7ETC01: CRYPTOGRAPHY AND NETWORK SECURITY

Course Pre-requisites:

1. 4ETC04 : Signals and Systems
2. 5ETC03 : Digital Signal Processing
3. 6ETC01: Communication Network

Course Objectives:

1. Explain the objectives of information security
2. Explain the importance and application of each of confidentiality, integrity, authentication and availability
3. Understand various cryptographic algorithms.
4. Understand the basic categories of threats to computers and networks
5. Describe public-key cryptosystem.
6. Describe the enhancements made to IPv4 by IPSec

Course Outcomes: Upon successful completion of this course, the student will be able to:

1. Understand basic cryptographic algorithms
2. Attain the knowledge of message and web authentication and security issues.
3. Identify information system requirements
4. Understand the current legal issues towards information security
5. Discuss the fundamental ideas of public-key cryptography
6. Understand Intrusions and intrusion detection.

Unit – I: Security Concepts: Introduction, The need for security, Security approaches, Principles of security, Types of Security attacks, Security services, Security Mechanisms, A model for Network Security Cryptography Concepts and Techniques: Introduction, plain text and cipher text, substitution techniques, transposition techniques, encryption and decryption, symmetric and asymmetric key cryptography, steganography, key range and key size, possible types of attacks. (6)

Unit-II: Symmetric key Ciphers: Block Cipher principles, DES, AES, Blowfish, RC5, IDEA, Block cipher operation, Stream ciphers, RC4. (6)

Unit-III: Asymmetric key Ciphers: Principles of public key cryptosystems, RSA algorithm, Elgamal Cryptography, Diffie-Hellman Key Exchange, Knapsack Algorithm. (6)

Unit-IV: Cryptographic Hash Functions: Message Authentication, Secure Hash Algorithm (SHA-512), Message authentication codes: Authentication requirements, HMAC, CMAC, Digital signatures, Elgamal Digital Signature Scheme. Key Management and Distribution: Symmetric Key Distribution Using Symmetric & Asymmetric Encryption, Distribution of Public Keys, Kerberos, X.509 Authentication Service, Public – Key Infrastructure (6)

Unit-V: Transport-level Security: Web security considerations, Secure Socket Layer and Transport Layer Security, HTTPS, Secure Shell (SSH) Wireless Network Security: Wireless Security, Mobile Device Security, IEEE 802.11 Wireless LAN, IEEE 802.11i Wireless LAN Security. (6)

Unit-VI: E-Mail Security: Pretty Good Privacy, S/MIME IP Security: IP Security overview, IP Security architecture, Authentication Header, Encapsulating security payload, Combining security associations, Internet Key Exchange Case Studies on Cryptography and security: Secure Multiparty Calculation, Virtual Elections, Single sign On, Secure Inter-branch Payment Transactions, Cross site Scripting Vulnerability. (6)

Text Books:

1. Cryptography and Network Security - Principles and Practice: William Stallings, Pearson Education, 6th Edition.
2. Cryptography and Network Security: Atul Kahate, Mc Graw Hill, 3rd Edition.

Reference Books:

1. Cryptography and Network Security: C K Shyamala, N Harini, Dr T R Padmanabhan, Wiley India, 1st Edition.
2. Cryptography and Network Security: Forouzan Mukhopadhyay, Mc Graw Hill, 3rd Edition.
3. Information Security, Principles, and Practice: Mark Stamp, Wiley India.
4. Principles of Computer Security: WM. Arthur Conklin, Greg White, TMH .
5. Introduction to Network Security: Neal Krawetz, CENGAGE Learning 6. Network Security and Cryptography: Bernard Menezes, CENGAGE Learning.

7ETC02: DIGITAL IMAGE AND VIDEO PROCESSING

Course Requisite:

1. Signals and Systems. (4ETC04)
2. Digital Signal Processing (5ETC03)

Course Objectives:

After taking this course student will be capable to learn and apply:

1. Fundamentals of digital image processing
2. Digital image filtering techniques in spatial and frequency domain.
3. Knowledge of image transform and enhancement techniques in digital image processing
4. Various image compression techniques used in digital image processing.
5. Fundamentals of Video Processing and segmentation.

Course Outcomes:

After successful completion of the course the student will be able to:

1. Comprehend fundamentals of digital image processing.
2. Understand & apply knowledge of spatial domain and frequency domain filtering to digital images.
3. Analysis of image segmentation and morphological techniques.
4. Understand image degradation model and its restoration; analyze various image compression techniques based on redundancy features.
5. Understand the Fundamentals of digital video processing.
6. Comprehend motion estimation and video processing applications.

Unit-I: Digital Image Fundamentals: Elements of visual perception, image as a 2-D signal, image sensing and acquisition, image sampling and quantization, image formats, image types, basic relationships between pixels neighborhood, adjacency, connectivity, distance measures. (6)

Unit-II: Image Enhancements and Filtering in Spatial and Frequency domain: Gray level transformations, histogram equalization and specifications, spatial-domain smoothing filters ï linear and order-statistics, spatial-domain sharpening filters: first and second derivative, two-dimensional DFT and its inverse, frequency domain filters low-pass and high-pass. (6)

Unit-III : Image Segmentation and Image morphological techniques: Detection of discontinuities, Thresholding : local and global, region-based segmentation, edge and boundary detection techniques using laplace, guassian and high pass filtering, Basic morphological image processing concepts, Basic concepts of erosion and dilation, The Hit-or-Miss Transformation. (6)

Unit –IV: Image restoration and Compression techniques.: Image degradation and restoration technique (Wiener filtering), Image Compression Redundancyï inter-pixel, psycho-visual and coding, entropy, Loss less compression (Huffman and Lempel-Ziv), Lossy compression- predictive and transform coding; Still image compression standards ï JPEG and JPEG-2000. (6)

Unit-V: Fundamentals of Video Processing : Time-Varying Image Formation model, fundamentals of Three-Dimensional Motion Model, Geometric Image Formation, Photometric Image Formation, Sampling of Video signals in spatial domain**,** formats of video signals**.** (6)

Unit-VI: Applications of digital video processing: Motion estimation using pixel based, block matching and mesh based**,** Application of motion estimation in video coding, Fundamentals of Temporal segmentation, Video object detection and tracking. (6)

Text Books:

1. Gonzaleze and Woods ,òDigital Image Processing ñ, 3rd edition , Pearson
2. S. Jayaraman, S. Esakkirajan, T. Veerakumar,òDigital Image Processing ñ, 2nd edition, McGraw Hill publication
3. M. Tekalp ,òDigital video Processingò, Prentice Hall International
4. Yao wang, Joem Ostarmann and Ya ï quin Zhang, òVideo processing and communication ñ, 1st edition , PHI

Reference Books:

1. Anil Kumar Jain, Fundamentals of Digital Image Processing, Prentice Hall of India.2nd edition 2004
2. Arthur R. Weeks, ñFundamentals of Electronic Image Processingò, Wileyï Blackwell
3. Wiliam Pratt,ò Digital Image Processing: PIKS Inside, Fourth Editionò, A Wiley-Interscience Publication

7ETC03 PROJECT MANAGEMENT & ENTREPRENEURSHIP

Course requisite: 6ETC05 Economics for Engineers:

Course Objectives:

1. To make them understand the concepts of Project Management for planning to execution of projects.
2. To make them understand the feasibility analysis in Project Management and network analysis tools for cost and time estimation.
3. To enable them to comprehend the fundamentals of Contract Administration, Costing and Budgeting.
4. Make them capable to analyze, apply and appreciate contemporary project management tools and methodologies in Indian context.

