molish, **"Wireless Communications"**, John Wiley and Sons, 2005.
R4. Kamil Sh. Zigangirov, **"Theory of Code Division Multiple Access Communication"**, Wiley IEEE Press, 2004.
R5. Stephen Wood & Roberto Aiello, **"Essentials of UWB"**, Cambridge University Press 2008.
R6. Ke-Lin Du &M.N.S.Swamy, **"Wireless Communication System from RF subsystems to 4G Enabling Technology"**, Cambridge University Press 2010.
R7**.** Simon Haykin and Michael Moher, **"Modern Wireless Communication",** Pearson Education 2005.

SPREAD SPECTRUM COMMUNICATION SYSTEMS

Subject Code	**17DEC211**	**Credits**	**5**
Hours/Week	**4+0+0+0**	**CIE**	**50 Marks**
Total Hours	**52**	**SEE**	**50 Marks**

Course Outcomes:

At the end of the course the student should be able to:

1. Appreciate the need of spread spectrum communication system.
2. Understand the concept and generation of pseudo random sequences.
3. Understand the effective means of synchronization between transmitter and receiver.
4. Realize the performance of spread spectrum systems in jamming environments.
5. Understand and appreciate the performance of spread spectrum systems with forward error correction.

UNIT-I

Introduction to Spread Spectrum Systems: Introduction,Need of spread spectrum, Notion of spread spectrum, Two communication problems, Direct sequence spread spectrum, Frequency hop spread spectrum, Hybrid direct sequence/frequency hop spread spectrum, Complex envelope representation of spread spectrum systems.

10 Hrs

UNIT-II

Binary Shift Register Sequences for Spread Spectrum Systems: Introduction, Mathematical background and sequence generator fundamentals, Maximum length sequences – Properties, Power spectrum, Autocorrelation properties, Gold Codes.
10 Hrs

UNIT-III

Synchronization of Spread Spectrum Systems: Acquisition, Trackimg, Optimum Tracking of wideband signals, Delay lock loop (baseband and Noncoherent), tau-dither noncoherent tracking loop, Noncoherent delay lock loop with arbitrary data and spreading modulation, Code tracking loops for frequency hop systems, Synchronization using matched filter, Sysnchronization by estimating the received spreading code.

12 Hrs

UNIT-IV

Performance of Spread Spectrum Systems in Jamming Environments: Introduction, Model of spread spectrum communication system, Performance of spread spectrum systems without coding, Performance in AWGN jamming, partial band jamming, pulsed noise jamming, single tone jamming, multiple tone jamming.

10 Hrs

UNIT-V

Performance of Spread Spectrum Systems with Forward Error Correction: Introduction, Elementary block coding concepts, Convolutional coding concepts, Results of specific error correction codes – BCH codes, RS codes, Maximunm free distance convolutional codes, Repeat coding for the hard decision FH/MFSK channel, Interleaving, Coding bounds.

10 Hrs .

Reference Books:

R1. Roger L.Peterson, Rodger E.Ziemer, DavidE.Borth, “Introduction to Spread Spectrum Communications”, Prentice Hall, 1995.

R2. Don Torrieri “Principles of Spreade Spectrum Communications”, Springer, Third Edition, 2015.

R3. Robert C. Dixon, “Spread Spectrum Systems with Commercial Applications”, John Wiley & Sons, Third Edition, 1994.

R4. Marvin Simon, Jim Omura, Robert Scholtz, Barry Levitt “Spread Spectrum Communication Handbook”, McGraw - Hill Inc., 2002..

IMAGE AND VIDEO PROCESSING

Subject Code	**17DEC212**	**Credits**	**4**
Hours/Week	**4+0+0+0**	**CIE**	**50 Marks**
Total Hours	**52**	**SEE**	**50 Marks**

Course Outcomes:

At the end of the course the student should be able to:

1. Provide an introduction to principles of digital image and video processing.
2. Use point operations, choose appropriate color spaces, perform basic image segmentation and image filtering.
3. Implement multiresolution and image matching techniques, video filters, and basic algorithms for image and video compression.

