SEMESTER VII

BTETC701 Microwave Engineering **4 Credits**

Course Objectives:

1. To lay the foundation for microwave engineering.
2. To understand the applications of microwave engineering.
3. Carryout the microwave network analysis.

Course Outcomes:

After successfully completing the course students will be able to

1. Formulate the wave equation in wave guide for analysis.
2. Identify the use of microwave components and devices in microwave applications.
3. Understand the working principles of all the microwave tubes.
4. Understand the working principles of all the solid-state devices.
5. Choose a suitable microwave tube and solid-state device for a particular application.
6. Carry out the microwave network analysis.
7. Choose a suitable microwave measurement instruments and carry out the required measurements.

UNIT – 1 Transmission Lines and Waveguides: **10 Hours**

RF and Microwave transmission Lines, Standing Waves, General Analysis of Time Harmonic waves, Introduction to coaxial line, Equivalent circuit parameters of Transmission Lines, Smith Chart, Single stub and Double stub matching, Microwave Frequency bands. General solution for TEM, TE and TM waves, Rectangular waveguide, Circular waveguide, Wave guide parameters, Rectangular waveguide cavity resonators, Circular waveguide cavity resonators.

UNIT – 2 Microwave Network Theory and Passive Devices: **07 Hours**

Introduction Properties of Z and Y matrices for reciprocal Networks, Scattering or S Matric representation of Multiport Network, Microwave Passive Components. Introduction and applications of Impedance and Equivalent voltages and currents, Impedance and Admittance matrices, The Transmission (ABCD) matrix Scattering Matrix: -Significance, formulation and properties. S-Matrix calculations for-2 port network junction, E plane, H-plane and E-H (Magic Tee) Tees, Directional coupler, Isolator and Circulator. Relatedproblems.

UNIT – 3 Microwave Tubes: 10 Hours

Limitations of conventional tubes, O and M type classification of microwave tubes, reentrant cavity, velocity modulation. O type tubes Two cavity Klystron: Construction and principle of operation, velocity modulation and bunching process Applegate diagram. Reflex Klystron: Construction and principle of operation, velocity modulation and bunching process, Applegate diagram, Oscillating modes, o/p characteristics, efficiency, electronic & mechanical tuning. M-type tubes Magnetron: Construction and Principle of operation of 8 cavity cylindrical travelling wave magnetron, hull cutoff condition, modes of resonance, PI mode operation, o/p characteristics, Applications. Slow wave devices Advantages of slow wave devices, Helix TWT: Construction and principle of operation, Applications.

UNIT – 4 Measurement devices and Microwave Measurements: 07 Hours

Measurement devices: Slotted line, Tunable detector, VSWR meter, Power Meter, S-parameter measurement, frequency measurements, Power measurement, Attenuation measurement, Phase shift measurement, VSWR measurement, Impedance measurement, Q of cavity resonator measurement.

UNIT – 5 Microwave Strip Lines Network Analysis and Microwave Hazards: 07 Hours

Striplines: Structural details and applications of Striplines, Microstrip line, Parallel Strip line, Coplanar Strip line, Shielded Strip Line.

Hazards: Hazards of Electromagnetic Radiation, Radiation Hazard Levels for Personnel, Radiation Hazard Limits and Radiation Protection.

TEXT/REFERENCE BOOKS:

1. Microwave Engineering – Annapurna Das, Sisir K Das TMH Publication, 2nd,2010
2. Microwave Devices and circuits- Liao / PearsonEducation
3. Antennas and Wave Propagation, John D. Krauss, Ronald J Marhefka and Ahmad S Khan, 4thSpecial Indian Edition, McGraw- Hill Education Pvt. Ltd.,2010.
4. Microwave Engineering – David M Pozar, John Wiley India Pvt. Ltd., 3rdEdn,2008
5. Microwave Engineering – Sushrut Das, Oxford Higher Education, 2ndEdn,2015
6. Antennas and Wave Propagation – Harish and Sachidananda: Oxford University Press, 2007.

BTETPE702A Digital Image Processing **4Credits**

Course Objectives:

An ability to use current techniques, skills, and tools necessary for computing practice with an understanding of the limitations

Course Outcomes:

After completion of this course students will be able to

1. Review the fundamental concepts of digital image processing system.
2. Analyze images in the frequency domain using various transforms.
3. Categories various compression techniques.
4. Interpret image segmentation and representation techniques.

UNIT –1 Introduction: **07 Hours**

Introduction to Digital Image Processing & Applications, Image Digitalization, Sampling, Quantization, Signal Reconstruction from Samples: Convolution Concept, Signal Reconstruction from Image using convolution, Basic Relationship Between Pixels: Relationship of Adjacency and Connected Components Labeling, Basic Transform: Translation, Rotation, Scaling, Image Formation

UNIT – 2 Image Transformation: **07 Hours**

Image Geometry, Stereo Imaging Model, Interpolation and Resampling, Interpolation Techniques, Separable Transformation, Basis Images, Fourier transformation, Properties of FT, Rotation Invariance Property, DCT and Walsh Transform, Hadamard Transformation, KL-transform

UNIT – 3 Image Enhancement and morphological image processing: **07 Hours**

Dilation, Erosion, Opening, Closing, Hit-miss transformation, Thinning, Thickening, Point Processing Techniques, Contrast Stretching Operation, Histogram Equalization, Histogram Implementation, Mask Processing Techniques: Linear smoothing filter, median filter, sharpening filter, Unsharp masking, High boost filter, first order derivative operator, Frequency Domain Processing Techniques: Smoothening (Ideal low pass filter, Butterworth LPF), Sharpening filters: (Ideal high pass filter, Butterworth HPF), Laplacianmask

UNIT – 4 Image Restoration and colour image processing: **07 Hours**

Image restoration techniques: Inverse filtering, minimum mean square error (wiener)

filtering, constrained least square filter, difference between image enhancement and image restoration, Image formation process, Estimation of degradation Model: by observation, by experimentation, Mathematical modeling, Primary and Secondary colours, colour characteristics, chromaticity diagram, RGB colour model, HIS colour model, conversion from one model to another, Pseudo color image processing

UNIT – 5 Image Segmentation and Object Recognition **07 Hours**

Different approaches for image segmentation: discontinuity based (point, line and edge detection) and region based, global thresholding, local thresholding, Adaptive thresholding, Edge detection: Roberts operator, prewitt operator, sobel operator, Laplacian operator, linking of edge points: local processing and global processing (Hough transform), region based segmentation: region growing technique, region merging and splitting technique, object recognition.

TEXT/REFERENCE BOOKS:

1. Rafael C. Gonzalez and Woods, "Digital Image Processing", Addison Wesley,1998

2. A. K. Jain, "Digital Image Processing", PHI, New Delhi, 1997

3. Pratt W.K., "Digital Image Processing", 2nd Edition, John Wiley, New York,2001

4. Edward R. Dougherty, "Random Processes for Image and Signal Processing",PHI-2001

BTETPE702B RF Circuit Design 4Credits

Course Objectives:

1. To study RF issues related to active and passive components.
2. To study circuit design aspects at RF
3. To learn design and modeling of circuits at RF.

Course Outcomes:

After successfully completion of the course students will be able to

1. Understand behavior of passive components at high frequency and modeling of HF circuit.
2. Design HF amplifiers with gain bandwidth parameters.
3. Understand Mixer types and characteristics.
4. Gain the knowledge about PLLs and Oscillators with respect to their circuit topologies.

UNIT – 1 RF Behavior of Passive Components: **07 Hours**

HF Resistors, HF Capacitors, HF Inductors, Chip Components. Circuit Board Considerations: Chip Resistors, Chip Capacitors, Surface Mounted Inductors.

UNIT – 2 Bandwidth Estimation: **07 Hours**

Open Circuit Time Constant Method: Observations & Interpretations, Accuracy of OC τs, Considerations, and Design examples. Short Circuit Time Constant Method: Background, Observations & Interpretations, Considerations. Delay of a system in cascade, Rise time of systems in cascade, Relation between Rise Time and Bandwidth.

UNIT – 3 High Frequency Amplifier Design: **07 Hours**

Shunt Peaked Amplifier, Shunt Series peak Amplifier, Two port bandwidth enhancement, Design example. Bandwidth enhancement techniques. Tuned Amplifier: Common Source Amplifier with Single Tuned Load, Analysis of Tuned Amplifier. Neutralization and uni lateralization. Characteristics of RF amplifier. Amplifier power relations. Stability considerations, Stabilization methods.

UNIT – 4 Low Noise Amplifier Design: **07 Hours**

MOSFET two port noise parameters, LNA topologies, Power-constrained noise optimization. Design examples: Single ended LNA, Differential LNA. Linearity and large signal performance. Spurious free dynamic range.

UNIT – 5 Oscillators and Mixers: **07 Hours**

Problem with Purely Linear Oscillators, Describing Functions, Describing Function for MOS. Colpitts Oscillator: Describing Function Model and Start-up Model of Colpitts Oscillator. Resonators: Quarter-Wave Resonators, Quartz Crystals. Tuned Oscillators: Basic LC Feedback Oscillators, Crystal Oscillator. Negative Resistance Oscillator.

Mixers: Mixer Fundamentals. Significant Characteristics of Mixer: Conversion Gain, Noise Figure, Linearity and Isolation, Spurs. Non-Linear Systems as Linear Mixers. Multiplier Based Mixers: Single Balanced Mixer, Linearization techniques of Mixer, Active Double Balanced Mixer. Passive Double Balanced Mixer, Diode Ring Mixers.