Course Outcomes:

Upon successful completion of this course, the student will be able to:

1. Understand basic concept of Project management
2. Attain the knowledge of cost estimation & working capital
3. Prepare Cost Sheets, balance sheets and Cash Flow statements
4. Understand the Entrepreneurial competencies & traits
5. Discuss the Management skills for Entrepreneurs
6. Understand Social Entrepreneurship

Unit-I: Project Management: Project management: meaning, scope & importance, role of project manager; project life-cycle Project appraisal: Preparation of a real time project feasibility report containing Technical appraisal,; Environmental appraisal, Market appraisal (including market survey for forecasting future demand and sales) and Managerial appraisal. (6)

Unit-II: Project Financing: Project cost estimation & working capital requirements, sources of funds, capital budgeting, Risk & uncertainty in project evaluation. (6)

Unit-III: Project Report and Finance: preparation of projected financial statements viz. Projected balance sheet, projected income statement, projected funds & cash flow statements, Preparation of detailed project report, Project finance. (6)

Unit-IV: Entrepreneurship: Entrepreneurship: need, scope, Entrepreneurialcompetencies & traits, Factors affecting entrepreneurial development,Entrepreneurial motivation (Mc Clellendôs Achievement motivationtheory), conceptual model of entrepreneurship, Entrepreneur vs.Entrepreneur; Classification of entrepreneurs; Entrepreneurial Development Programmes. (6)

Unit-V: Entrepreneurial Idea and Innovation: Introduction to Innovation, Entrepreneurial Idea Generation and Identifying Business Opportunities,Management skills for Entrepreneurs and managing for Value Creation,Creating and Sustaining Enterprising Model & Organizational Effectiveness. (6)

Unit-VI: Social Entrepreneurship: Social Sector Perspectives and Social Entrepreneurship, Social Entrepreneurship Opportunities and Successful Models, Social Innovations and Sustainability, Marketing Management for Social Ventures, Risk Management in Social Enterprises, Legal Framework for Social Ventures. (6)

Text Books:

1. Innovation and Entrepreneurship by Drucker, P.F.; Harper and Row
2. Business, Entrepreneurship and Management: Rao, V.S.P.; Vikas

Reference Books:

1. Entrepreneurship: Roy Rajeev; OUP.
2. Text Book of Project Management: Gopalkrishnan, P. and Ramamoorthy, V.E.;McMillan
3. Project Management for Engineering, Business and Technology: Nicholas, J.M., andSteyn, PHI

7ETC04 PROFESSIONAL ELECTIVE - III (PE-III)
(i) HIGH SPEED ELECTRONICS

Course Requisite: 4ETC02 Analog Circuits

Course Objectives: To learn:

1. Basic concepts of the active and passive devices.
2. Basics of non-ideal interconnect issues.
3. The PCB making design concepts.

Course Outcomes: At the end of the course, students will demonstrate the ability to:

1. Explain significance and the areas of application of high-speed electronics circuits.
2. Analyze effect of noise in high speed application
3. Summarize the properties of various components used in high speed electronics
4. Design the various type of RF amplifier for high speed application
5. Explain the operation of the Mixer, Oscillator and PLL transceiver
6. Design the various types of PCB using CAD tool

Unit-I: Transmission line theory (basics): The Importance of Interconnect Design, Transmission Line Structures, Wave Propagation, Transmission Line Parameters, Transmission Line Reflections, Termination Schemes to Eliminate Reflections, Multiple Reflections, Crosstalk, Crosstalk Estimation, Crosstalk Termination Schemes. (6)

Unit-II: Basics of Non ideal Interconnect Issues, Transmission Line Losses, Concentric-Ring Skin-Effect Model, Serpentine Traces. Noise Analysis: Sources, Noise Figure, Gain compression, Harmonic distortion, Inter modulation, Cross-modulation, Dynamic range. (6)

Unit-III: Buffer Modeling, Types of Models, CMOS Output Buffer, Digital Timing Analysis, Common-Clock Timing, Source Synchronous Timing, Clock Repeaters, Zero-Delay Clock Repeaters, Clock Jitter. (6)

Unit-IV: Devices: Passive and active, Lumped passive devices (models), Active (models, low vs. high frequency). (6)

Unit-V: RF Amplifier Design, Stability, Low Noise Amplifiers, Broadband Amplifiers (and Distributed) Power Amplifiers, Class A, B, AB and C, D E Integrated circuit realizations. (6)

Unit VI: Printed Circuit Board: Printed Circuit Board Anatomy, CAD tools for PCB design, Standard fabrication, Microvia Boards. Board Assembly: Surface Mount Technology, Through Hole Technology, Process Control and Design Challenges. (6)

Text Books:

1. Stephen H. Hall, Garrett W. Hall, James A. McCall ñHigh-Speed Digital System Design: A Handbook of Interconnect Theory and Design Practicesò, August 2000, Wiley-IEEE Press
2. Thomas H. Lee, ñThe Design of CMOS Radio-Frequency Integrated Circuitsò, Cambridge University Press, 2004, ISBN 0521835399.
3. Behzad Razavi, ñRF Microelectronicsò, Prentice-Hall 1998, ISBN 0-13-887571-5.

Reference Books:

1. Guillermo Gonzalez, ñMicrowave Transistor Amplifiersò, 2nd Edition, Prentice Hall.
2. Kai Chang, ñRF and Microwave Wireless systemsò, Wiley.
3. R.G. Kaduskar and V.B.Baru, Electronic Product design, Wiley India, 2011.
4. Chris Schroeder , ñPCB Design Using AutoCADò 1st Edition, 1997.

7ETC04 PROFESSIONAL ELECTIVE - III (PE-III)
(ii) MOBILE COMMUNICATION AND NETWORKS

Course Requisite: 4ETC01 Analog and Digital Communication.

Course Objectives:

1. To know the evolution of Mobile communication and cell concept to improve capacity of the system.
2. To know the role of equalization in Mobile communication and to study different types of Equalizers and Diversity techniques.
3. To understand the concepts of orthogonal frequency division multiplexing.

Course Outcomes:

After completing the course, the students will be able to:

1. Explain basic concept of Cellular systems and standards
2. Demonstrate knowledge of Signal propagation model
3. Compare different multiple access techniques in mobile communication.
4. Summarise the concept of rake receiver
5. Demonstrate advance knowledge of MIMO
6. Compare different Mobile Communication Systems and standards

Unit-I: Cellular concepts: Evolution of Mobile Radio Communication Systems, 1G, 2G, 2.5G, and 3G Wireless Cellular Networks and Standards, Cell structure, frequency reuse, cell splitting and sectoring, Channel assignment, concept of handoff, Interference (both Adjacent Channel and Co-Channel), capacity, power control mechanisms. (7)

Unit-II : Signal propagation-Mobile Radio Propagation: Large Scale Path Loss, Free Space Propagation Model, Reflection, Ground Reflection (Two-Ray) Model, Diffraction, Scattering, Small Scale Fading and Multipath Propagation, Types of Small-Scale Fading: Time Delay Spread; Flat, Frequency selective, Doppler Spread. (7)

Unit-III: Multiple access schemes-Multiple access techniques in wireless communication: FDMA TDMA, CDMA, SDMA and Hybrid, Introduction of OFDM techniques. (5)

Unit-IV: Receiver Structure- Diversity receivers- selection and MRC receivers, RAKE receiver, Equalization: Linear and Adaptive, Algorithms for adaptive equalization, space, polarization, frequency diversity, Interleaving. (6)

Unit-: MIMO Channels: Physical modelling, MIMO and space time signal processing, spatial multiplexing, diversity/multiplexing tradeoff. (5)

Unit-VI: Mobile Systems - GSM, GPRS, CDMA 2000 and WCDMA, LTE, Introduction to Cognitive Radio, Introduction to 5G. (6)

Text Books:

1. T.S.Rappaport, ñWireless Communications Principles and Practiceò, 2nd edition, PHI, 2002.
2. William C.Y.Lee, ñMobile Cellular Telecommunications Analog and Digital Systemsò, 2nd edition, TMH, 1995. Asha Mehrotra, ñA GSM system Engineeringò Artech House Publishers Bosten, London,1997
3. V.K.Garg, J.E.Wilkes, ñPrinciple and Application of GSMò, Pearson Education, 5th edition, 2008.
4. V.K.Garg, ñIS-95 CDMA & CDMA 2000ò, Pearson Education, 4th edition, 2009.

Reference Books:

1. D. Tse and P. Viswanath, Fundamentals of Wireless Communication, Cambridge Univ. Press, 2005.
2. A. Goldsmith, Wireless Communications, Cambridge Univ. Press, 2005.
3. A. Kumar, D. Manjunath, and J. Kuri, Wireless Networking, Morgan Kaufmann, 2008.

7ETC04 PROFESSIONAL ELECTIVE - III (PE-III)
(iii) MIXED SIGNAL DESIGN

Course Requisite: 4ETC02 Analog Circuits.

Course Objectives: The student will understand the concepts of :

1. CMOS Process flow, basic MOSFET and op-amp circuits,
2. Switched capacitors Circuits
3. Phase lock loops
4. Data Converter fundamentals.
5. Nyquist Rate A/D Converters and applications
6. The Oversampling Converters and Continuous-Time Filters

Course outcomes: After successfully completing the course, the students will be able to:

1. Expand knowledge of the CMOS Process, and op-amp design
2. Devise appropriate switch capacitor circuits
3. Analyze phase lock loop circuits
4. Use desired data converters in various applications.
5. Explain Various types of A/D Converters
6. Understand D/A converters.