UNIT-I

Introduction: 2D systems, Mathematical preliminaries – Fourier Transform, Z - Transform, Optical & Modulation transfer function, Matrix theory, Random signals, Discrete Random fields, Spectral density function.

Image Perception: Light, Luminance, Brightness, Contrast, MTF of the visual system, Visibility function, Monochrome vision models, Fidelity criteria, Color representation, Chromaticity diagram, Color coordinate systems, Color difference measures, Color vision model, Temporal properties of vision.

10 Hrs

UNIT-II

Image Sampling and Quantization: Introduction, 2D sampling theory, Limitations in sampling & reconstruction, Quantization, Optimal quantizer, Compander, Visual quantization.

Image Transforms: Introduction, 2D orthogonal & unitary transforms, Properties of unitary transforms, DFT, DCT, DST, Hadamard, Haar, Slant, KLT, SVD transform.

10Hrs

UNIT-III

Image Representation by Stochastic Models: Introduction, one-dimensional Causal models, AR models, Non-causal representations, linear prediction in two dimensions.

Image Enhancement: Point operations, Histogram modeling, spatial operations, Transform operations, Multispectral image enhancement, false color and Pseudo-color, Color Image enhancement.

Image Filtering & Restoration: Image observation models, Inverse & Wiener filtering, Fourier Domain filters, Smoothing splines and interpolation, Least squares filters, generalized inverse, SVD and Iterative methods, Maximum entropy restoration, Bayesian methods, Coordinate transformation & geometric correction, Blind de-convolution.

12 Hrs

UNIT-IV

Image Analysis & Computer Vision: Spatial feature extraction, Transform features, Edge detection, Boundary Extraction, Boundary representation, Region representation, Moment representation, Structure, Shape features, Texture, Scene matching & detection, Image segmentation, Classification Techniques.

Image Reconstruction from Projections: Introduction, Radon Transform, Back projection operator, Projection theorem, Inverse Radon transform, Fourier reconstruction, Fan beam reconstruction, 3D tomography.

10Hrs

UNIT-V

Image Data Compression: Introduction, Pixel coding, Predictive techniques, Transform coding, Inter-frame coding, coding of two tone images, Image compression standards.

Video Processing: Fundamental Concepts in Video –Types of video signals, Analog video, Digital video, Color models in video, Video Compression Techniques – Motion compensation, Search for motion vectors, H.261, H.263, MPEG I, MPEG 2, MPEG 4, MPEG 7 and beyond, Content based video indexing.

10Hrs

Reference Books:

R1. A.K. Jain, **"Fundamentals of Digital Image Processing"**, Pearson Education (Asia) Pte. Ltd./Prentice Hall of India,2004.

R2. Z. Li and M.S. Drew, **"Fundamentals of Multimedia"**, Pearson Education (Asia) Pte. Ltd. 2004

R3. R. C. Gonzalez and R. E. Woods, **"Digital Image Processing"**, 2nd edition, Pearson Education (Asia) Pte. Ltd/Prentice Hall of India, 2004.

R4. M. Tekalp, **"Digital Video Processing"**, Prentice Hall, USA, 1995.

PATTERN & VOICE RECOGNITION

Subject Code	**17DEC213**	**Credits**	**4**
Hours/Week	**4+0+0+0**	**CIE**	**50 Marks**
Total Hours	**52**	**SEE**	**50 Marks**

Course Outcomes:

At the end of the course the student should be able to:

1. Design systems and algorithms for pattern recognition (signal classification), with focus on sequences of patterns that are analyzed using, e.g., hidden Markov models (HMM).
2. Analyse classification problems probabilistically and estimate classifier performance.
3. Understand and analyse methods for automatic training of classification systems.
4. Apply Maximum-likelihood parameter estimation in relatively complex probabilistic models, such as mixture density models and hidden Markov models.
5. Understand and design the systems with voice recognition

UNIT-I

Introduction: Applications of pattern recognition, statistical decision theory, image processing and analysis.