TEXT/REFERENCE BOOKS:

1. Reinhold Ludwig, Pavel Bretchko, "RF Circuit Design Theory and Applications", Pearson Education.
2. Thomas H. Lee, "The Design of CMOS Radio-Frequency Integrated Circuits", Second Edition, Cambridge Publications.
3. T. Yettrdal, Yunhg Cheng, "Devices modeling for analog and RF COMS circuits design", John Wiley publication.
4. Calvin Plett, "Radio frequency Integrated Circuits Design", Artechhouse.

BTETPE702C Satellite Communication 4 Credits

Course Objectives:

1. To provide students with good depth of knowledge in radar and Satellite communication.
2. Knowledge of theory and practice of advanced communication techniques e.g. TDMA, CDMA,FDMA.
3. This will equip the students for further studies and research knowledge of modern applications in radar and Satellite communication.

Course Outcomes:

At the end of the course, the students will have:

1. Knowledge of theory and practice related to radar and Satellite communication.
2. Ability to identify, formulate and solve engineering problems related to radar and Satellite communication.
3. The student would be able to analyze the various aspects of establishing a geo-stationary satellite communication link.
4. Acquired knowledge about Satellite Navigation System.
5. Acquired knowledge about Radar and Radar Equations.

UNIT – 1 Basic Principles and Earth Station: 07 Hours

Basic Principles: General features, frequency allocation for satellite services, properties of satellite communication systems.

Earth Station: Introduction, earth station subsystem, different types of earth stations.

UNIT – 2Satellite Orbits: **07 Hours**

Introduction, Kepler's laws, orbital dynamics, orbital characteristics, satellite spacing and orbital capacity, angle of elevation, eclipses, launching and positioning, satellite drift and station keeping.

UNIT – 3 Satellite Construction (Space Segment): **07 Hours**

Introduction; attitude and orbit control system; Telemetry Tracking and command; Power systems, communication subsystems, antenna subsystem, equipment reliability and space qualification.

UNIT – 4 Satellite Links: **07 Hours**

Introduction, general link design equation, system noise temperature, uplink design, downlink design, complete link design, effects of rain.

UNIT – 5 The Space Segment Access and Utilization: **07 Hours**

Introduction, space segment access methods: TDMA, FDMA, CDMA, SDMA, assignment methods.

The Role and Application of Satellite Communication

Introduction to Digital Satellite and Mobile Satellite Communication.

TEXT/REFERENCE BOOKS:

1. Timothy Pratt, Charles W. Bostian, Satellite Communications, John Wiley &Sons.
2. Dennis Roddy, Satellite Communications, 3rd Ed., McGraw-Hill International Ed.2001.
3. W. L. Pritchard, J. A. Sciulli, Satellite Communication Systems Engineering, Prentice-Hall, Inc.,NJ.
4. M. O. Kolawole, Satellite Communication Engineering, Marcel Dekker, Inc.NY.
5. Robert Gagliardi, "Satellite Communication" , CBSPublication.
6. Ha, "Digital Satellite Communication", McGraw- Hill.
7. Timothy Pratt and Charles Bostian, "Satellite Communications", John Wiley andSons.

BTETPE702D Fiber Optic Communication **4Credits**

Course Objectives:

1. To learn the basic elements of optical fiber transmission link, fiber modes configurations and structures.
2. To understand the different kind of losses, signal distortion in optical wave guides and other signal degradation factors.
3. To learn the various optical source materials, LED structures, quantum efficiency, Laser diodes
4. Understand the functionality of each of the components that comprise a fiber-optic communication system: transmitter, fiber, amplifier, and receiver.
5. Understand the properties of optical fiber that affect the performance of a communication link.
6. Understand basic optical amplifier operation and its effect on signal power and noise in the system.
7. Apply concepts listed above to the design of a basic communication link.

Course Outcomes:

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

1. Understand the principles fiber-optic communication, the components and the bandwidth advantages.
2. Understand the properties of the optical fibers and optical components.
3. Understand operation of lasers, LEDs, and detectors.
4. Analyze system performance of optical communication systems.
5. Design optical networks and understand non-linear effects in optical fibers.

UNIT –1Introduction: **07 Hours**

Introduction to vector nature of light, propagation of light, propagation of light in a cylindrical dielectric rod, Ray model, wavemodel.

UNIT – 2 Types of optical fibers: **07 Hours**

Different types of optical fibers, Modal analysis of a step index fiber, Signal degradation on optical fiber due to dispersion and attenuation. Fabrication of fibers and measurement techniques like OTDR.

UNIT – 3 Optical sources: **07 Hours**

LEDs and Lasers, Photo-detectors - pin-diodes, APDs, detector responsively, noise, optical receivers. Optical link design - BER calculation, quantum limit, power penalties

UNIT – 4 Optical switches and Optical amplifiers: **07 Hours**

Coupled mode analysis of directional couplers, electro-optic switches. Optical amplifiers: EDFA, Raman amplifier, WDM and DWDM systems, Principles of WDM networks.

UNIT – 5 Non linear effects in fiber optic links: **07 Hours**

Nonlinear effects in fiber optic links, Concept of self-phase modulation, group velocity dispersion and solition based communication.

TEXT/REFERENCE BOOKS:

1. J. Keiser, Fibre Optic communication, McGraw-Hill, 5th Ed. 2013 (Indian Edition).
2. T. Tamir, Integrated optics, (Topics in Applied Physics Vol.7), Springer-Verlag,1975.
3. J. Gowar, Optical communication systems, Prentice Hall India,1987.
4. S.E. Miller and A.G. Chynoweth, eds., Optical fibres telecommunications, Academic Press,1979.
5. G. Agrawal, Nonlinear fibre optics, Academic Press, 2nd Ed.1994.
6. G. Agrawal, Fiber optic Communication Systems, John Wiley and sons, New York,1997
7. F.C. Allard, Fiber Optics Handbook for engineers and scientists, McGraw Hill, New York (1990).

BTETPE702E Bio-medical Signal Processing 4 Credits

Course Objectives:

1. To understand the basic signals in the field of biomedical.
2. To study origins and characteristics of some of the most commonly used biomedical signals, including ECG, EEG, evoked potentials, and EMG.
3. To understand Sources and characteristics of noise and artifacts in biosignals.
4. To understand use of bio signals in diagnosis, patient monitoring and physiological investigation.
5. To explore research domain in biomedical signal processing.
6. To explore application of established engineering methods to complex biomedical signal problems.

Course Outcomes:

After successfully completing the course students will be able to:

1. The student will be able to model a biomedical system
2. The student will be able to understand various methods of acquiring bio signals.
3. The student will be able to understand various sources of bio signal distortions and its Remedial techniques
4. The students will be able to analyze ECG and EEG signal with characteristic feature points.
5. The student will have a basic understanding of diagnosing bio-signals and classifying them.

UNIT – 1 Introduction to Biomedical Signals: 07 Hours

ECG, EEG, EMG, ENG etc. Event related potentials Biomedical Signal Analysis- Computer Aided Diagnosis. Concurrent, coupled and correlated processes - illustration with case studies. Noise Filtering: Random noise structured noise and physiological interference- noise and artifacts in ECG.

UNIT – 2 Time domain filters and Frequency domain Filters: 07 Hours

Principles of adaptive filters- Winer Filtering- Steepest Descent algorithms- WidrowHopf Least mean square adaptive algorithms- Adaptive noise canceller- Interference cancellation in Electrocardiography- noise cancellation in electrosurgery.

UNIT – 3 Events Detection: 07 Hours

Detection of P, QRS and T waves in ECG- EEG rhythms- Correlation and coherence analysis of EEG channels- Detection of EEG spike and wave complexes- Homomorphic filtering. Analysis of event related potential – Morphological analysis of ECG waves- Envelope extraction and analysis- Analysis of activity: zero crossingrates.

UNIT – 4 Fourier Spectrum, Estimation of power spectral density and Modeling of Biomedical systems: 07Hours

Moments and spectral power ratio. Power Cepstrum- Complex Cepstrum Biomedical applications of Cepstrum analysis.

Modeling of Biomedical systems: Point processes- Parametric system modeling- All-pole, pole zero modeling, electromechanical models of signal generation. Analysis of non-stationary signals: Characterization- Fixed segmentation- Short Time Fourier Transform- Adaptive segmentation Adaptive filters for segmentation- RLS and Lattice Filter.

UNIT – 5 Pattern classification and diagnostic decision: 07 Hours

Supervised and unsupervised pattern classification Probabilistic models and statistical decisions- Logistic regression analysis- training and test steps neural networks- Measures of diagnostic accuracy and cost- Reliability of classifiers and decisions. Application: Normal versus Ectopic ECG beats- Detection of Knee Joint cartilagepathology.

TEXT/REFERENCE BOOKS:

1. Rangaraj M. Rangayyan, "Biomedical Signal Analysis: A case study Approach", Wiley Interscience2002.24.
2. D. C. Reddy, "Biomedical Signal Processing: Principles and techniques", Tata McGrawHill, NewDelhi,2005.
3. MetinAkay, "Biomedical Signal Processing", Academic press,Inc.
4. Bruce, "Biomedical Signal Processing & Signal Modeling," Wiley,2001.
5. Sornmo, "Bioelectrical Signal Processing in Cardiac & Neurological Applications", Elsevier.
6. Semmlow, Marcel Dekker "Biosignal and Biomedical Image Processing",2004.
7. Enderle, "Introduction to Biomedical Engineering," 2/e, Elsevier,2005.