Unit-I: Submicron CMOS: Overview and Models, CMOS process flow, Capacitors and Resistors. Digital circuit design: The MOSFET Switch, Delay Elements, An Adder. Analog Circuit Design: Biasing, Basic Op-Amp Design. (6)

Unit-II: Switched Capacitor Circuits: Introduction to Switched Capacitor circuits basic building blocks, Operation and Analysis, Non-ideal effects in switched capacitor circuits, switched capacitor integrators, first order filters, Switch sharing. (6)

Unit-III: Phased Lock Loop (PLL): Basic PLL topology, Design and Analysis of various PLL blocks, Basic charge pump PLL, Non-ideal effects in PLLs, Design of FM detector circuit. (6)

Unit-IV: Data Converter Fundamentals: DC and dynamic specifications, Quantization noise, Nyquist rate D/A converters-Decoder based converters, Binary-Scaled converters, Hybrid converters. (6)

Unit-V: Nyquist Rate A/D Converters: Successive approximation converters, Flash converter, Interpolating A/D converters, Folding A/D converters, Pipelined A/D converters, Time interleaved converters. (6)

Unit-VI: Oversampling Converters: Noise shaping modulators, Decimating filters and interpolating filters, Higher order modulators, Delta sigma modulators with multibit quantizers, Delta sigma D/A. (6)

Text Books:

1. Design of Analog CMOS Integrated Circuits- Behzad Razavi, Tata McGraw Hill, 2nd Edition.
2. Analog Integrated Circuit Design- David A. Johns,Ken Martin, Wiley Student Edition.

Reference Books:

1. CMOS Mixed-Signal Circuit Design - R. Jacob Baker, Wiley Interscience, 2009.
2. CMOS Analog Circuit Design ï Philip E. Allen and Douglas R. Holberg, Oxford University Press, International Second Edition/Indian Edition, 2010.

7ETC05 PROFESSIONAL ELECTIVE - IV (PE-IV)
(i) INTRODUCTION TO MEMS

Course Requisite: 3ETC02 - Electronic Devices & Circuits

Course Objectives: The learners will-

1. Understand Scope, importance and application of MEMS
2. Distinguish materials for MEMS devices
3. Examine fundamental laws governing MEMS devices
4. Summarize MEMS design process.
5. Recommend MEMS sensors and actuators
6. Devise MEMS Applications.

Course Outcomes:
After successfully completing the course, the students will be able to:

1. Demonstrate skills to select appropriate material for MEMS devices
2. Understand fabrication process of MEMS
3. Select appropriate sensor and actuator in a given application.

Unit-I: Introduction: Historical background**,** classification, intrinsic characteristics of MEMS, miniaturization issues, microelectronic integration, precision parallel fabrication, scaling effects, future trends. (6)

Unit-II: MEMS Materials: Overview, Physical Properties, Materials: Piezoelectric, Electrostrictive, Magnetostrictive, Magneto-electric; Fluids: Magnetorheological and Electrorheological Fluids. (6)

Unit-III: Mechanics of solids in MEMS/NEMS: Stress, Strain, Hookesõs law, Poisson effect, Linear Thermal Expansion, Bending; Overview of Finite Element Method, Modeling of Coupled Electromechanical Systems. (6)

Unit-IV: Review of Basic MEMS fabrication modules: Oxidation, deposition techniques, lithography (LIGA), Etching, Surface Micromachining, sacrificial layer processes, bulk micromachining, isotropic and anisotropic etching. (6)

Unit-V: MEMS Sensors and Actuation: Sensors and actuators consideration, Electrostatic Sensors, Micro Grippers, Micro Motors, Thermal Resistors, Thermal Bimorph , Piezoresistive Sensors, Pressure and flow Sensors. (6)

Unit-VI: Applications of MEMS : Electronics, automotive and medical; automotive airbag sensor, medical pressure sensor, blood Pressure Sensors, microphone, Bio-MEMS, acceleration sensing, gyros. (6)

Text Books:

1. G. K. Ananthasuresh, K. J. Vinoy, S. Gopalkrishnan K. N. Bhat, V. K. Aatre, ñMicro and Smart Systemsò, Wiley India, 2012. 2.
2. S. E.Lyshevski, ñNano-and Micro-Electromechanical systems: Fundamentals of Nano-and Microengineeringò (Vol. 8). CRC press, (2005).
3. S. D. Senturia, ñMicrosystem Designò, Kluwer Academic Publishers, 2001.

Reference Books:

1. Tai-Ran Hsu, ñMEMS and Microsystems Design and Manufactureò, Tata McGraw Hill Publishing Co. Ltd., New Delhi, 2002.
2. Chang Liu, ñFoundations Of MEMSò, Pearson Education Inc., 2012.
3. Mark Madou, ñFundamentals of Microfabricationò, CRC Press, New York, 1997.

7ETC05 PROFESSIONAL ELECTIVE - IV (PE-IV)
(ii) ERROR CORRECTING CODES

Course Requisite: 4ETC01 Analog and Digital Communication

Course Objectives: After completing this course the students should be able to:

1. Understand Block Codes and Maximum Likelihood Decoding.
2. Understand Decoding Tables, Hamming Weight and Distance and Error Correction vs Detection.
3. Understand Generator Matrix, Parity-Check Matrix and Error-Correcting Capability of a Linear Code
4. Understand Binary Cyclic Codes, encoding with (n-k)-Stage Shift Register and Syndrome Calculations and Error Detection.
5. Understand Error Trapping Decoding for Cyclic Codes.
6. Understand BCH Codes and the encoding and decoding techniques.

Course Outcomes: At the end of the course, students will demonstrate the ability to:

1. Understand the error sources
2. Understand error control coding applied in digital communication
3. Able to transmit and store reliable data and detect errors in data through coding
4. Able to understand the designing of various codes like block codes, cyclic codes, convolution codes, turbo codes and space codes.

Unit-I: Error Control Coding: Introduction to Error Control Coding, Types of Errors, Methods of Controlling Errors, Linear Block Codes: Matrix Description of Linear Block codes, Hamming Distance, Hamming Weight, Minimum Hamming Distance, Hamming Codes. (6)

Unit-II: Linear block codes: Systematic linear codes and optimum decoding for the binary symmetric channel; Generator and Parity Check matrices, Syndrome decoding on symmetric channels; Encoder for Linear Block code, Syndrome Decoding, Syndrome Decoder for (n, k) Linear Block Code, Error Detection and Correction capability of Linear Block Codes (Derivation expected). (7)

Unit-III: Cyclic Codes: Properties of Cyclic Codes, Systematic and Non-Systematic generator Matrix, Parity Check Matrices for Cyclic Codes, Encoders for Cyclic Codes, Syndrome Decoding for Cyclic Codes.
Introduction to Convolution Codes: Time Domain Approach and Transform domain approach for convolution code generation, Code Tree and Code Trellis for Convolution code. (6)

Unit-IV: Cyclic Codes. BCH codes; Reed-Solomon codes, MDS codes, Spectral properties of cyclic codes. ; Cyclic codes - Syndrome calculation, Encoder and decoder ï CRC. (6)

Unit-V: Decoding of BCH codes: Berlekamp's decoding algorithm, Massey's minimum shift register synthesis technique and its relation to Berlekamp's algorithm. (5)

Unit-V: A fast Berlekamp - Massey algorithm. Convolution codes; Wozencraft's sequential Decoding algorithm, Fann's algorithm and other sequential decoding algorithms; Viterbi decoding algorithm. **(6)**

Text Books:

1. F.J. McWilliams and N.J.A. Slone, The theory of error correcting codes, 1977.
2. R.E. Balahut, Theory and practice of error control codes, Addison Wesley, 1983.

Reference Books:

1. Digital Communications-Fundamental and Application - Bernard Sklar, PE
2. Digital Communications- John G. Proakis, 5th ed., 2008, TMH.

7ETC05 PROFESSIONAL ELECTIVE - IV (PE-IV)
(iii) ANTENNA AND PROPAGATION

Course Requisite: 3ETC04: Electromagnetic Waves.