Probability: Introduction, probability of events, random variables, Joint distributions and densities, moments of random variables, estimation of parameters from samples, minimum risk estimators.

10 Hrs

UNIT-II

Statistical Decision Making: Introduction, Baye's Theorem, multiple features, conditionally independent features, decision boundaries, unequal costs of error, estimation of error rates, the leaving-one—out technique. Characteristic curves, estimating the composition of populations.

10 Hrs

UNIT-III

Nonparametric Decision Making: Introduction, histograms, Kernel and window estimators, nearest neighbor classification techniques, adaptive decision boundaries, adaptive discriminate Functions, minimum squared error discriminate functions, choosing a decision making technique.

10 Hrs

UNIT-IV

Clustering: Introduction, hierarchical clustering, partitional clustering.

Artificial Neural Networks: Introduction, nets without hidden layers. nets with hidden layers, the back Propagation algorithms, Hopfield nets, an application.

Processing of Waveforms and Images: Introduction, gray level sealing transformations, equalization, geometric image and interpolation, Smoothing, transformations, edge detection, Laplacian and sharpening operators, line detection and template matching, logarithmic gray level sealing, the statistical significance of image features.

12 Hrs

UNIT-V

Speech Synthesis: Principles of speech synthesis, Synthesizer methods, Synthesis of intonation, Speech synthesis for different speakers, Speech synthesis in other languages, Evaluation, Practical speech synthesis. Automatic Speech Recognition: Introduction, Speech recognition vs. Speaker recognition, Signal processing and analysis methods, Pattern comparison techniques, Hidden Markov Models, Artificial Neural Networks.

10 Hrs

Reference Books:

R1. EartGose, Richard Johnsonburg and Steve Joust, **"Pattern Recognition and Image Analysis"**, Prentice-Hall of India, 2003.

R2. Duda and Hart, **"Pattern recognition (Pattern recognition a scene analysis)".**

R3. Robert J Schalkoff, **"Pattern recognition: Statistical, Structural and Neural approaches",** John Wiley.

R4. L. R. Rabiner and R. W. Schafer, **"Digital Processing of Speech Signals"**, Pearson Education (Asia) Pte. Ltd. 2004.

CLOUD COMPUTING

Subject Code	**17DEC214**	**Credits**	**4**
Hours/Week	**4+0+0+0**	**CIE**	**50 Marks**
Total Hours	**52**	**SEE**	**50 Marks**

Course Outcomes:

After completion of this subject, students will be able to

1. Understand the concepts of distributed systems, parallel computing, cluster computing and virtualization.
2. Design and implement cloud networks for various applications.
3. Maintain cloud data centers and cloud based information systems for cloud computing.

UNIT I:

Introductory concepts and overview: Datacentre technologies, cloud service models, Distributed systems, Parallel computing architectures: Vector processing, Symmetric multi-processing and Massively parallel processing systems,
High performance Cluster computing, Grid computing, Service Oriented Architecture overview, Virtualization, distributed management of virtual infrastructure ,cloud computing architecture, Direct I/O access Architecture, LUN access architecture.

10 Hrs

UNIT II:

Advanced Cloud Architecture: Hypervisor clustering architecture, Zero downtime architecture, Cloud Balancing Architecture
Web services delivered from the cloud: Infrastructure as a service, Platform-as-a-service, Software-as-a-service. computing and software-as-a service, Approach to a data centre based SOA, Software defined Storage.

10 Hrs

UNIT III:

Work engine for clouds: Workflow management system and clouds, Architecture of workflow management system, Utilizing clouds for workflow execution
Federation Presence, Identity and Privacy in the cloud: Federation in the cloud, Presence in the cloud, Privacy and its relation to cloud based information system.
Security in the Cloud: Cloud security challenges, cloud security mechanisms, Identity access managements.

12 Hrs

UNIT IV:

Openstack: Introduction to Openstack, Open stack deployment for cloud, Integration pattern for open stack cloud

Collaboration Mobile internet devices and the cloud: Smartphone, mobile operating systems for smart phones, Mobile Platform virtualization, Collaboration applications for mobile platforms, Future trends.