BTETPE702F Principles of Modern Radar Engineering 4 Credits

Course Objectives:

1. To list basic terminology, principles and concepts related to the modern RADAR systems and operation
2. To describe theory of operation of a simple RADAR including RADAR range equation, waveform design, Doppler effect, resolution, coverage and multipath
3. To explain how RADAR works and compare different type of RADAR system functionality, and configurations along with associated applications
4. To discuss principles, procedures, techniques and evolution of RADAR technology
5. To sketch a high-level architecture of a simple RADAR system covering components and subsystems including transmitters, receivers, antennas, clutter and noise, detection, signal processing modules
6. To provide detection, identification, and classification of objects/targets using different RADAR systems
7. To understanding environmental and terrain effects on RADAR operations RADAR

countermeasures target probability of detection and probability of falsealarm.

Course Outcomes:

8. Demonstrate an understanding of the factors affecting the radar performance using Radar Range Equation.
2. Analyze the principle of FM-CW radar and apply it in FM- CW Altimeter.
3. Differentiate between a MTI Radar and a Pulse Doppler Radar based on their working principle.
4. Demonstrate an understanding of the importance of Matched Filter Receivers in Radars.
5. Familiarize with the different types of Radar Displays and their application in real time scenario
6. Know the suitable measurement methodologies to characterize and verify the performance of radar systems
7. Design radar systems and to undertake measurements to characterize and verify the performance of radar systems

UNIT– 1 **07 Hours**

Basic Principles: Radar equation, Radar Cross section, CW Radar, FMCW Radar, Pulsed Radar Principles.

UNIT– 2 **07 Hours**

Clutter Analysis, MTI Improvement Factor, Pulsed Doppler Radar, Tracking Radar, Angular resolution, Mono pulse Technique.

UNIT– 3 **07 Hours**

Detection Theory: Match Filtering, Radar Ambiguity Function, Imaging Radar: Resolution Concept, Pulse Compression, Synthetic Aperture Processing, ISAR Imaging

UNIT– 4 **07 Hours**

Probability of false alarm and Detection, Modified Radar Range Equation with Swerling Models, Ground Penetrating Radar for close sensing

UNIT– 5 **07 Hours**

Radar Tomography and Radar based Microwave Imaging, Emerging and Modern Applications of Radar Principles

TEXT/REFERENCE BOOKS:

1. Introduction to Radar Systems, M.I. Skolnik, 3rdEdition, Tata Mcgraw hill edition,2001

2. Radar Systems Analysis and Design using MATLAB, B.R.Mahafza, 3rd Edition, CRC Press,2013
3. Monopulse Principles and Techniques, S.M.sherman and D.K.Barton, 2ndEdition,Artech house, 2011
4. Fundamentals of Radar Signal Processing, M.A.Richards, TMH,2005
5. Ground Penetrating Radar: Theory and Applications, Ed: H.M. Jolt, Elsevier,2009
6. Microwave Imaging, M.Pastorino, John Wiley,2010

BTETOE703A Wireless Sensor Networks 4 Credits

Course Objectives:

1. To introduce the emerging research areas in the field of wireless sensor networks
2. To understand different protocols and there uses in WSN.

Course Outcomes:

At the end of the course the students will be able to

1. Design wireless sensor networks for a given application
8. Understand emerging research areas in the field of sensor networks
9. Understand MAC protocols used for different communication standards used in WSN
10. Explore new protocols for WSN.

UNIT –1 Introduction: **07 Hours**

Introduction to Sensor Networks, unique constraints and challenges, Advantage of Sensor Networks, Applications of Sensor Networks, Types of wireless sensor networks

UNIT –2 Networks: **07 Hours**

Mobile Ad-hoc Networks (MANETs) and Wireless Sensor Networks, Enabling technologies for Wireless Sensor Networks. Issues and challenges in wireless sensor networks.

UNIT –3 Protocols: **07 Hours**

Routing protocols, MAC protocols: Classification of MAC Protocols, S-MAC Protocol, B-MAC protocol, IEEE 802.15.4 standard and ZigBee.

UNIT – 4 Dissemination protocol: **07 Hours**

Dissemination protocol for large sensor network, Data dissemination, data gathering, and data fusion; Quality of a sensor network; Real-time traffic support and security protocols.

UNIT – 5 Design Principles for WSNs: **07 Hours**

Design Principles for WSNs, Gateway Concepts Need for gateway, WSN to Internet

Communication, and Internet to WSN Communication.

Single-node architecture, Hardware components & design constraints, Operating systems and execution environments.

TEXT/REFERENCE BOOKS:

1. WaltenegusDargie, Christian Poellabauer, "Fundamentals of Wireless Sensor Networks Theory and Practice", By John Wiley & Sons Publications,2011.
2. SabrieSoloman, "Sensors Handbook" by McGraw Hill publication.2009
3. Feng Zhao, Leonidas Guibas, "Wireless Sensor Networks", ElsevierPublications,2004
4. KazemSohrby, Daniel Minoli, "Wireless Sensor Networks": Technology, Protocols and Applications, Wiley-Interscience
5. Philip Levis, And David Gay "Tiny OS Programming" by Cambridge University Press 2009.

BTETOE703B Block Chain Technology 4 Credits

UNIT – 1 Introduction to Block chain: 07 Hours

History: Digital Money to Distributed Ledgers, Design Primitives: Protocols, Security, Consensus, Permissions, and Privacy.

UNIT – 2 Block chain Architecture and Design and Consensus: 07 Hours

Basic crypto primitives: Hash, Signature, Hash chain to Block chain, Basic consensus mechanisms. Requirements for the consensus protocols, Proof of Work (PoW), Scalability aspects of Block chain consensus protocols, Permissioned Block chains: Design goals, Consensus protocols for Permissioned Block chains

UNIT – 3 Hyper ledger Fabric: 07 Hours

Hyper ledger Fabric I: Decomposing the consensus process, Hyper ledger fabric components, Chain code Design and Implementation

Hyper ledger Fabric II: Beyond Chain code: fabric SDK and Front End, Hyper ledger composer tool

UNIT – 4 Use Cases: 07 Hours

Use case I: Block chain in Financial Software and Systems (FSS): Settlements, KYC, Capital markets, Insurance.

Use case II: Block chain in tradesupply chain: Provenance of goods, visibility, trade supply

chain finance, invoice management discounting, etc

Use case III: Block chain for Government: Digital identity, land records and other kinds of record keeping between government entities, public distribution system social welfare systems.

UNIT – 5 Block chain Cryptography Privacy and Security on Block chain: 07 Hours

Research aspects I: Scalability of Block chain consensus protocols, Case Study "Various recent works on scalability,

Research aspects II: Secure cryptographic protocols on Block chain, Case Study "Secured Multi-party Computation, Block chain for science: making better use of the data-mining network, Case Studies: Comparing Ecosystems - Bitcoin, Hyper ledger, Ethereum and more.

TEXT/REFERENCE BOOKS:

1. Mastering Bitcoin: Unlocking Digital Crypto currencies, by Andreas Antonopoulos
2. Blockchain by Melanie Swa,O'Reilly
3. Hyperledger Fabric -https://www.hyperledger.org/projects/fabric
4. Zero to Blockchain - An IBM Redbooks course, by Bob Dill, David Smits - https://www.redbooks.ibm.com/Redbooks.nsf/RedbookAbstracts/crse0401.html

BTETOE703C Cyber Security 4 Credits

Course Objectives:

1. For secured and under control since the information stored and conveyed is ultimately an invaluable resource of the business.
2. The growing number of the computer Network(internet/intranet) attacks and sophistication in attack technologies has made this task still morecomplicated
3. To update the knowledge of the personnel manning networks and systems on the network security issues and solutions.

Course Outcomes:

Students should be able to understand:

1. The difference between threat, risk, attack andvulnerability.
2. How threats materialize intoattacks.
3. Where to find information about threats, vulnerabilities andattacks.
4. Typical threats, attacks and exploits and the motivations behindthem.

UNIT – 1 Introduction to Cyber Security: 07 Hours

Overview of Cyber Security, Internet Governance – Challenges and Constraints, Cyber Threats – Cyber Warfare-Cyber Crime-Cyber Terrorism-Cyber Espionage, need for a Comprehensive Cyber Security Policy, Need for a Nodal Authority, Need for an International convention on Cyberspace.

UNIT – 2 Cyber Security Vulnerabilities and Cyber Security Safeguards: 07 Hours

Cyber Security Vulnerabilities-Overview, vulnerabilities in software, System administration, Complex Network Architectures, Open Access to Organizational Data, Weak Authentication, Unprotected Broadband communications, Poor Cyber Security Awareness. Cyber Security Safeguards- Overview, Access control, Audit, Authentication, Biometrics, Cryptography, Deception, Denial of Service Filters, Ethical Hacking, Firewalls, Intrusion Detection Systems, Response, Scanning, Security policy, Threat Management.

UNIT – 3 Securing Web Application, Services and Servers: 07 Hours

Introduction, Basic security for HTTP Applications and Services, Basic Security for SOAP Services, Identity Management and Web Services, Authorization Patterns, Security Considerations, Challenges.

Intrusion Detection and Prevention: Intrusion, Physical Theft, Abuse of Privileges, Unauthorized Access by Outsider, Malware infection, Intrusion detection and Prevention Techniques, Anti-Malware software, Network based Intrusion detection Systems, Network based Intrusion Prevention Systems, Host based Intrusion prevention Systems, Security Information Management, Network Session Analysis, System Integrity Validation.