Course Objectives: The student will learn and understand -

1. Basic terminology and concepts of Antennas.
2. Concept of radiation mechanism of various antennas and antenna array.
3. Principle of aperture antennas.
4. Concept of Broadband & Micro strip antennas.
5. Smart antenna environments & implementation.
6. Mechanism and models for radio-wave propagation

Course Outcomes: At the end of the course, students will demonstrate the ability to:

1. Describe the basic concepts and applications of Antenna systems.
2. Determine the radiation pattern and directivity of antenna arrays.
3. Describe the concept of Huygens Principle & Babinetôs Principle.
4. Understated the properties of broadband antennas and micro strip antennas.
5. Describe the basic principles of smart antenna systems.
6. Understand different ways of propagation of radio waves.

Unit-I: Antenna Fundamental: Concept of radiation, Radiation pattern, near-and far-fields, reciprocity, directivity and gain, effective aperture, polarization, input impedance, efficiency, Friis transmission equation. (6)

Unit-II: Antenna Arrays: Radiation from Wires and Loops- Infinitesimal dipole, finite-length dipole, small circular loop, Antenna array, Analysis of uniformly spaced arrays with uniform and non-uniform excitation amplitudes, extension to planar arrays. (6)

Unit-III: Aperture Antennas: Huygensô Principle, radiation from rectangular and circular apertures, design considerations, Babinetôs principle, Radiation from sectoral and pyramidal horns, designconcepts, parabolic reflector and Cassegrain antennas. (6)

Unit-IV: Broadband & Micro strip Antennas: Broadband Antennas: Broadband concept, Log-periodic and Yagi-Uda antennas, frequency independent antennas. Micro strip Antennas- Basic characteristics of micro strip antennas, feeding methods, Introduction of rectangular and circular patch antennas. (6)

Unit-V: Smart Antennas: Smart Antennas: Concept and benefits of smart antennas, fixed weight beam forming basics, Adaptive beam forming. (6)

Unit-VI: Wave Propagation: Modes of Propagation: Ground, Sky & Space Wave Propagations, Structure of Atmosphere, Fading, ionospheric absorptions, Multi-hop propagation and Super refraction. (6)

Text Books:

1. C. A. Balanis, "Antenna Theory and Design", 3rd Ed., John Wiley &Sons, 2005.
2. Harish A. R., Antenna and wave propagation, Oxford University Press. Tri T. Ha, ñDigital
3. Satellite Communicationsò, Tata McGraw-Hill,2009 J.D.Kraus,òAntennas,McGraw-Hill,1988
4. R.S.Elliot, ñAntenna Theory and Designò, IEEE Press, John Wiley, 2005,
5. K.D.Prasad, ñAntennas and Radiating Systemsò, Satyaprakasa

Reference Books:

1. R.E. Collin, Antennas and Radio Wave Propagation, McGraw Hill, 1985.
2. R.C. Johnson and H. Jasik, Antenna Engineering Handbook, McGraw hill, 1984.
3. I.J. Bahl and P. Bhartia, Micro Strip Antennas, Artech House, 1980.
4. R.K. Shevgaonkar, Electromagnetic Waves, Tata McGraw Hill, 2005.
5. R.E. Crompton, Adaptive Antennas, John Wiley.

7ETC06- CRYPTOGRAPHY AND NETWORK SECURITY

Minimum Eight Experiments based on syllabus of 7ETC01:CRYPTOGRAPHY & NETWORK SECURITY must be conducted. Course Objectives and Course Outcomes shall be specified based on the experiments conducted

7ETC07- DIGITAL IMAGE AND VIDEO PROCESSING – LAB.

Minimum Eight Experiments based on syllabus of 7ETC02: Digital Image and Video Processing must be conducted. Course Objectives and Course Outcomes shall be specified based on the experiments conducted

7ETC08- PROJECT MANAGEMENT & ENTREPRENEURSHIP – LAB.

Minimum Eight Experiments based on syllabus of 7ETC03 Project Management and Entrepreneurship must be conducted. Course Objectives and Course Outcomes shall be specified based on the experiments conducted.

7ETC09- PROJECT STAGE-I (SEMINAR)

Seminar based on Final Year Major Project should be conducted with submission of Seminar Report as part of 7ETC09-Project Stage-I (Seminar).

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SEMESTER VIII

8ETC01: EMBEDDED SYSTEMS

Course Requisite:

1. (3ETC03) Digital System Design
2. (3ETC05) Object Oriented Programming
3. (5ETC01) Microcontroller

Course Objectives:

1. To study the concept of Embedded Systems
2. To understand core of the Embedded System
3. To study architecture and inbuilt peripherals of AVR Microcontroller
4. To know microcontroller C Language Programming concepts.
5. To recognize the importance task scheduling in real time embedded systems.
6. To get acquainted with architecture & design of an Embedded System.

Unit-III: Aperture Antennas: Huygensô Principle, radiation from rectangular and circular apertures, design considerations, Babinetôs principle, Radiation from sectoral and pyramidal horns, designconcepts, parabolic reflector and Cassegrain antennas. (6)

Unit-IV: Broadband & Micro strip Antennas: Broadband Antennas: Broadband concept, Log-periodic and Yagi-Uda antennas, frequency independent antennas. Micro strip Antennas- Basic characteristics of micro strip antennas, feeding methods, Introduction of rectangular and circular patch antennas. (6)

Unit-V: Smart Antennas: Smart Antennas: Concept and benefits of smart antennas, fixed weight beam forming basics, Adaptive beam forming. (6)

Unit-VI: Wave Propagation: Modes of Propagation: Ground, Sky & Space Wave Propagations, Structure of Atmosphere, Fading, ionospheric absorptions, Multi-hop propagation and Super refraction. (6)

Text Books:

1. C. A. Balanis, "Antenna Theory and Design", 3rd Ed., John Wiley &Sons, 2005.
2. Harish A. R., Antenna and wave propagation, Oxford University Press. Tri T. Ha, ñDigital
3. Satellite Communicationsò, Tata McGraw-Hill,2009 J.D.Kraus,òAntennas,McGraw-Hill,1988
4. R.S.Elliot, ñAntenna Theory and Designò, IEEE Press, John Wiley, 2005,
5. K.D.Prasad, ñAntennas and Radiating Systemsò, Satyaprakasa

Reference Books:

1. R.E. Collin, Antennas and Radio Wave Propagation, McGraw Hill, 1985.
2. R.C. Johnson and H. Jasik, Antenna Engineering Handbook, McGraw hill, 1984.
3. I.J. Bahl and P. Bhartia, Micro Strip Antennas, Artech House, 1980.
4. R.K. Shevgaonkar, Electromagnetic Waves, Tata McGraw Hill, 2005.
5. R.E. Crompton, Adaptive Antennas, John Wiley.

7ETC06- MICROWAVE THEORY AND TECHNIQUES – LAB.

Minimum Eight Experiments based on syllabus of 7ETC01: Microwave Theory and Techniques must be conducted. Course Objectives and Course Outcomes shall be specified based on the experiments conducted

7ETC07- DIGITAL IMAGE AND VIDEO PROCESSING – LAB.

Minimum Eight Experiments based on syllabus of 7ETC02: Digital Image and Video Processing must be conducted. Course Objectives and Course Outcomes shall be specified based on the experiments conducted

7ETC08- PROJECT MANAGEMENT & ENTREPRENEURSHIP – LAB.

Minimum Eight Experiments based on syllabus of 7ETC03 Project Management and Entrepreneurship must be conducted. Course Objectives and Course Outcomes shall be specified based on the experiments conducted.

7ETC09- PROJECT STAGE-I (SEMINAR)

Seminar based on Final Year Major Project should be conducted with submission of Seminar Report as part of 7ETC09-Project Stage-I (Seminar).

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SEMESTER VIII

8ETC01: EMBEDDED SYSTEMS

Course Requisite:

1. (3ETC03) Digital System Design
2. (3ETC05) Object Oriented Programming
3. (5ETC01) Microcontroller

Course Objectives:

1. To study the concept of Embedded Systems
2. To understand core of the Embedded System
3. To study architecture and inbuilt peripherals of AVR Microcontroller
4. To know microcontroller C Language Programming concepts.
5. To recognize the importance task scheduling in real time embedded systems.
6. To get acquainted with architecture & design of an Embedded System.