10 Hrs

UNIT V:

Virtualization: Adding guest Operating system. Cloud computing case studies1: Amazon EC2, Amazon simple DB, Amazon S3, Amazon Cloud Front, Amazon SQS.

10 Hrs

Text Books:

1. John W. Rittinghouse, James F. Ransome, “Cloud Computing implementation, management and security”, CRC Press, Taylor & Francis group, 2010.
2. Anthony T.velte, Toby J.velte Robert Elsenpeter “Cloud Computing: A practical approach”, Tata McGraw Hill edition, 2010.

References:

1. George Reese , “Cloud Application Architectures”, Oreilly publishers.
2. David S. Linthicum, Addison, “Cloud Computing and SOA convergence in your enterprise”, Wesley Publications
3. RajkumarBuyya , James Broberg, Andrzej Goscinski: Cloud Computing Principles and Paradigms, Willey 2014.
4. John W Rittinghouse, James F Ransome:Cloud Computing Implementation, Management and Security, CRC Press 2013
5. Openstack for architects.Michaelsolberghpackt publishing limited 2017

MULTI-RATE SYSTEMS AND FILTER BANKS

Subject Code	**17DEC221**	**Credits**	**5**
Hours/Week	**4+2+0+0**	**CIE**	**50 Marks**
Total Hours	**52**	**SEE**	**50 Marks**

Course Outcomes

1. Distinguish between single rate and multi-rate systems
2. Realize the perfect reconstruction and efficient systems
3. Develop decomposition and reconstruction of signals using filter bank structures
4. Design systems using time-frequency decomposition techniques

UNIT- I

Fundamentals of Multi-rate Systems: Basic multirate operations, interconnection of building blocks, polyphase representation, multistage implementation, applications of multirate systems, special filters and filter banks.

12 Hrs

UNIT- II

Maximally decimated filter banks: Errors created in the QMF bank, alias free QMF system, power symmetric QMF banks, M-channel filter banks, polyphase representation, perfect reconstruction systems, alias free filter banks, tree structured filter banks, transmultiplexers.

10 Hrs

UNIT- III

Paraunitary Perfect Reconstruction Filter Banks: Lossless transfer matrices, filter bank properties induced by paraunitariness, two channel Paraunitary lattices, transform coding.

10 Hrs

UNIT- IV

Linear Phase Perfect Reconstruction (PR) QMF Banks: Necessary conditions, lattice structures for linear phase FIR PR QMF banks, formal synthesis of linear phase FIR PR QMF lattice. Cosine Modulated Filter Banks: Pseudo-QMF bank and its design, efficient poly-phase structures, properties of cosine matrices, cosine modulated perfect reconstruction systems.

10 Hrs

UNIT-V

Wavelet Transform: Short-time Fourier transform, Wavelet transform, Analysis of audio, Speech, Image and video signals.

10 Hrs

TEXT BOOK:

1. P.P. Vaidyanathan, “Multi-Rate Systems & Filter banks,” Prentice Hall, 2004.

REFERENCES:

1. Gilbert Strang and Truong Nguyen, "Wavelets and Filter Banks," Wellesley-Cambridge Press, 1996.
2. E.J. Candè and Wakin MB, “An introduction to compressive sampling,” IEEE *Signal Processing Magazine*, vol. 25, no. 2, pp. 21-30, Mar. 2008.
3. MATLAB Toolbox for Wavelet Transforms.

MIMO SYSTEMS

Subject Code	**17DEC222**	**Credits**	**5**
Hours/Week	**4+0+0+0**	**CIE**	**50 Marks**
Total Hours	**52**	**SEE**	**50 Marks**

Course Outcomes:

At the end of the course the student should be able to:

1. Understand MIMO system and how the capacity enhancement is achieved in MIMO systems.
2. Apply the MIMO capacity formula to get an insight about MIMO communications.
3. Realize multipath propagation and MIMO channel models
4. Understand and appriciate the use of Alamouti codes and Space-time codes.
5. Understand the spatial multiplexing scheme and associated transmit architecture as well as demultiplexing methods.