UNIT – 4 Cryptography and Network Security: 07 Hours

Introduction to Cryptography, Symmetric key Cryptography, Asymmetric key Cryptography, Message Authentication, Digital Signatures, Applications of Cryptography. Overview of Firewalls- Types of Firewalls, User Management, VPN Security Security Protocols: - security at the Application Layer- PGP and S/MIME, Security at Transport Layer- SSL and TLS, Security at Network Layer-IPSec.

UNIT – 5 Cyberspace and the Law, Cyber Forensics: 07 Hours

Introduction, Cyber Security Regulations, Roles of International Law, the state and Private

Sector in Cyberspace, Cyber Security Standards. The INDIAN Cyberspace, National Cyber Security Policy 2013 Introduction to Cyber Forensics, Handling Preliminary Investigations, Controlling an Investigation, Conducting disk-based analysis, Investigating Information-hiding, Scrutinizing E-mail, Validating E-mail header information, Tracing Internet access, Tracing memory in real-time.

TEXT/REFERENCE BOOKS:

1. Charles P. Pfleeger Shari Lawrence Pfleeger Jonathan Margulies, Security in Computing, 5th Edition, Pearson Education,2015
2. George K.Kostopoulous, Cyber Space and Cyber Security, CRC Press,2013.
3. MarttiLehto, Pekka Neittaanmäki, Cyber Security: Analytics, Technology and Automation edited, Springer International Publishing Switzerland2015.
1. NelsonPhillipsandEnfingerSteuart,—ComputerForensicsandInvestigations‖,Cengage Learning, New Delhi,2009.

BTETOE703D Mobile Computing 4Credits

Course Objectives:

1. To provide guidelines, design principles and experience in developing applications for small, mobile devices, including an appreciation of context and location aware services.
2. To introduce wireless communication and networking principles, that support connectivity to cellular networks, wireless internet and sensordevices.
3. To appreciate the social and ethical issues of mobile computing, including privacy.

Course Outcomes:

1. At the end of the course, the student will be able to demonstrate:
2. A working understanding of the characteristics and limitations of mobile hardware devices including their user-interface modalities
3. The ability to develop applications that are mobile-device specific and demonstrate current practice in mobile computing contexts.
4. A comprehension and appreciation of the design and development of context-aware solutions for mobile devices.
5. An awareness of professional and ethical issues, in particular those relating to security and privacy of user data and user behavior.

UNIT– 1 **07 Hours**

Mobile Computing, Mobile Computing vs. wireless Networking, Mobile Computing Applications, Characteristics of Mobile computing, Structure of Mobile Computing Application.

UNIT– 2 **07 Hours**

MAC Protocols, Wireless MAC Issues, Fixed Assignment Schemes, Random Assignment Schemes, Reservation Based Schemes.

UNIT– 3 **07 Hours**

Overview of Mobile IP, Features of Mobile IP, Key Mechanism in Mobile IP, route Optimization. Overview of TCP/IP, Architecture of TCP/IP- Adaptation of TCP Window, Improvement in TCP Performance, Global System for Mobile Communication (GSM), General Packet Radio Service (GPRS), Universal Mobile Telecommunication System (UMTS).

UNIT– 4 **07 Hours**

Ad-Hoc Basic Concepts, Characteristics, Applications, Design Issues, Routing, Essential of Traditional Routing Protocols, Popular Routing Protocols, Vehicular Ad Hoc networks (VANET), MANET vs. VANET, Security.

UNIT– 5 **07 Hours**

Mobile Device Operating Systems, Special Constrains & Requirements, Commercial Mobile Operating Systems, Software Development Kit: iOS, Android, BlackBerry, Windows Phone, M Commerce, Structure, Pros & Cons, Mobile Payment System, Security Issues.

TEXT/REFERENCE BOOKS:

1. Principles of Mobile Computing, 2nd Edition, UweHansmann, LotharMerk, Martin Nicklous, Thomas Stober,Springer
2. Mobile Computing, Tomasz Imielinski,Springer.

BTETOE703E Mobile Communication and Networks **4Credits**

Course Objectives:

1. To provide an overview of Mobile Communication Networks area and its applications in communication engineering.
2. To appreciate the contribution of mobile communication networks to overall technological growth.
3. To explain the various terminology, principles, devices, schemes, concepts, algorithms and different methodologies used in Mobile Communication Networks.

Course Outcomes:

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

1. Understand the working principles of the mobile communication systems.
2. Understand the relation between the user features and underlying technology.
3. Analyze mobile communication systems for improved performance.

UNIT – 1Cellularconcept: **07 Hours**

Cell structure, frequency reuse, cell splitting, channel assignment, handoff, interference, capacity, power control; Wireless Standards: Overview of 2G and 3G cellular standards.

UNIT – 2 Signal propagation: **07 Hours**

Propagation mechanism- reflection, refraction, diffraction and scattering, large scale signal propagation and lognormal shadowing. Fading channels-Multipath and small scale fading-Doppler shift, statistical multipath channel models, narrowband and wideband fading models, power delay profile, average and rms delay spread, coherence bandwidth and coherence time, flat and frequency selective fading, slow and fast fading, average fade duration and level crossing rate, Capacity of flat and frequency selective channels.

UNIT – 3 Antennas and Multiple access schemes: **07 Hours**

Antennas for mobile terminal- monopole antennas, PIFA, base station antennas and arrays. FDMA, TDMA, CDMA and SDMA, Modulation schemes- BPSK, QPSK and variants, QAM, MSK and GMSK, multicarrier modulation, OFDM

UNIT – 4 Receiver structure: **07 Hours**

Diversity receivers- selection and MRC receivers, RAKE receiver, equalization: linear-ZFE and adaptive, DFE. Transmit diversity-Altamonte scheme, MIMO and space time signal processing, spatial multiplexing, diversity/multiplexing tradeoff

UNIT – 5 Performance measures: **07 Hours**

Outage, average SNR, average symbol/bit error rate, System examples- GSM, EDGE, GPRS, IS-95, CDMA 2000 and WCDMA.

TEXT/REFERENCE BOOKS:

1. WCY Lee, Mobile Cellular Telecommunications Systems, McGraw Hill,1990.
2. WCY Lee, Mobile Communications Design Fundamentals, Prentice Hall,1993.
3. Raymond Steele, Mobile Radio Communications, IEEE Press, New York,1992.
4. AJ Viterbi, CDMA: Principles of Spread Spectrum Communications, Addison Wesley, 1995.
5. VK Garg &JE Wilkes, Wireless & Personal Communication Systems, Prentice Hall, 1996.

BTETOE703F EMI and EMC 4 Credits

Course Objectives:

1. To provide an overview of EMI and EMC
2. To provide the knowledge to compare and contrast the strengths and weaknesses of various errors correctingcode

Course Outcomes:

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

1. Be familiar with importance of error correction methods in data communication and storage.
2. Have gained experience of use of mathematical tools from from groups and finite fields, in the design of codes and sequences.
3. Develop an ability to compare and contrast the strengths and weaknesses of various errors correcting code for a given application.
4. Develop and model different error correcting codes for appraise of reaching data rate to Shannon limit.
5. Demonstrate competence in analyzing and evaluating the practice of different error correcting coded in digital communication system

UNIT –1 Introduction: **07 Hours**

History of EMI/EMC, Analysis of EMI, Type of Noise and Interference, Electromagnetic Compatibility, Benefits of Good EMC Design, EMC Regulations (Government, Commercial And Military), Examples of EMC Related Problems.

UNIT–2 EMC requirements for electronic systems: **07 Hours**

Radiated Emission Limits For Class A, Class B, FCC And CICPR, Measurement of Emissions For Verification of Compliance, Radiated Emission And Susceptibility, Conducted Emissions And Susceptibility, Typical Product Emissions, Additional Product Requirements, Design Constraints For Products, Advantages of EMC Design.

UNIT–3 Conducted emission and susceptibility: **07 Hours**

Measurement of Conducted Emission: LISN, Common And Differential Mode Currents, Power Supply Filters, Basic Properties of Filters, A Generic Topology, Effect of Filter Elements on Common And Differential Mode Currents, Separation of Conducted Emissions In to Common And Differential Mode Components For Diagnostic Purpose, Power Supplies: Linear And SMPS, Effect of Power Supply Components on Conducted Emissions, Power Supply And Filter Placement, Conducted Susceptibility.

UNIT–4 Radiated emission and susceptibility: **07 Hours**

Simple Emission Models For Wires and PCB Lands: Differential Mode versus Common Mode Currents, Differential Mode Current Emission Model, Common Mode Current Emission Model, Current Probes, Simple Susceptibility Models for Wires and PCB Lands: Shielded Cables and Surface Transfer Impedance.

UNIT–5 Shielding and system design for EMC: **07 Hours**

Shielding Effectiveness, Far Field Sources, Exact Solution, and Approximate Solution, Near Field Sources: Near Field Versus Far Field, Electric Sources, Magnetic Sources, Low Frequency, Magnetic Fielding Shielding, And Effect of Apertures.

Shielding and Grounding, PCB Design, System Configuration and Design, Electrostatic Discharge, Diagnostic Tools.