Course Outcomes:

After successfully completing the course, the students will be able to,

1. Recognize the concept of Embedded Systems
2. Summarize the quality attributes of Embedded System
3. Articulate the architecture and inbuilt peripherals of AVR Microcontroller
4. Evaluate the programming of AVR Microcontroller in C
5. Compare task, process & threads in Real Time Embedded System
6. Assess validation and debugging of Embedded System

Unit-I ; Introduction to Embedded systems: History of Embedded system, Embedded systems vs. General computing systems, Classification of Embedded systems, Major application areas of Embedded systems, Purpose of Embedded systems. (6)

Unit –II: Building blocks of Embedded systems: Core of the Embedded system, Memory Devices, Sensors and Actuators, Communication Interface, Embedded Firmware, Other System components, Characteristics of Embedded systems, Quality attributes of Embedded System. (6)

Unit-III: Introduction to AVR Microcontroller: AVR microcontroller, History, Features and AVR family and its inbuilt Peripherals, Architecture of ATMega 32: signal description, registers of AVR, Data Memory, data formats. (6)

Unit-IV: AVR Application and Programming in C: Data types, I/O programming, I2C, Timer Structure, Watch dog timer, UART, Interrupt Structure, Analog to Digital convertors. (6)

Unit-V: RTOS based Embedded System Design: Operating System basics, Types of Operating Systems, Tasks, Process and Threads, Multiprocessing and Multitasking, Task Scheduling, Processes and Scheduling. (6)

Unit-VI: Embedded System Architecture: Architecture Styles, implementation Aspects, validation & debugging of embedded systems, hardware – software co-design in an embedded system. (6)

Text Books:

1. Introduction to Embedded System, Shibu K. V.,McGraw Hill Education
2. Embedded Real-time Systems Programming, S.V. Iyer & Pankaj Gupta, McGraw Hill Education
3. "AVR Microcontroller and Embedded systems using assembly and C", Muhammad Ali Mazidi, Sarmad Naimi and Sephers Naimi, Pearson Education, Inc. publishing as Prentice Hall 2013.

Reference Books:

1. "Embedded Systems", Rajkamal, 2nd Edition, Tata McGraw Hill
2. "Scheduling in Real Time Systems", Cottet, Delacroix & Mammeri, John Wiley & Sons.

NOTIFICATION

No. 65 /2022 Date : 18/06/2022

Subject : Implementation of new Syllabi of Semester VII & VIII of B.E. (Electronics & Telecommunication Engg.) (C.B.C.S.) as per A.I.C.T.E. Model Curriculum…

It is notified for general information of all concerned that the authorities of the University have accepted to implement new Syllabi of **Semester VII & VIII of B.E. (Electronics & Telecommunication Engg.) (C.B.C.S.)** as per A.I.C.T.E. Model Curriculum to be implemented from the academic session 2022-23 onwards as per "**Appendix – A**" as given below:

Sd/-
(Dr.T.R.Deshmukh)
Registrar

"**Appendix A**"

SYLLABUS OF B.E. SEM. VII & VIII (ELECTRONICS & TELECOMMUNICATION ENGINEERING) [C.B.C.S.]

8ETC02 : MICROWAVE THEORY AND TECHNIQUES

Course Requisite: (3ETC04) Electromagnetic Waves

Course Objectives: To learn:

1. Basic concepts of Microwave active and passive devices.
2. Operations of Semiconductor Microwave Devices.
3. Transmission characteristic of microwave through waveguide and parallel microstrip line.
4. Operations of Microwave resonators
5. S-parameters for characterization of microwave devices
6. Measurement of microwave parameters.

Course Outcomes: At the end of the course students will be able to:

1. Understand operations of microwave active and passive devices.
2. Understand operations of Semiconductor Microwave Devices.
3. Describe characteristics of microwave propagation through waveguide and parallel microstrip line
4. Understand Operations of Microwave resonators.
5. Use S-parameters for characterization of microwave devices.
6. Measure various parameters of microwave system.

Unit-I: Introduction to Microwaves: History of Microwaves, Microwave Frequency bands; Applications of Microwaves, Microwave Tubes: Limitation of Conventional devices at high frequency, Construction & working principle with supportive expressions of Two cavity, Reflex klystron, Cylindrical Cavity Magnetron & TWT. (7)

Unit-II: Semiconductor Microwave Devices: Construction & working of Gunn Diodes, IMPATT diodes, TRAPAT diodes & Parametric amplifiers and MASERs. (5)

Unit-III: Waveguide system and Microstrip line: Waveguides: Introduction, TE & TM Modes of propagation through rectangular wave guide & circular waveguide, Microstrip line: Introduction, characteristic impedance & losses in parallel microstrip line. (8)

Unit-IV: Microwave Resonator: Transmission line resonators, Cavity resonators: rectangular and circular cavities, resonant frequency, and quality factor of resonators. (6)

Unit-V: Passive Microwave Devices: Scattering matrix formulation for E-plane tee, H-plane tee , Magic Tee, Directional Coupler, Principle of Faraday's rotation, Isolator, Gyrator & Circulator. (6)

Unit-VI: Microwave Measurements: Frequency Measurements, Power Measurements, Attenuation Measurements, VSWR Measurements, Impedance Measurements, Noise at microwave frequency and measurement of noise figure. (4)

Text Books:

1. Liao, Samuel Y., "Microwave Devices & Circuits", Tata Mc-Graw Hill Co. Ltd., New Delhi. 2
2. David M Pozar, "Microwave Engineering" Wiely 3 rd Edition.
3. Collin, Robert E., "Foundations for Microwave Engineering", Mc- Graw Hill, New York.

Reference Books:

1. Kennedy G., "Electronics Communication Systems", Tata Mc-Graw Hill Book Co.,New Delhi..
2. K.C. Gupta, "Microwave Engineering", New Age.
3. Reich, Scolnik, Ordung, Krangs, "Microwave Principles", PHI.
4. M.L. Sisodiya and G.S. Raghuwanshi, "Microwave Circuits and Passive devices", John Wiley & Sons Ltd.
5. Mathew M. Radmanesh, "RF and Microwave Electronics – Illustrated", Prentice Hall.

8ETC03 PROFESSIONAL ELECTIVE V (PE-V)
(i) NANO ELECTRONICS

Course Prerequisite: 3ETC02: Electronics Devices and Circuits.

Course Objectives:

1. The course intends to give students a broad understanding of fundamentals, fabrication technologies and applications of nano scale structures.
2. Students will also be trained for literature study and critique, oral presentation, problem formulation, solution development, and formal writing.
3. To introduce the students to nano-electronics, nano-devices, spintronics and molecular electronics. To identify quantum mechanics behind nano-electronics.
4. To describe the principle and the operation of nano-electronic devices.
5. To explain the principle and application of spintronic devices.
6. To identify quantum mechanics behind nano-electronics.

Course Outcomes: After successfully completing the course, the students will be able to:

1. Understand various aspects of nano-technology and the processes involved in making nano components and material.
2. Leverage advantages of the nano-materials and appropriate use in solving practical problems.
3. Understand various aspects of nano-technology and the processes involved in making nano components and material.
4. Leverage advantages of the nano-materials and appropriate use in solving practical problems.
5. Students will understand the divers electronic device fabrication.
6. Students will have in-depth technical knowledge in one or more areas of specialization.

Unit- I : Introduction: Recent past, the present and its challenges, Future, Overview of basic Nano electronics. Introduction to nanotechnology, meso structures, Basics of Quantum Mechanics: Schrodinger equation, Density of States. Particle in a box Concepts, Degeneracy. Band Theory of Solids. Kronig Penny Model. Brillouin Zones. (6)

Unit-II: Nano electronics & Nano computer architectures: Introduction to Nano computers, Nano computer Architecture, Quantum DOT cellular Automata (QCA), QCA circuits, Single electron circuits, molecular circuits, Logic switches, Interface engineering, Properties (Self-organization, Size-dependent) – Limitations. (6)

Unit-III: Nano electronic Architectures: Nanofabrication, Nano patterning of Metallic/Semiconducting nanostructures (e-beam/X-ray, Optical lithography, STM/AFM- SEM & Soft-lithography) – Nano phase materials – Self assembled Inorganic/Organic layers. (6)

Unit-IV: Spintronics: Introduction, Overview, History & Background, Generation of Spin Polarization Theories of spin Injection, spin relaxation and spin dephasing, Spintronic devices and applications, spin filters, spin diodes, spin transistors. (6)

Unit-V: Memory Devices and Sensors: Memory devices and sensors, Nano Ferroelectric random access memory, Fe-RAM circuit design, ferroelectric thin film properties and integration, calorimetric ï sensors, semiconductor sensor array. (6)

Unit-VI : Shrink-down approaches: Introduction, CMOS Scaling, The nanoscale MOSFET, Finfets, Vertical MOSFETs, limits to scaling, system integration limits (interconnect issues etc.) (6)

Text Books:

1. Stephen D. Sentaria, Microsystem Design, Kluwer Academic Press
2. Marc Madou, Fundamentals of microfabrication & Nanofabrication.
3. T. Fukada & W.Mens, Micro Mechanical system Principle & Technology, Elsevier, 1998.
4. Julian W.Gardnes, Vijay K. Varda, Micro sensors MEMS & Smart Devices, 2001.
5. G.W. Hanson, Fundamentals of Nanoelectronics, Pearson, 2009.
6. K.E. Drexler, Nanosystems, Wiley, 1992.