UNIT-I

Overview of MIMO communications: Introduction to MIMO, Smart antenna vs MIMO, Single-user and multi-user MIMO, Introduction to Spatial Diversity and Spatial Multiplexing, Open and Closed loop MIMO, Practical use of MIMO, MIMO capacity formula, MIMO System Model, Evaluating capacity.

10Hrs

UNIT-II

Application of MIMO Capacity: MIMO capacity under the CSIR assumption, Eigen-channels and channel rank, Optimum distribution of channel eigen values, Eigen beamforming, Optimal allocation of power in Eigen beamforming, Single-mode Eigen beamforming, Performance comparison, Capacities of SIMO and MISO channels, Capacity of random channels.

10 Hrs

UNIT-III

RF Propagation and MIMO channel models: Phenomenology of multipath channels, Power law propagation, Impulse response of a multipath channel, Intrinsic multipath channel parameters, Classes of multipath channels, Statistics of small-scale fading, MIMO channels in LOS geometry, General channel model, Kronecker channel model, Impact of antenna correlation on MIMO capacity, Antenna spacing and scattering angle, Pinhole-scattering, LOS channel model.

12 Hrs

UNIT-IV

Alamouti Coding and Space-time Coding: Maximal ratio receive combining (MRRC), Challenges with achieving transmit diversity, Alamouti coding 2 x 1, 2 x *N*, Maximum likelihood decoding in MRRC and Alamouti receivers, Performance results, Space-time coding: Definition, Spectral efficiency, Space-time code design criteria, Orthogonal space-time block codes, Space-time trellis codes.

10 Hrs

UNIT-V

Spatial Multiplexing: Overview of spatial multiplexing, BLAST architecture, V-BLAST, H-BLAST, D-BLAST, Demultiplexing method for H-BLAST and V-BLAST, Multi-group space-time coded modulation, Practical MIMO examples:Wi-Fi, LTE.

10 Hrs .

Reference Books:

R1. Jerry R.Hampton, “Introduction to MIMO Communications”, Cambridge University Press, 2014.

R2. A.Paulraj, R. Nabar, D. Gore, “Introduction to Space-Time Wireless Communications”, Cambridge University Press, 2003.

R3. Andrea Goldsmith, “Wireless Communication”, Cambridge University Press 2005.

R4. Jafarkhani, “Space-Time Coding: Theory and Practice”, Cambridge University Press, 2005.

SOFTWARE DEFINED RADIO

Subject Code	**17DEC223**	**Credits**	**4**
Hours/Week	**4+0+0+0**	**CIE**	**50 Marks**
Total Hours	**52**	**SEE**	**50 Marks**

Outcomes:

After completion of this course the students will be able to

1. Get an idea about software defined radio and multi standard terminals.
2. Summarize the architectures of software defined radio.
3. Analyse and differentiate all amplifiers, transmitters and filters.
4. Design single and multi-carrier receiver systems.
5. Design multi band receiver and apply dynamic range assignment in radio systems.
6. Differentiate about linearity and non-linearity techniques and apply these techniques.

UNIT I

INTRODUCTION ABOUTSOFTARE DEFINED RADIO: Definition of Software defined radio, Benefits of multi-standard terminals, models for SDR, and its operation system.

10 Hrs

UNIT II

ARCHITECTURE OF SOFTARE DEFINED RADIO: Software defined radio architectures, Hardware specifications, Digital aspects of Software defined radio, its limitations.

10 Hrs

UNIT III

TRANSMITTERS: Flexible transmitters, Power amplifiers, Analogue quadrature up conversion, Interpolated band pass up conversion, PLL based modulator transmitter, All-pass filtering, Poly phase filtering.

10 Hrs

UNIT IV

RECIEVRS: Flexible RF receiver architectures, Digital receiver, Single carrier and multi-carrier designs, Receiver sensitivity, ADC spurious signals.