TEXT/REFERENCE BOOKS:

1. Paul Clayton,"Introduction to Electromagnetic Compatibility", Wiley Interscience, 2nd Ed., 2006.
2. Ott H. W.,"Noise Reduction Techniques in Electronic Systems", Wiley Interscience, 2nd Ed., 1988.
3. Goedbloed,"Electromagnetic Compatibility", Prentice Hall, 1st English Language Ed., 1993
4. Kaiser K. L.,"Electromagnetic Shielding", CRC Press, 1st Ed.,2006.
5. Stallings W.,"Cryptography and Network Security Principles and Practices", Pearson Education, 3rd Ed.,2007.
6. Michel Mardiguian,"EMI Troubleshooting Techniques", McGraw-Hill Professional, 1st Ed., 1999.

BTETOE704A Soft Computing 4Credits

Course Objectives:

1. Introduce a relatively new computing paradigm for creating intelligent machines useful for solving complex real-world problems.
2. Insight into the tools that make up the soft computing technique: fuzzy logic, artificial neural networks and hybrid systems Techniques.
3. To create awareness of the application areas of soft computing technique.
4. Provide alternative solutions to the conventional problem-solving techniques in image/signal processing, pattern recognition/classification, control system.

Course Outcomes:

After the successful completion of this course, students will be able to:

1. Use a new tool /tools to solve a wide variety of real-world problems.
2. Find an alternate solution, which may offer more adaptability, resilience and optimization.
3. Identify the suitable antenna for a given communication system.
4. Gain knowledge of soft computing domain which opens up a whole new career option.
5. Tackle real world research problems.

UNIT – 1 Artificial Neural Network–I: **07 Hours**

Biological neuron, Artificial neuron model, concept of bias and threshold, McCulloch- Pits Neuron Model, implementation of logical AND, OR, XOR functions Soft Topologies of neural networks, learning paradigms: supervised, unsupervised, reinforcement, Linear neuron model: concept of error energy, gradient descent algorithm and application of linear neuron for linear regression, Activation functions: binary, bipolar (linear, signup, log sigmoid, tan sigmoid)Learning mechanisms: Hebbian, Delta Rule o Perceptron and its limitationsDraft.

UNIT – 2 Artificial Neural Network-II: **07 Hours**

Multilayer perceptron (MLP) and back propagation algorithm o Application of MLP for classification and regression o Self- organizing Feature Maps, k- means clustering o Learning vector quantization Radial Basis Function networks: Cover‟s theorem, mapping functions (Gaussian, Multi-quadrics, Inverse multi quadrics, Application of RBFN for classification and regression o Hopfield network, associativememories.

UNIT – 3 Fuzzy Logic –I: **07 Hours**

Concept of Fuzzy number, fuzzy set theory (continuous, discrete) o Operations on fuzzy sets, Fuzzy membership functions (core, boundary, and support), primary and composite linguistic terms, Concept of fuzzy relation, composition operation (T-norm,T-conorm) o Fuzzy if-then rules.

UNIT – 4 Fuzzy Logic –II: **07 Hours**

Fuzzification, Membership Value Assignment techniques, De-fuzzification (Max membership principle, Centroid method, Weighted average method), Concept of fuzzy inference, Implication rules- Dienes-Rescher Implication, Mamdani Implication, Zadeh Implication, Fuzzy Inference systems -Mamdani fuzzy model, Sugeno fuzzy model , Tsukamoto fuzzy model, Implementation of a simple two-input single output FIS employing Mamdani model Computing.

UNIT – 5 Fuzzy Control Systems and Adaptive Neuro-Fuzzy Inference Systems (ANFIS): 07Hours

Control system design problem 1.5, Control (Decision) Surface, Assumptions in a Fuzzy Control System Design V, Fuzzy Logic Controllers Soft o Comparison with traditional PID control, advantages of FLC, Architecture of a FLC: Mamdani Type, Example Aircraft landing control problem.

ANFIS architecture, Hybrid Learning Algorithm, Advantages and Limitations of ANFIS Application of ANFIS/CANFIS for regression.

TEXT/REFERENCE BOOKS:

1. Fundamentals of Neural Networks: Architectures, Algorithms and Applications, LaureneFausett, Pearson Education, Inc,2008.
2. Fuzzy Logic with Engineering Applications, Third Edition Thomas, Timothy Ross, John Wiley & Sons,2010.
3. Neuro- Fuzzy and Soft Computing, J.S. Jang, C.T. Sun, E. Mizutani, PHI Learning Private Limited.
4. Principles of Soft Computing, S. N. Sivanandam, S. N. Deepa, John Wiley & Sons,2007.
5. Introduction to the theory of neural computation, John Hertz, Anders Krogh, Richard Palmer, Addison –Wesley Publishing Company,1991.
6. Neural Networks A comprehensive foundation,, Simon Haykin, Prentice Hall InternationalInc-1999.
7. NeuralandAdaptiveSystems:FundamentalsthroughSimulations,JoséC.PrincipeNeil R. Euliano, W. Curt Lefebvre, John-Wiley & Sons, 2000.
8. Pattern Classification, Peter E. Hart, David G. Stork Richard O. Duda, Second Edition, 2000.
9. Pattern Recognition, SergiosTheodoridis, KonstantinosKoutroumbas, Fourth Edition, Academic Press,2008.
10. A First Course in Fuzzy Logic, Third Edition, Hung T. Nguyen, Elbert A. Walker, Taylor & Francis Group, LLC,2008.
11. Introduction to Fuzzy Logic using MATLAB, S. N. Sivanandam, S. Sumathi, S. N. Deepa, Springer Verlag,2007.

BTETOE704B Big Data Analytics **4 Credits**

Course Objectives:

1. To provide an overview of an exciting growing field of Big Data analytics.
2. To discuss the challenges traditional data mining algorithms face when analyzing Big Data.
3. To introduce the tools required to manage and analyze big data like Hadoop, NoSql Map Reduce.
4. To teach the fundamental techniques and principles in achieving big data analytics with scalability and streaming capability
5. To introduce to the students several types of big data like social media, web graphs and data streams
6. To enable students to have skills that will help them to solve complex real-world problems in for decision support.

Course Outcomes:

At the end of this course, Students will able to:

1. Explain the motivation for big data systems and identify the main sources of Big Data in the real world.
2. Demonstrate an ability to use frameworks like Hadoop, NOSQL to efficiently store retrieve and process Big Data for Analytics.
3. Implement several Data Intensive tasks using the Map Reduce Paradigm
4. Apply several newer algorithms for Clustering Classifying and finding associations in BigData.

UNIT – 1 Big Data Platforms: **07 Hours**

Big Data Platforms for the Internet of Things: network protocol- data dissemination –current state of art- Improving Data and Service Interoperability with Structure, Compliance, Conformance and Context Awareness: interoperability problem in the IoT context- Big Data Management Systems for the Exploitation of Pervasive Environments - Big Data challenges and requirements.

UNIT – 2YATRAP: **07 Hours**

YA TRAP – Necessary and sufficient condition for false authentication prevention - Adaptive Pipelined Neural Network Structure in Self-aware Internet of Things: self-healing systems

Role of adaptive neural network- Spatial Dimensions of Big Data: Application of Geographical Concepts and Spatial Technology to the Internet of Things- Applying spatial relationships, functions, and models.

UNIT – 3 Fog Computing: 07 Hours

Fog Computing: A Platform for Internet of Things and Analytics: a massively distributed number of sources - Big Data Metadata Management in Smart Grids: semantic inconsistencies - role of metadata.

UNIT – 4 Web Enhanced Building and Technologies for Healthcare: 07 Hours

Toward Web Enhanced Building Automation Systems: heterogeneity between existing installations and native IP devices - loosely-coupled Web protocol stack –energy saving in smart building- Intelligent Transportation Systems and Wireless Access in Vehicular Environment Technology for Developing Smart Cities: advantages and achievements.

Emerging Technologies in Health Information Systems: Genomics Driven Wellness Tracking and Management System (GO-WELL) – predictive care – personalized medicine.

UNIT – 5 Sustainability Data and Analytics: 07 Hours

Sustainability Data and Analytics in Cloud-Based M2M Systems - potential stakeholders and their complex relationships to data and analytics applications - Social Networking Analysis - Building a useful understanding of a social network - Leveraging Social Media and IoT to Bootstrap Smart Environments: lightweight Cyber Physical Social Systems - citizen actuation.

TEXT/REFERENCE BOOKS:

1. Stackowiak, R., Licht, A., Mantha, V., Nagode, L.," Big Data and the Internet of Things Enterprise Information Architecture for A New Age", Apress, 2015. 2. Dr. John Bates, "Thingalytics - Smart Big Data Analytics for the Internet of Things", john Bates,2015.
2. Dr. John Bates, "Thingalytics - Smart Big Data Analytics for the Internet of Things", john Bates,2015.

BTETOE704C Data Structure & Algorithms Using Java Programming 4 Credits

Prerequisites: Basic knowledge of Java Programming fundamentals required.

Course Objectives:

1. To assess how the choice of data structures and algorithm design methods impacts the performance of programs.
2. To choose the appropriate data structure and algorithm design method for a specified application.
3. To study the systematic way of solving problems, various methods of organizing large amounts ofdata.
4. To solve problems using data structures such as linear lists, stacks, queues, binary trees, binary search trees, and graphs and writing programs for these solutions.
5. To employ the different data structures to find the solutions for specific problems

Course Outcomes:

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

1. To impart the basic concepts of data structures and algorithms.
2. To understand concepts about searching and sorting techniques
3. Describe how arrays, records, linked structures are represented in memory and use them in algorithms.
4. To understand basic concepts about stacks, queues, lists trees and graphs.
5. To enable them to write algorithms for solving problems with the help of fundamental data structures.