Reference Books:

1. Nano Terchnology and Nano Electronics ï Materials, devices and measurement Techniques by WR Fahrner ï Springe
2. Nano: The Essentials ï Understanding Nano Scinece and Nanotechnology by T.Pradeep; Tata Mc.Graw Hill.
3. Spin Electronics by M. Ziese and M.J. Thornton
4. Nanoelectronics and Nanosystems ï From Transistor to Molecular and Quantum Devices by Karl Goser, Peter Glosekotter, Jan Dienstuhl
5. Silicon Nanoelectronics by Shunri Odo and David Feny, CRC Press, Taylor & Franicd Group
6. Nanotubes and nanowires by C.N.R. Rao and A. Govindaraj, RSC Publishing
7. Quantum-Based Electronic Devices and Systems by M. Dutta and M.A. Stroscio, World Scientific. 8. James R Sheats and Bruce w.Smith, ñMicrolithography Science and Technologyò, Marcel Dekker Inc., New York, 1998.
8. J.P. Hirth and G.M.Pound ñEvaporation: Nucleation and Growth Kineticsò Pergamon Press, Oxford, 1963.

8ETC03 PROFESSIONAL ELECTIVE V (PE-V)
(ii) WIRELESS SENSOR NETWORKS

Course Requisite: 7ETC04: Mobile Communication and Networks.

Course Objectives:

1. Basic concepts of Wireless Sensor Networks
2. Architecture details of WSN
3. Case study of the WSN.

Course Outcomes: After successfully completing the course, the students will be able to:

1. Understand the basis of Sensors with its applications
2. To learn the architecture and placement strategies of Sensors
3. To analyze routing and congestion algorithms
4. To design, develop , and carry out performance analysis of sensors on specific applications
5. To explore and implement solutions to real world problems using sensor devices, enumerating its principles of working
6. To understand the working through the case study on WSN.

Unit-I: Introduction to wireless sensor Networks ï Advantages of ad-hoc/sensor networks, Unique constraints and challenges-. Applications Platforms for WSN: Sensor node hardware: mica2, micaZ, telosB, cricket, Imote2, tmote, btnode . Sensor node software introduction (Operating System): tiny0S, MANTIS, Contiki, and Ret0S. (7)

Unit-II: Single-Node Architecture. WSN coverage and placement: Coverage problems in WSN ï Type of coverage ï OGDC coverage Algorithm- Placement Problem. (6)

Unit-III: Topology management in wireless sensor Networks-: Different classification of topology management Algorithms-topology discovery-sleep cycle management. Medium access control in wireless networks. (6)

Unit-IV: Routing in sensor networks: Data centric- position based routing- data aggregation- Clustered based routing Algorithms. (5)

Unit-V: Congestion and flow control: Source of congestion- congestion control scenarios- Protocols for congestion and flow control in sensor networks: ESRT-CODA-PSFQ-RCRT-RMST-Fusion. (6)

Unit-VI: Hard ware design of sensor Networks : Characteristics ï Design challenges- Design of Architecture- Functional components- Energy supply- operating system. Application: Home Control, Highway Monitoring, Environmental Engineering Applications. (6)

Test Books:

1. Holger Karl and Andreas Willig, ñProtocols and Architectures for Wireless Sensor Networksò, John Wiley & Sons, 2005.
2. Zhao and L. Guibas, ñWireless Sensor Networksò, Morgan Kaufmann, San Francisco, 2004
3. C. S. Raghavendra, K.M.Shivalingam and T.Znati, ñWireless Sensor Networksò, Springer, New York, 2004

Reference Books

1. Anna Hac, ñWireless Sensor Network Designsò, John Wiley & Sons, 2004.
2. Kazem Sohraby, Daniel Minoli and Taieb Znati, ñWireless Sensor Networks: Technology, Protocols, and Applicationsò, Wiley Inter Science, 2007.

8ETC03 PROFESSIONAL ELECTIVE V (PE-V)
(iii) WAVELETS

Course Requisite:

1. (5ETC03) Digital Signal Processing
2. (7ETC02) Digital Image and Video Processing

Course Objectives: After taking this course student will be capable to:

1. Introduce with basic concepts of Wavelets.
2. Understand the wavelet transform for continuous and discrete time signals
3. Study the basic concepts of multi resolution analysis.
4. Study filter bank algorithm in details.
5. Study the application of wavelet transform for data compression.
6. Learn the application of Wavelet transform in different fields.

Course Outcomes: After successfully completing the course, the students will be able to:

1. Comprehend the fundamentals of wavelets.
2. Explain the concepts, theory, and algorithms related with wavelet transform.
3. Understand the modern signal processing tools using signal spaces, bases, operators etc.
4. Analyse wavelets, filter banks, and multiresolution techniques.
5. Understand data compression techniques using wavelets.
6. Comprehend projects ideas based on wavelet transform.

Unit-I: Introduction to Time Frequency Analysis: Vector Spaces, Properties, Dot Product, Dimension, Orthogonality and Orthonormality, Relationship Between Vectors and Signals, Signal Spaces, Signal representation using basis and frames, Brief introduction to Fourier transform and short time Fourier transform, Time frequency analysis . (6)

Unit-II: Continuous Wavelet transform: Continuous Time Wavelets, definition of CWT, Construction of continuous wavelets: Spline, orthonormal, bi-orthonormal, Inverse continuous wavelet transform, Redundancy of CWT, zoom property of the continuous wavelet transform, Filtering in continuous wavelet transform domain (6)

Unit III: Discrete Wavelet Transform and Filter Bank Algorithms: Introduction to Discrete Wavelet Transform, Decimation and Interpolation, Convolution Followed by Decimation, Interpolation Followed by Convolution, Signal Representation in the Approximation Subspace, Wavelet Decomposition Algorithm, Reconstruction Algorithm (6)

Unit-IV: Multi-resolution Analysis: Introduction, Formal definition of MRA, Construction of general orthonormal MRA, A Wavelets basis for MRA, Digital Filtering Interpretations, Examples of orthogonal basis generating wavelets, interpreting orthonormal MRAs for discrete time signal. (6)

Unit-V: Wavelet Transform and Data Compression: Introduction, transform Coding, DTWT for Image Compression, Image compression using DTWT and run length coding, Embedded Tree Image Coding, Audio Compression, Audio Masking, standard specifying sub band implementation, wavelet-based audio coding, video coding using multi-resolution techniques. (6)

Unit-VI: Applications of Wavelet transform: Introduction, Wavelet Denoising, speckle Removal, Edge Detection or Object Isolation, Image Fusion, Object detection by wavelet transform of projections (6)

Text Books:

1. Raghuveer Rao and Ajit S. Bopardikar, Wavelet transforms: Introduction to Theory and applications, Pearson Education Asia, 2000.
2. J. C. Goswami & A. K. Chan, Fundamentals of Wavelets: Theory, Algorithms, and Applications, 2nd edition, Wiley, 2011
3. S. Mallat, A Wavelet Tour of Signal Processing, 2nd edition, Academic Press, 1999.

Reference Books:

1. Y.T. Chan, Wavelet Basics, Kluwer Publishers, Boston.
2. J. S. Walker, A premier on Wavelets and their scientific applications, CRC press, 2002.
3. Gerald Kaiser, A Friendly Guide to Wavelets, Birkhauser, New York, 1995.
4. P. P. Vaidyanathan, Multirate Systems and Filter Banks, Prentice Hall, New Jersey, 1993.
5. A.N. Akansu and R.A. Haddad, Multiresolution signal Decomposition: Transforms, Subbands and Wavelets, Academic Press, Oranld, Florida, 1992.
6. B. Boashash, Time-Frequency signal analysis, In S. Haykin, (editor), Advanced Spectral Analysis, pages 418--517. Prentice Hall, New Jersey, 1991.