10 Hrs

UNIT V

RECIVER'S DESIGN: Multiband Flexible receiver design, RF Transmit / receive switch, Image rejection mixing, dynamic range enhancement.

TECHNIQUES IN SOFTWARE DEFINED RADIO: Feed forward techniques, linearity, non-linearity techniques, their differences, its limitations and Applications.

12 Hrs

Text Books:

1. Markus Dillinger, KambizMadani, Nancy Alonistioti, "Software Defined Radio: Architectures, Systems and Functions", John Wiley & Sons, 2005.
2. Walter H.W. Tuttlebee, "Software Defined Radio: Enabling Technologies", John Wiley & Sons, 2003.
3. Eugene Grayver, "Implementing Software Defined Radio", Springer, 2012.

Reference Books:

1. P Kenington, "RF and Baseband Techniques for Software Defined Radio", Artec House, 2005
2. JoukoVanakka, "Digital Synthesizers and Transmitter for Software Radio", Springer, 2005
3. Wally H. W. Tuttlebee**, "**Software Defined Radio: Baseband Technologies for 3G Handsets and Base stations",John Wiley & sons , 2003

WIRELESS AND MOBILE NETWORKS

Sub Code : 17DEC224	**Credits : 04**
Hrs/Week : 4+0+0+0	**CIE :**
50 Marks Total Hours : 52	**SEE :**
50 Marks	

Course Outcomes:

At the end of the course the student should be able to:

6. Understand the fundamentals of wireless and mobile networks.
7. Explain different propagation modeling used in wireless networks.
8. Detail the concepts of Wireless Body Area and Personal Area Networks.
9. Understand wireless adhoc and sensor networks.
10. Appreciate the concepts of radio planning.

UNIT I

Fundamentals of Wireless Networks: Wireless Network, Wireless Switching Technology, Wireless Communication Problems, Wireless Network Reference Model, Wireless Networking Issues, Wireless Networking Standards. Mobility Management, Handoff, Roaming Management, Hard and Soft Handoff.

10 Hrs

UNIT II

Propagation Modeling: Fixed to mobile channels, mobile to mobile channels, Statistical Characterization of Multipath- Fading Channels, Polarized Channel Modeling, MIMO Channels, Shadowing, Path Loss models.

10 Hrs

UNIT III

Wireless Body Area and Personal Area Networks: Wireless Body Area Network (WBAN), Network Architecture, Network Components, Design Issues, Network Protocols, WBAN Technologies.

Wireless Personal Area Network (WPAN), Network Architecture, WPAN Components, WPAN Technologies and Protocols.

12 Hrs

UNIT IV

Wireless Ad Hoc Networks: Wireless Ad Hoc Networks, Mobile Ad Hoc Networks, Wireless Sensor Networks, Wireless Mesh Networks, Vehicular Ad Hoc Networks (VANETs), Research issues in Wireless Networks.

10 Hrs

UNIT V

Frequency Planning and CDMA Systems: OFDMA Radio Planning, Cluster-Planned Hierarchical Architecture, Macrodiversity Architectures. CDMA Cellular Systems: CDMA Power Control, Capacity of Cellular CDMA, Hierarchical Macrodiversity CDMA Cellular Architectures.

10 Hrs

REFERENCE BOOKS:

1. S. S. Manvi, and M. S. Kakkasageri, **"Wireless and Mobile Network Concepts and Protocols",** Wiley, 2010.
2. Gordan L. Stuber, **"Principles of Mobile Communication"**, Springer, 2017.
3. Yi-Bing Lin and ImrichChlamtac, **"Wireless and Mobile Network Architectures"**, John Wiley & Sons, 2008.
4. Ivan Stojmenovic, **"Handbook of Wireless Networks and Mobile Computing"**, John Wiley & Sons, 2003.
5. Murthy, C. Siva Ram, and B. S. Manoj. **"Ad hoc Wireless Networks: Architectures and Protocols"**, Pearson Education, 2004.

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