UNIT –1 Introduction: 07 Hours

Basic Terminologies: Elementary Data Organizations, Data Structure Operations: insertion, deletion, traversal etc.; Analysis of an Algorithm, Asymptotic Notations, Time-Space trade off. Searching: Linear Search and Binary Search Techniques and their complexity analysis

UNIT – 2 Stacks and Queues: 07 Hours

ADT Stack and its operations: Algorithms and their complexity analysis, Applications of Stacks: Expression Conversion and evaluation – corresponding algorithms and complexity analysis. ADT queue, Types of Queue: Simple Queue, Circular Queue, Priority Queue; Operations on each type of Queues: Algorithms and their analysis.

UNIT – 3 Linked Lists: **07 Hours**

Singly linked lists: Representation in memory, Algorithms of several operations: Traversing, Searching, Insertion into, Deletion from linked list; Linked representation of Stack and Queue, Header nodes, doubly linked list: operations on it and algorithmic analysis; Circular Linked Lists: all operations their algorithms and the complexityanalysis.

UNIT –4Trees: **07 Hours**

Basic Tree Terminologies, Different types of Trees: Binary Tree, Threaded Binary Tree, Binary Search Tree, AVL Tree; Tree operations on each of the trees and their algorithms with complexity analysis. Applications of Binary Trees, B Tree, B+ Tree: definitions, algorithms and analysis.

UNIT – 5 Sorting and Hashing: **07 Hours**

Objective and properties of different sorting algorithms: Selection Sort, Bubble Sort, Insertion Sort, Quick Sort, Merge Sort, Heap Sort; Performance and Comparison among all the methods, Hashing. Graph: Basic Terminologies and Representations, Graph search and traversal algorithms and complexityanalysis.

TEXT/REFERENCE BOOKS:

1. Algorithms, Data Structures, and Problem Solving with C++", Illustrated Edition by Mark Allen Weiss, Addison-Wesley PublishingCompany
2. "How to Solve it by Computer", 2nd Impression by R. G. Dromey, PearsonEducation.
3. Ellis Horowitz, SartajSahni, "Fundamentals of Data Structures", Galgotia Books Source. ISBN 10:0716782928.
4. Richard F. Gilberg&Behrouz A. Forouzan, Data Structures: A Pseudocode Approach with C, Cengage Learning, second edition. ISBN-10:0534390803.
5. Seymour Lipschutz, Data Structure with C, Schaum‟s Outlines, Tata Mc Graw Hill. ISBN-10:1259029964.
6. E Balgurusamy - Programming in ANSI C, Tata McGraw-Hill, Third Edition. ISBN-10: 1259004619.
7. YedidyahLangsam, Moshe J Augenstein, Aaron M Tenenbaum – Data structures using C and C++ - PHI Publications, Second Edition). ISBN 10:8120311779.

BTETOE704D Entrepreneurship Development 4Credits

Course Objectives:

1. To Develop and Strengthen Entrepreneurial Quality and Motivation in Students and To Impart Basic Entrepreneurial Skills and Understanding to Run a Business Efficiently and Effectively.
2. The students develop and can systematically apply an entrepreneurial way of thinking that will allow them to identify and create business opportunities that may be commercialized successfully.

Course Outcomes:

After the completion of the course, the students will be able to:

1. Have the ability to discern distinct entrepreneurial traits.
2. Know the parameters to assess opportunities and constraints for new business ideas.
3. Understand the systematic process to select and screen a business idea.
4. Design strategies for successful implementation of ideas.
5. Write a business plan.

UNIT –1Entrepreneurship: 07 Hours

Entrepreneur – Types of Entrepreneurs – Difference Between Entrepreneur and Intrapreneur Entrepreneurship in Economic Growth, Factors Affecting Entrepreneurial Growth.

UNIT –2 Motivation: 07 Hours

Major Motives Influencing an Entrepreneur – Achievement Motivation Training, Self-Rating, Business Games, Thematic Apperception Test – Stress Management, Entrepreneurship Development Programs – Need, Objectives.

UNIT –3 Business: 07 Hours

Small Enterprises – Definition, Classification – Characteristics, Ownership Structures – Project Formulation – Steps Involved in Setting Up A Business – Identifying, Selecting A Good Business Opportunity, Market Survey and Research, Techno Economic Feasibility Assessment – Preparation of Preliminary Project Reports – Project Appraisal – Sources of Information – Classification of Needs and Agencies.

UNIT – 4 Financing and Accounting: **07 Hours**

Need – Sources of Finance, Term Loans, Capital Structure, Financial Institution, Management of Working Capital, Costing, Break Even Analysis, Taxation – Income Tax, Excise Duty – SalesTax.

UNIT – 5 Support to Entrepreneurs: **07 Hours**

Sickness in Small Business – Concept, Magnitude, Causes and Consequences, Corrective Measures – Business Incubators – Government Policy for Small Scale Enterprises – Growth Strategies in Small Industry – Expansion, Diversification, Joint Venture, Merger And Sub Contracting.

TEXT/REFERENCE BOOKS:

1. Khanka. S.S., "Entrepreneurial Development" S. Chand & Co. Ltd., Ram Nagar, New Delhi,2013.
2. Donald F Kuratko, "Entreprenuership – Theory, Process and Practice", 9th Edition, Cengage Learning2014.
3. Hisrich R D, Peters M P, "Entrepreneurship" 8th Edition, Tata McGraw-Hill,2013.
4. Mathew J Manimala, "Enterprenuership Theory At Cross Roads: Paradigms and Praxis" 2nd Edition Dream Tech,2005.
5. Rajeev Roy, „Entrepreneurship" 2nd Edition, Oxford University Press,2011.
6. EDII "Faulty and External Experts – A Hand Book For New Entrepreneurs Publishers: Entrepreneurship Development", Institute of India, Ahmadabad,1986.
8. , Design of analog filters by, Prentice-Hall 1990 (or neweradditions).
9. M. Burns et al., An introduction to mixed-signal IC test and measurement by, Oxford University Press, First Indian edition,2008.

BTETOE704E Software Defined Radio — 4 Credits

Course Objectives:

1. The objective of this course is to provide knowledge of fundamental and state-of the art concepts in software defined radio.

2. To understand the various components of software-defined-radios with the understanding of their limitation and application of „software-defined-solutions" to overcome suchlimitations.
3. To Understanding the interplay of analog and digital signal processing for power as well as spectrum efficient transmission and reception of signal leads to an optimized, yet, practical radiosolution.

Course Outcomes:

1. The student will study Needs, Characteristics, Benefits and Design Principles of a Software Radio.
2. The student will be study design aspects of software radios.
3. The student will understand concept of Smart Antennas.
4. The student will study key hardware elements and related Trade-Offs.

UNIT – 1 Fundamentals of SDR: **07 Hours**

Software Radios, Needs, Characteristics, Benefits, Design Principles of a Software Radio, Radio frequency implementation issues, Principal Challenge of Receiver Design

UNIT – 2 RF and SDR: **07 Hours**

RF Receiver Front-End Topologies, Enhanced Flexibility of the RF Chain with Software Radios, Transmitter Architectures and their issues, Noise and Distortion in the RF Chain, Timing Recovery in Digital Receivers Using Multirate Digital Filters

UNIT – 3 Signals in SDR: **07 Hours**

Approaches to Direct Digital Synthesis, Analysis of Spurious Signals, Spurious Components due to Periodic Jitter, Band-pass Signal Generation, Hybrid DDS-PLL Systems, Generation of Random Sequences, Parameters of data converters

UNIT – 4 Smart Antennas: **07 Hours**

Concept of Smart Antennas, Structures for Beam-forming Systems, Smart Antenna Algorithms, Digital hardware choices, Key Hardware Elements, DSP Processors, Field Programmable Gate Arrays, Trade-Offs in Using DSPs, FPGAs and ASICs.

UNIT – 5 Case studies in Radio System: **07 Hours**

Power Management Issues, Object-oriented representation of radios and network resources, Mobile Application Environments, Joint Tactical Radio System, Case studies in software radio design.

TEXT/REFERENCE BOOKS:

1. Jeffrey H. Reed, "Software Radio: A Modern Approach to Radio Engineering", Prentice Hall PTR; May 2002 ISBN:0130811580
2. Dillinger, Madani, Alonistioti (Eds.), "Software Defined Radio, Architectures, Systems and Functions", Wiley2003
3. Bard, Kovarik, "Software Defined Radio, The Software Communications Architecture", Wiley2007
4. Johnson, C.R. and W.A. Sethares, "Telecommunication Breakdown: Concepts of Communication Transmitted via Software-Defined Radio, Pearson Prentice Hall,2004
5. Bard, John and Kovarik, Vincent, "Software Defined Radio: The Software Communications Architecture", Wiley Series in Software Radio,2007.

BTETOE704F E Waste Management — 4 Credits

Course Objectives:

1. To understand the problems of municipal waste, biomedical waste, hazardous waste, e-waste, industrial waste etc
2. To understand health and environmental issues related to E waste and management.