8ETC03 PROFESSIONAL ELECTIVE V (PE-V)
(iv) BIO-MEDICAL ELECTRONICS

Course Requisite:
1. (3ETC02) Electronic Devices and Circuits
2. (5ETC01) Microcontroller
3. (7ETC02) Digital Image and Video Processing

Course Objectives:
1. Understanding role of engineers in medical field
2. Studying various electrical signals generated in human body.
3. To study various transducers, electrodes, recorders and problems for recording biomedical signals.
4. Study different medical imaging systems.
5. Introduction to patient care & safety
6. Introduction of various therapeutic life saving instruments.

Course Outcomes:
After successfully completing the course, the students will be able to:
1. Understand fundamentals of Medical Instrumentation, Biomedical Signals and Electrode.
2. Identify and classify various Biomedical Transducers.
3. Illustrate the significance of human signals and recording techniques
4. Familiarize with Modern medical imaging systems.
5. Conceptualize requirements and importance of Patient Care and Monitoring and Safety.
6. Describe the function and necessity of Physiological and electrotherapy equipments.

Unit-I: Introduction: Sources of bioelectric potentials, Different bioelectric signals like ECG, EMG and EEG, Bio potential Electrode theory, Basic electrode, Electrodes for EEG, ECG, EMG, Biochemical electrodes. Skin contact Theory, motion artifacts, Nernst Equation. (6)

Unit-II: Biomedical transducers: Classification of Transducers-Pressure, force, acceleration, flow, respiration sensor, Smart sensors, pulse sensor, temperature, potential, dissolved ions and gases. (6)

Unit-III: Biomedical Recorders and Measurement: Biomedical recorders for EEG, ECG, EMG, Measurement of Blood Pressure: Direct method, Indirect methods- The Rheographic method, Ultrasonic Doppler shift method, Blood flow meter - Square wave electromagnetic, Measurement of Heart rate, Measurement of pulse rate. (6)

Unit-IV: Medical Imaging System: Instrumentation for diagnostics X-rays, X- rays basics properties, X-ray machine, Special imaging techniques: Computerized Axial Tomography (CAT), Ultrasonic imaging system: Physics of Ultrasound, Biological effect of ultrasound. Ultrasonics: A-scan, M-scan, B-scan (6)

Unit-V: Patient Care and Monitoring and Safety:
System concepts, Bedside patient monitors, central monitors, Intensive care monitoring. Biotelemetry: Single channel and Multichannel bio-telemetry, PATIENT SAFETY: Electric shock hazards, leakage current. Types of Leakage current, measurement of leakage current, methods of reducing leakage current, precautions to minimize electric shock hazards. (6)

Unit-VI: Therapeutic Equipments & Ventilators:
Need of Physiological and electrotherapy equipments. Cardiac pacemakers, Cardiac Defibrillators, Nerve and Muscle stimulators. Diathermy Machines: Short wave, Microwave, Ultrasonic. Ventilators: Mechanics of respiration, Artificial Ventilators, Microprocessor controlled Ventilators. (6)

Text Books:
1. Khandpur R.S. ñHandbook of Biomedical Instrumentationò, Tata Mc-Graw Hill, New Delhi.
2. Cromwell L. & Wiebell. F. J., ñBiomedical Instrumentationò, PHI Publications.

Reference Books:
1. Webstar J.G., ñMedical Instrumentationò, Third ed. John Wiely & Sons.
2. Carr & Brown, ñIntroduction to Biomedical Equipment Technologyò, Prentice Hall.

8ETC04 PROFESSIONAL ELECTIVE VI (PE-VI)
(i) 5G-6G MOBILE COMMUNICATION

Course Pre-requisites: 7ET04: Mobile Communication and Networks

Course Objectives:
1. To Understand latest trends in wireless technologies, a path towards 5G and 6G system.
2. To study network architecture, components, features and benefits of 5G system.
3. To understand various radio waveforms and channel model for 5G.
4. To understand different networking techniques in 5G system.
5. To study introduction of 6G system.

Course Outcomes:
Upon successful completion of this course, the student will be able to:

1. Illustrate the evolution of mobile communication leading to the introduction of 5G.
2. Explain the mm wave 5G and overview of MIMO.
3. Elaborate the Channel access methods of 5G.
4. Discuss key issues and challenges in 5G deployment.
5. Understand the applications of 5G.
6. Understand the concept of 6G.

Unit-I:
Introduction To 5G: Historical trend and evolution of LTE technology to beyond 4G – Key building blocks of 5G, Specification requirements for driving 5G technology , 5G Use Cases and System Concepts – The 5G Architecture – IoT in relation to 5G. **(6 Hours)**

Unit-II:
Rf Front End For 5G: Millimeter Wave Communications: Hardware technologies for mmW systems – Characteristics, Use cases, Advantages. Massive MIMO: Fundamentals, Advantages MIMO – Beamforming Overview. **(6 Hours)**

Unit-III:
5G Waveforms And Channel Models: 5G Radio Access Technologies: Radio Access for V2X Communication - Radio access for massive machine-type communication – RAN introduction and types. 5G channel access methods. **(6 Hours)**

Unit-IV:
Networking In 5G: Coordinated multi-point transmission in 5G: Joint Transmission CoMP enablers - Distributed cooperative transmission - Relaying techniques, Multi-flow wireless backhauling. **(6 Hours)**

Unit-V:
Applications of 5G: Machine-type communications: Fundamental techniques for MTC - Massive MTC - Ultra-reliable low-latency MTC - Device-to-device (D2D) communications- Multi-operator D2D communication. (6 Hrs.)
Unit-VI: Introduction To 6G:
Key building blocks of 6G – 6G use cases and System Concepts – The 6G Architecture . **(6 Hours)**

Text Books:

1. Wei Xiang, Kan Zheng, Xuemin (Sherman) Shen, - 5G Mobile Communications, Springer, 2017.
2. Afif Osseiran, Jose F. Monserrat and Patrick Marsch, - 5G Mobile and Wireless Communications Technology, Cambridge University Press, 2016.

Reference Book: Jonathan Rodriguez, - Fundamentals of 5G mobile networks, John Wiley & Sons, Ltd, 2015.

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8ETC04 PROFESSIONAL ELECTIVE VI (PE-VI)
(ii) INFORMATION THEORY AND CODING

Course Prerequisite:
1. 3ETC03: Digital System Design
2. 4ETC01: Analog and Digital Communication

Course Objectives: Students undergoing this course are expected to:

1. Understand the basics of information theory and coding theories.
2. Introduce the concept of amount of information, entropy, channel capacity, error-detection and error-correction codes, block coding, convolution coding.
3. Understand and explain the basic concepts of information theory, source coding, channel and channel capacity, channel coding and relation among them.
4. Describe the real life applications based on the fundamental theory.
5. Calculate entropy, channel capacity, bit error rate, code rate, and steady-state probability and so on.
6. To get exposed to information and entropy, compression technique, audio & video

Course Outcomes: After successfully completing the course, the students will be able to:

1. Understand the concept of information and entropy
2. Understand Shannon's theorem for coding
3. Calculation of channel capacity
4. Discuss the various capacity reduction based coding techniques for text, audio and speech type of data
5. Compare various capacity reduction based coding techniques for image and video type of data.
6. Implement various error control techniques for Convolutional codes

Unit-I: Basics of information theory, Entropy, Information rate, classification of codes, entropy for discrete ensembles; Source coding theorem, Shannon-Fano coding, Huffman coding. (6)

Course Outcomes: Upon successful completion of this course, the student will be able to:

1. Illustrate the evolution of mobile communication leading to the introduction of 5G.
2. Explain the key innovations in radio and network.
3. Elaborate the standardization process and timeline for 5G
4. Identify the spectrum requirements.
5. Discuss key issues and challenges in 5G deployment.
6. Understand the concept of 6G

Unit-I: INTRODUCTION TO 5G:

Historical trend and evolution of LTE technology to beyond 4G ï Key building blocks of 5G ï 5G use cases and System Concepts ï The 5G Architecture ï IoT: relation to 5G. (6)

Unit-II: RF FRONT END FOR 5G:

Millimeter Wave Communications: Hardware technologies for mmW systems ï Architecture and Mobility ï Massive MIMO: Resource allocation and Fundamentals of baseband and RF implementations in massive MIMO ï Beam forming. (6)

Unit-III: 5G WAVEFORMS AND CHANNEL MODELS:

5G Radio Access Technologies: Radio Access for V2X Communication - Radio access for massive machine-type communication - 5G wireless propagation channel models: Modelling requirements and scenarios. (6)

Unit-IV: NETWORKING IN 5G:

Coordinated multi-point transmission in 5G: Joint Transmission CoMP enablers - Distributed cooperative transmission - Relaying and network coding in 5G: Multi-flow wireless backhauling - Buffer aided relaying. (6)

Unit-VI: APPLICATIONS of 5G:

Machine-type communications: Fundamental techniques for MTC - Massive MTC - Ultra-reliable low-latency MTC - Device-to-device (D2D) communications - Multi-hop D2D communications - Multi-operator D2D communication - Simulation methodology: Evaluation methodology ï Calibration (6)

Unit-VI: INTRODUCTION TO 6G:

Key building blocks of 6G ï 6G use cases and System Concepts ï The 6G Architecture. (6)

Text Books:

1. Wei Xiang, Kan Zheng, Xuemin (Sherman) Shen, - 5G Mobile Communications, Springer, 2017.
2. Afif Osseiran, Jose F. Monserrat and Patrick Marsch, - 5G Mobile and Wireless Communications Technology, Cambridge University Press, 2016.

Reference Book: Jonathan Rodriguez, - Fundamentals of 5G mobile networks, John Wiley & Sons, Ltd, 2015.

8ETC04 PROFESSIONAL ELECTIVE VI (PE-VI)
(ii) INFORMATION THEORY AND CODING

Course Prerequisite:

1. 3ETC03: Digital System Design
2. 4ETC01: Analog and Digital Communication

Course Objectives: Students undergoing this course are expected to:

1. Understand the basics of information theory and coding theories.
2. Introduce the concept of amount of information, entropy, channel capacity, error-detection and error-correction codes, block coding, convolution coding.
3. Understand and explain the basic concepts of information theory, source coding, channel and channel capacity, channel coding and relation among them.
4. Describe the real life applications based on the fundamental theory.
5. Calculate entropy, channel capacity, bit error rate, code rate, and steady-state probability and so on.
6. To get exposed to information and entropy, compression technique, audio & video

Course Outcomes: After successfully completing the course, the students will be able to:

1. Understand the concept of information and entropy
2. Understand Shannonôs theorem for coding
3. Calculation of channel capacity
4. Discuss the various capacity reduction based coding techniques for text, audio and speech type of data
5. Compare various capacity reduction based coding techniques for image and video type of data.
6. Implement various error control techniques for Convolutional codes

Unit-I: Basics of information theory, Entropy, Information rate, classification of codes, entropy for discrete ensembles; Source coding theorem, Shannon-Fano coding, Huffman coding. (6)

Unit-II: Extended Huffman coding ï Joint and conditional entropies, Mutual information ï Discrete memoryless channels ï BSC, BEC ï Channel capacity, Shannon limit Shannon's noiseless Coding theorem; Encoding of discrete sources. (6)

Unit-III: Markov sources; Shannon's noisy coding theorem and converse for discrete channels; Calculation of channel capacity and bounds for discrete channels; Application to continuous channels. **(6)**

Unit-IV: Text: Adaptive Huffman Coding, Arithmetic Coding, LZW algorithm Audio: Perceptual coding, Masking techniques, Psychoacoustic model, MEG Audio layers I,II,III, Dolby AC3 ï Speech: Channel Vocoder, Linear Predictive Coding. (7)

Unit-V: Image and Video Formats ï GIF, TIFF, SIF, CIF, QCIF ï Image compression: READ, JPEG Video Compression: Principles-I, B, P frames, Motion estimation, Motion compensation, MPEG standard. (6)

Unit-VI: Techniques of coding and decoding; Huffman codes and uniquely detectable codes; Cyclic codes, convolutional arithmetic codes. **(**5)

Text Books :

1. N. Abramson, Information and Coding, McGraw Hill, 1963.
2. M. Mansurpur, Introduction to Information Theory, McGraw Hill, 1987.

Reference Books :

1. R.B. Ash, Information Theory, Prentice Hall, 1970.
2. Shu Lin and D.J. Costello Jr., Error Control Coding, Prentice Hall, 1983.
3. Ranjan Bose, Information Theory, Coding and Cryptography, Publication,2005

8ETC04 PROFESSIONAL ELECTIVE VI (PE-VI)
(iii) SCIENTIFIC COMPUTING

Course Prerequisite: 3ETC01: Engineering Mathematics-III

Course Objectives: To enable the student to understand :

1. the basics of scientific computing
2. variety of tools and techniques to transform into computer model
3. Use of Matlab and python in scientific computing.

Course Outcomes: After successfully completing the course, the students will be able to:

1. View scientific computing as the point of intersection between computer science, numerical mathematics, and modeling.
2. introduce to numerical mathematics and prepares them for the scientific computing part.
3. Learn to solve Nonlinear equations useful for computer models
4. Learn to solve Numerical differentiation useful for computer models
5. Learn to use MATLAB
6. Learn to use python for the applications in scientific computing

Unit-I: Introduction to scientific computing, applications involving scientific computing, Tools and languages to solve complex scientific problems. (6)

Unit-II: Systems of Linear Algebraic equations: Introduction, Gauss Elimination Method, LU decomposition, Symmetric and banned coefficient Matrices, Pivoting, Matrix Inversion, Iterative Methods, Other methods. (6)

Unit-III: Solving Nonlinear Equations. The Bisection Method for Root-Finding.,Convergence Criteria and Efficiency, Scripts and Function Files , The False Position Method, The Newtonð Raphson Method for Root-Finding , Fixed Point Iteration. (6)

Unit-IV: Numerical Differentiation: Finite Difference approximations; Numerical Integration; Initial Value Problems; Two-Point Boundary Value Problems; Symmetric Matrix Eigen value problems; Introduction to Optimization. (6)

Unit-V: Basics of MATLAB. Defining and Using Scalar Variables, Saving and Reloading the Workspace, Defining and Using Arrays, Operations on Vectors and Matrices, more on Plotting Functions of One Variable, Loops and Logical Operators, Working with indices and arrays, Number representation. (6)

Unit VI:: Scientific computation using python - Statistical data analysis, image processing, web development and hardware interfacing using Python. (6)

Text Books:

1. Hans Petter Langtangen, A Primer on Scientific Programming with Python (Link)
2. Claus Fuhrer, Jan Erik Solem, Olivier Verdier, Scientific Computing with Python 3 Packt Publishing Limited
3. Martin C. Brown, Python: The Complete Reference, McGraw Hill Education
4. Hemant Kumar Mehta, Mastering Python Scientific Computing, Packt Publishing Limited

Reference Books:

1. By Dan Stanescu Long Lee ,òA Gentle Introduction to Scientific Computing ñ, First edition Chapman and Hall/CRC
2. Jaan Kiusalaas, ñNumerical Methods in Engineering with Pythonò, Cambridge University Press, 2005.

8ETC05- EMBEDDED SYSTEMS LAB

1. Minimum Eight Experiments based on syllabus of 8ETC01: Embedded Systems must be conducted.
2. Course Objectives and Course Outcomes shall be specified based on the experiments conducted

8ETC06- MICROWAVE THEORY AND TECHNIQUES – LAB

1. Minimum Eight Experiments based on syllabus of 8ETC02: MICROWAVE THEORY & TECHNIQUES must be conducted.
2. Course Objectives and Course Outcomes shall be specified based on the experiments conducted.

8ETC07- PROJECT STAGE-II

Course Objectives: Students will be required to:

1. Perform a literature search to review current knowledge and developments in the chosen technical area;
2. Undertake detailed technical work in the chosen area using one or more of:
   - theoretical studies
   - computer simulations
   - hardware construction;
3. Produce progress reports or maintain a professional journal to establish work completed, and to schedule additional work within the time frame specified for the project;
4. Deliver a seminar on the general area of work being undertaken and specific contributions to that field;
5. Prepare a formal report describing the work undertaken and results obtained so far; and
6. Present the work in a forum involving poster presentations and demonstrations of operational hardware and software.

Course Outcomes: On successful completion of the course students will be able to:

1. Demonstrate a sound technical knowledge of their selected project topic.
2. Undertake problem identification, formulation and solution.
3. Design engineering solutions to complex problems utilising a systems approach.
4. Conduct an engineering project.
5. Communicate with engineers and the community at large in written an oral forms.
6. Demonstrate the knowledge, skills and attitudes of a professional engineer.

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