UNIT– 1 **07 Hours**

E-Waste Overview, E-waste Management Overview

UNIT– 2 **07 Hours**

Environmental and Public Health Issues, E-waste Health Risk Assessment

UNIT– 3 **07 Hours**

Environmental and Public Health Issues, Recovery of Materials from E-Waste

UNIT– 4 **07 Hours**

Metal Recovery Process, Recovery of Metals from Electronic Waste

UNIT– 5 **07 Hours**

E-waste Management, Electronics and LCA, LCA applications for Electronics

TEXT BOOKS/REFERENCES:

1. G H Eduljee, R M Harrison, "Electronic Waste Management" 2nd edition.
2. Hugo Marcelo Veit, Andréa Moura Bernardes, "Electronic Waste: Recycling Techniques"Springer.
3. Anish Khan, Inamuddin, Abdullah M. Asiri, "E-waste Recycling and Management: Present Scenarios and Environmental Issues"Springer.

BTHM705 Engineering Economics and Financial Mathematics 3 Credits

Course Objective:

- After completing this course, students will be able to conduct simple economic studies. They will also be able to make evaluation of engineering projects and make decisions related to investment.

UNIT – 1 Introduction Engineering Economy: **07 Hours**

Introduction to Economics- Flow in an economy, Law of supply and demand, Concept of Engineering − Economics − Engineering efficiency, Economic efficiency, Scope of engineering economics − Element of costs, Marginal cost, Marginal Revenue, Sunk cost, Opportunity cost, Break-even analysis, P − V ratio, Elementary economic Analysis− Material selection for product, Design selection for a product, Process planning.

UNIT – 2 Value Engineering: **07 Hours**

Make or buy decision, Value engineering − Function, aims, Value engineering procedure. Interest formulae and their applications− Time value of money, Single payment compound amount factor, Single payment present worth factor, Equal payment series sinking fund factor,EqualpaymentseriespaymentPresentworthfactor–equalpaymentseriescapital

recovery factor − Uniform gradient series annual equivalent factor, Effective interest rate, Examples in all the methods.

UNIT – 3 Cash Flow: **07 Hours**

Methods of comparison of alternatives − Present worth method (Revenue dominated cash flow diagram), Future worth method (Revenue dominated cash flow diagram, Cost dominated cash flow diagram), Annual equivalent method (Revenue dominated cash flow diagram, Cost dominated cash flow diagram), rate of return method, Examples in all the methods.

UNIT – 4 Replacement And Maintenance Analysis: **07 Hours**

Replacement and Maintenance analysis − Types of maintenance, types of replacement problem, determination of economic life of an asset, Replacement of an asset with an ewasset − capital recovery with return and concept of challenger and defender, Simple probabilistic model for items which fail completely.

UNIT –5 Depreciation: **07 Hours**

Depreciation − Introduction, Straight line method of depreciation, − Declining balance method of depreciation − Sum of the years digits method of depreciation, − Sinking fund method of depreciation/Annuity method of depreciation, service output method of depreciation − Evaluation of public alternatives − Introduction − Examples – Inflation adjusted decisions − Procedure to adjust inflation, Examples on comparison of alternatives and determination of economic life of asset.

TEXT BOOKS/REFERENCES:

1. Panneer Selvam, R, “Engineering Economics”, Prentice Hall of India Ltd, New Delhi,2001.
2. Suma Damodaran, “ Managerial economics”, Oxford university press2006
3. A Text book of Economic Theory: by stonier and hauge,pearsonPublication.
4. Modern Economic Theory: by Sampat Mukherjee, New Age InternationalPublisher
5. Engineering Economics: by Degramo, prenticeHall.
6. International Economics: by Bo Sodersten,Macmillan.

7. Principle of Macroeconomics : by Rangarajan and Dholokia, Tata McGrawHill.
8. Monetary Economics: by SurajB.Gupta, Schand.
9. Project planning analysis, Selection, Implementation and review: by Prasanna Chandra, Tata McGraw Hill Education.8.Cost Accounting: by Jawahar Lal ,McGrawHill.

COURSE CURRICULUM MAPPING WITH MOOC PLATFORM NPTEL

Sr. No	SEMESTER	COURSE CODE	NAME OF SUBJECT AS PER CURRICULUM	SWAYAM / NPTEL COURSE	NAME OF THE INSTITUTE OFFERING COURSE	RELEVANCE %	DURATION OF COURSE
1	SEM-III	BTBS301	Engineering Mathematics – III	Differential equations for engineers	IIT Madras	80%	12 WEEK
2		BTETC302	Electronic Devices & Circuits	Fundamentals of semiconductor devices	IISc Bangalore	80%	12 WEEK
3		BTETC303	Digital Electronics	Digital Circuits	IIT Madras	60%	14 WEEK
4		BTES304	Electrical Machines and Instruments	Electrical Machines - I	IIT Kharagpur	70%	12 WEEK
5	SEM-IV	BTETC401	Network Theory	Network Analysis	IIT Kharagpur.	80%	12 WEEK
6		BTETC402	Signals and Systems	Signals and Systems	IIT Bombay	90%	11 WEEK
7		BTHM403	Basic Human Rights	Human Rights, International Law and International Humanitarian Law	O.P. Jindal Global University	80%	08 WEEK
8		BTBS404	Probability Theory and Random Processes	Probability and Random rocesses(Video)	IIT Kharagpur.	90%	12 WEEK
9		BTETPE405A	(A) Numerical Methods and Computer Programming	Numerical Methods and Computations	IIT Delhi	60%	12 WEEK
		BTETPE405B	(B) Data Compression & Encryption	Multimedia Processing (Web)	IIT Kharagpur.	90%	09 WEEK
		BTETPE405C	(C) Computer Organization and Architecture	Computer Arcitecture and Organization	IIT Kharagpur.	80%	09 WEEK
		BTETPE405D	(D) Introduction to MEMS	MEMs and Microsystems	IIT Kharagpur.	90%	9 WEEK
		BTETPE405E	(E) Python Programming	Programming, Data Structures and Algorithms using Python	IIT Madras	40%	8 WEEK
10	SEM-V	BTETC501	Electromagnetic Field Theory	Electomagnetic Theory	IIT KHARAGPUR	90%	12 WEEK
11		BTETC502	Digital Signal Processing	Digital Signal Processing	IIT Delhi	90%	12 WEEK
12		BTETC503	Analog Communication	Analog Communication	IIT KHARAGPUR	90%	12 WEEK
13		BTETPE504A	(A) Analog Circuits	Analog Circuits	IIT Delhi	70%	12 WEEK

		BTETPE504 B	(B) Embedded System Design	Embedded System Design	IIT KHARAGPUR	70%	6 WEEK
		BTETPE504 C	(C) Digital System Design	Digital System Design	IIT KHARAGPUR	70%	6 WEEK
		BTETPE504 E	(E) Mixed Signal Design	Mixed Signal Design	IITBombay	90%	8 WEEK
		BTETPE504 F	(F) Power Electronics	Power Electronics	IIT DELHI	55%	12 WEEK
14		BTETOE505 A	(A) Control System Engineering	Control Engineering	IIT Madras	90%	12 WEEK
		BTETOE505 B	(B) Artificial Intelligence and Machine learning	Introduction to AI	IIT DELHI	90%	12 WEEK
		BTETOE505 D	(D) Project Management and Operation Research	Project Management for managers	IIT ROORKEE	90%	12 WEEK
		BTETOE505 E	(E) Augmented, Virtual and Mixed Reality	Virtual Reality	IIT Madras	90%	12 WEEK
15	SEM-VI	BTETC601	Antennas and Wave Propagation	Antennas	IIT Bombay	70%	12 WEEK
16		BTETC602	Digital Communicatio n	Principles of Digital Communication	IIT DELHI	50%	12 WEEK
17		BTETPE603 A	(A) Microprocessor s and Microcontroller s	Microprocessors And Microcontrollers	IIT KHARAGPUR	90%	12 WEEK
17		BTETPE603 B	(B) CMOS Design	CMOS Digital VLSI Design	IIT ROORKEE	30%	8 WEEK
		BTETPE603 D	(D) Advanced Digital Signal Processing	Multirate DSP	IIT Madras	25%	12 WEEK
		BTETPE603 E	(E) Information Theory and Coding	Information Theory	IISC BANGLORE	40%	12 WEEK
		BTETPE603 F	(F) VLSI Signal Processing	VLSI Signal Processing	IIT KHARAGPUR	30%	8 WEEK
		BTETPE603 G	(G) VLSI Design & Technology	CMOS Digital VLSI Design	IIT ROORKEE	20%	8 WEEK
18		BTETOE604 A	(A) IoT and Industry 4.0	Introduction to Industry 4.0 and Industrial Internet of Things	IIT KHARAGPUR	90%	12 WEEK
		BTETOE604 B	(B) Deep Learning	Deep Learning	IIT KHARAGPUR	25%	12 WEEK
		BTETOE604 C	(C) Computer Network	Computer Networks and Internet Protocol	IIT KHARAGPUR	70%	12 WEEK

		BTETOE604 F	(F) Patents and IPR	Patent Search for Engineers and Lawyers	IIT KHARAGPUR	20%	8 WEEK
19	SEM-VII	BTETC701	Microwave Engineering	Microwave theory and Technique	IIT Bombay	60%	12 WEEK
20		BTETPE702 A	(A) Digital Image Processing	Digital Image Processing	IIT KHARAGPUR	70%	12 WEEK
		BTETPE702 D	(D) Fiber Optic Communicatio n	Optical Engineering	IIT Madras	50%	12 WEEK
21		BTETOE703 A	(A) Wireless Sensor Networks	Principles of modern CDMA/MIMO/OFDM,Wire less communication,Introductio n to wireless and cellular communication	IIT KANPUR	30%	8 WEEK
		BTETOE703 D	(D) Mobile Computing	Cloud computing	IIT KHARAGPUR	25%	8 WEEK
		BTETOE703 E	(E) Mobile Communicatio n and Networks	Introduction to wireless and cellular communication	IIT Madras	60%	12 WEEK
22		BTETOE704 B	(B) Big Data Analytics	Data science and Engineering	IIT Madras	60%	8 WEEK
		BTETOE704 C	(C) Data Structure & Algorithms Using Java Programming	Data Structure & Algorithms Using Java	IIT Kharagpur	60%	12 WEEK

COURSE CURRICULUM MAPPING WITH MOOC PLATFORM COURSERA

Sr. No	SEMESTER	COURSE CODE	NAME OF SUBJECT AS PER CURRICULUM	COURSERA COURSE	NAME OF THE INSTITUTE OF OFFERING COURSE	RELEVANCE %	DURATION OF COURSE
1	SEM-III	BTBS301	Engineering Mathematics – III	Differential Equations for Engineers	The Hong Kong University of Science and Technology (HKUST)	70%	6 WEEK
2		BTETC302	Electronic Devices & Circuits	Introduction to Electronics	The Georgia Institute of Technology	80%	7 WEEK
3		BTETC303	Digital Electronics	Digital Systems: From Logic Gates to Processors-	Universitat Autònoma de Barcelona	70%	8 WEEK
4		BTES304	Electrical Machines and Instruments	Motors and Motor Control Circuits	University of Colorado Boulder	60%	5 WEEK
5	SEM-IV	BTETC401	Network Theory	Linear Circuits 1: DC Analysis	The Georgia Institute of Technology	60%	7 WEEK
6		BTETC402	Signals and Systems	Digital Signal Processing 3: Analog vs Digital	École Polytechnique Fédérale de Lausanne	60%	4 WEEK
7		BTHM403	Basic Human Rights	Human Rights for Open Societies	Utrecht University	60%	6 WEEK

8		BTBS404	Probability Theory and Random Processes	Probability Theory, Statistics and Exploratory Data Analysis	National Research University Higher School of economics	80%	6 WEEK
9		BTETPE405 A	(A) Numerical Methods and Computer Programming	Introduction to numerical analysis	National Research University Higher School of Economics	50%	7 WEEK
		BTETPE405 C	(C) Computer Organization and Architecture	Computer Architecture	Princeton University	80%	11 WEEK
		BTETPE405 E	(E) Python Programming	Python Data Structures	University of Michigan	80%	7 WEEK
10	SEM-V	BTETC502	Digital Signal Processing	Digital Signal Processing 2: Filtering	École Polytechnique Fédérale de Lausanne	70%	3 WEEK
11		BTETPE504 B	(B) Embedded System Design	Embedded Hardware and Operating System	University of Turku,Finland	30	3 WEEK
		BTETPE504 F	(F) Power Electronics	Converter Circuits	University of Colorado Boulder	60%	4 WEEK
12		BTETOE505 B	(B) Artificial Intelligence and Machine learning	Machine Learning	Stanford University	70%	11 WEEK
		BTETOE505 C	(C) Optimization Techniques	Discrete Optimization	MelbourneUniversity	70%	8 WEEK
		BTETOE505 D	(D) Project Management and Operation Research	Managing Project Risks and Changes	University of California, Irvine	50%	5 WEEK
		BTETOE505 E	(E) Augmented, Virtual and Mixed Reality	Introduction to XR: VR, AR, and MR Foundations	Unity Technologies	60%	4 WEEK
13	SEM-VI	BTETC602	Digital Communication	Digital Signal Processing 4: Applications	École Polytechnique Fédérale de Lausanne	40%	3 WEEK
14		BTETPE603 A	(A) Microprocessors and Microcontrollers	Introduction to the Internet of Things and Embedded Systems	University of California, Irvine	30%	4 WEEK
		BTETPE603 E	(E) Information Theory and Coding	Information Theory	The Chinese University of Hong Kong	70%	11 WEEK
		BTETPE603 G	(G) VLSI Design & Technology	VLSI CAD Part I: Logic	University of Illinois at Urbana-Champaign	50%	5 WEEK
15		BTETOE604 A	(A) IoT and Industry 4.0	" Introduction to the Internet of Things and Embedded Systems	University of California, Irvine	30%	4 WEEK
15	SEM-VI	BTETOE604 B	(B) Deep Learning	Neural Networks and Deep Learning	deeplearning.ai	60%	4 WEEK
		BTETOE604 C	(C) Computer Network	The Bits and Bytes of Computer Networking	Google	80%	6 WEEK
		BTETOE604 E	(E) Robotics Design	Robotics: Mobility	University of Pennsylvania	50%	4 WEEK

		BTETOE604 F	(F) Patents and IPR	Introduction to Intellectual Property	University of Pennsylvania	60%	4 WEEK
16	SEM-VII	BTETPE702 A	(A) Digital Image Processing	Fundamentals of Digital Image and Video Processing	Northwestern University	60%	12 WEEK
		BTETPE702 E	(E) Bio-medical Signal Processing	The Development of Mobile Health Monitoring Systems	Saint Petersburg State University	40%	5 WEEK
17		BTETOE703 B	(B) Block Chain Technology	Blockchain: Foundations and Use Cases	Consensys Academy	70%	5 WEEK
		BTETOE703 C	(C) Cyber Security	Web Connectivity and Security in Embedded Systems	EIT Digital	60%	6 WEEK
		BTETOE703 E	(E) Mobile Communication and Networks	Wireless Communications for Everybody	Yonsei University	60%	6 WEEK
18		BTETOE704 A	(A) Soft Computing	Neural Networks and Deep Learning	deeplearning.ai	30%	4 WEEK
		BTETOE704 B	(B) Big Data Analytics	Introduction to Big Data	University of California San Diego	30%	3 WEEK
		BTETOE704 C	(C) Data Structure & Algorithms Using Java Programming	Data Structures	University of California San Diego	60%	6 WEEK
		BTETOE704 D	(D) Entrepreneurship Development	Entrepreneurship 1: Developing the Opportunity	University of Pennsylvania	40%	4 WEEK

COURSE CURRICULUM MAPPING WITH MOOC PLATFORM Edx

Sr. No	SEMESTER	COURSE CODE	NAME OF SUBJECT AS PER CURRICULUM	EDX COURSE	NAME OF INSTITUTE OFFERING COURSE	RELEVANCE %	DURATION OF COURSE
1	SEM-III	BTETC302	Electronic Devices & Circuits	Principle of Semiconductor Devices Part I: Semiconductors, PN Junctions and Bipolar Junction Transistors	The Hong Kong University of Science and Technology	70%	8 WEEK
2		BTETC303	Digital Electronics	Computation Structures - Part 1: Digital Circuits	Massachusetts Institute of Technology	60%	10 WEEK
3	SEM-IV	BTETC401	Network Theory	Principles of Electric Circuits	Tsinghua University	40%	18 WEEK
4		BTETC402	Signals and Systems	1) Discrete Time Signals and Systems, Part 1: Time Domain , Discrete Time Signals and Systems, Part 2: Frequency Domain 2) Discrete Time Signals and Systems	Rice University	70%	1)4 WEEK 2)8 WEEK
5		BTHM403	Basic Human Rights	Human Rights Defenders	Amnesty International	40%	4 WEEK
6		BTBS404	Probability Theory and Random Processes	Probability: Basic Concepts & Discrete Random Variables	Purdue University	50%	6 WEEK

7		BTETPE405 E	(E) Python Programming	Introduction to Python: Fundamentals	Microsoft	50%	5 WEEK
8	SEM-V	BTETC501	Electromagnetic Field Theory	Electromagnetism	Tsinghua University	30%	7 WEEK
9		BTETPE504 F	(F) Power Electronics	Power Electronics	Massachusetts Institute of Technology	45%	12 WEEK
10		BTETOE505 A	(A) Control System Engineering	Introduction to Control System Design - A First Look	Massachusetts Institute of Technology	40%	4 WEEK
		BTETOE505 B	(B) Artificial Intelligence and Machine learning	AI, ML	Columbia University	40%	12 WEEK
		BTETOE505 E	(E) Augmented, Virtual and Mixed Reality	How Virtual Reality Works	The University of California, San Diego	40%	6 WEEK
11	SEM-VI	BTETC602	Digital Communication	A System View of Communications: From Signals to Packets (Part 1)+(Part2)+(Part3)	The Hong Kong University of Science and Technology	40%	7/5/6 WEEK
12		BTETPE603 A	(A) Microprocessors and Microcontrollers	Embedded Systems - Shape The World: Microcontroller Input/Output	The University of Texas at Austin	50%	8 WEEK
13		BTETOE604 E	(E) Robotics Design	Robotics	Columbia University	50%	10 WEEK
14	SEM-VII	BTETPE702 A	(A) Digital Image Processing	Image Processing and Analysis for Life Scientists	École polytechnique fédérale de Lausanne	50%	7 WEEK
		BTETPE702 D	(D) Fiber Optic Communication	Optical Materials and Devices	Massachusetts Institute of Technology	20%	6 WEEK
15		BTETOE703 B	(B) Block Chain Technology	Blockchain: Understanding Its Uses and Implications	The Linux Foundation	50%	14 WEEK
		BTETOE703 C	(C) Cyber Security	Introduction to Cybersecurity	University of Washington	40%	6 WEEK