Addition of Elective courses and minor corrections in course contents of following courses of the M.Tech programmes

Two additional Elective courses namely

a. **Recent Trends and Technologies (Under Elective-I of all existing M.Tech programmes)**
b. **Radio Spectrum Management (Under Elective-IV of all existing M.Tech programmes)**

are added under as **Elective-I and Elective –IV** in the first and second semester of all PG programmes.

Also curriculums of all **existing M.Tech programmes** of Electronics from 1st semester to 4th semester have been thoroughly revisited and minor corrections in the course contents following courses are made.

Sr. No.	Course Name	Course Code in EXTC	Remark
1	Signal Theory	MTETC101	Minor corrections in the course contents. All these changes in the respective courses will be applicable to all respective M.Tech programmes related to Electronics Engg Please see Annexure-I for the details
2	Signal Processing Algorithms & Applications	MTETC103	
3	Estimation and Detection Theory	MTETC201	
4	Information Theory & Coding	MTETC202	
5	Multirate Digital Signal Processing	MTETE233	
6	IOT	MTETE255	

Annexure-I

Addition of Course under Elective-I: Recent Trends and Technologies

(In existing M. Tech Programme in E & TC/E&C/ Electronics) Semester-II Course Code: MTETE233/MTECE233/MTEEE233)

Recent Trends and Technologies

1. Open Source Technologies

Fundamentals of open source, Linux introduction, Open RTOS, Open source virtualisation, Testing platforms, Open source networking, Programming for open source, Open source software principles, Open source projects. Open source code sharing, GIT

2. Blockchain

Blockchain Fundamentals, How Blockchain Works, Hyperledger, Linux Foundation Project, A Brief History of Blockchain Technology,Blockchain Basics: Managing Digital Transactions, What is a Distributed Ledger?, Blockchain Beyond Bitcoin,Implications of Blockchain: Big Data, Privacy & Personal Data, Limitations & Challenges of Blockchain, The Future of Blockchain technologies

3. Internet Of Things (IoT)

Understanding the Internet of Things, Value Creation in the Internet of Thing, Technology Stack and Platforms for the Internet of Things, Technology Stack and Platforms for the Internet of Things, Technology Stack and Platforms for the Internet of Things, Technology Stack and Platforms for the Internet of Things, Technology Stack and Platforms for the Internet of Things, Technology stack and platform for internet of things, Challenges and future direction

4. Virtualization & cloud computing

Virtualization concepts, Cloud Fundamentals, Cloud as IaaS, Public Cloud Environment, Managing Hybrid Cloud environment, Setting up your own cloud environment, Future directions, Cloud Domain and scope of work.

5. Artificial Intelligence and Data analytics

Introduction to Artificial indigence, Sample AI applications, Data Analytics basics, Data Protection Implications, Compliance Tools

6. Machine Learning

Introduction to Machine Learning, Linear Regression with One Variable, Linear Algebra Review, Linear Regression with Multiple Variables, Logistic Regression, Regularization, Neural Networks, Machine Learning System Design, Support Vector Machines, Unsupervised Learning, Anomaly rejection, Large Scale Machine Learning, Applications.

7. Virtual reality & Augmented reality

Introduction to computer graphics, The graphics pipeline, OpenGL, WebGL, and GLSL shader programming, JavaScript with Three.js, Stereoscopic perception and rendering, Head mounted display optics and electronics, Inertial measurement units: gyros, accelerators, magnetometers, Sensor fusion: complementary filter, Kalman filter, Human perception: visual, audio, vestibular, tactile.

Text and Reference Books

1. Dayanand Ambavade, Kogent Publishing, Linux Labs and Open Source Technologies

2. Imran Bashir,Packt Publishing, Mastering Blockchain: Deeper insights into decentralization, cryptography, Bitcoin, and popular Blockchain frameworks

3. Hanes David, Pearson Publications, IoT Fundamentals: Networking Technologies, Protocols and Use Cases for the Internet of Things

4. Thomas Erl, The Prentice Hall, Cloud Computing: Concepts, Technology & Architecture

5. Wolfgang Ertel, Springer, Introduction to Artificial Intelligence

6. Tom Mitchell, McGraw Hill, Machine Learning

7. Steve Aukstakalnis, Practical Augmented Reality: A Guide to the Technologies, Applications, and Human Factors for AR and VR

Addition of Course under Elective-IV: Radio Spectrum Management

(In existing M. Tech Programme in E & TC/E&C/ Electronics)
Semester-II Course Code : MTETE233/MTECE233/MTEEE233

Course Outcomes

Students will be (i) familiar with fundamental issues in radio spectrum management, (ii) conversant with issues in EMI/EMC, (iii) aware of functioning of International organizations like International Telecommunications Union (ITU) and National Spectrum Management Authorities, (iv) knowing fundamentals of spectrum planning, (v) aware of spectrum monitoring techniques and their role in spectrum management, (vi) understanding legal and economic aspects of radio spectrum management etc.

1. **The legal basis and regulatory framework of spectrum management (SM)**

- Historical background and evolution of SM principles and strategies;
- ITU role and structure;
- ITU Radio-communication Sector;
- ITU Constitution and Convention, World Radio-communication Conferences (WRCs);
- ITU Radio Regulations;
- National legal frameworks relevant to SM (including internal frequency coordination processes); and
- National frequency allocation tables.

2. **Spectrum Engineering fundamentals**

- Radio wave propagation;
- Radio link budgets;
- Measuring spectrum use efficiency; and
- EMI/EMC of radio-communication systems.

3. **Wireless telecommunication technologies**

- TV broadcasting;
- History of International Mobile Telecommunications (IMT); and
- Cellular mobile systems: Evolution from 1G to 4G and beyond.

4. **Economic and market tools of spectrum management**

- models of spectrum pricing and administrative incentive pricing;
- designing spectrum auctions, “beauty contests”; and
- Re-farming of spectrum bands.

5. **Spectrum monitoring**

- The role of spectrum monitoring in the SM process; tasks of a monitoring service; and
- ITU Radio Regulations, Recommendations, reports, and handbooks in relation to monitoring.

6. **Enforcement and type approval of equipment**

- Role of enforcement in the operation of SM organizations and supervision of spectrum users; and
- Typical national arrangements for enforcement, role and functioning of inspectorates.

7. **Spectrum management for satellite systems**

- Overall principles of SM for satellite systems; and
- Overview of the ITU Radio Regulations and Appendices pertaining to satellite systems.

8. **Spectrum management for HF systems etc**

- Broadcasting and other systems in the HF bands;
- Spectrum requirements and planning of assignments for maritime services;
- Spectrum bands used by radio amateurs and their administrations.

9. **Terrestrial TV broadcasting planning and digital transition**

- Processes of negotiating and planning allotments/assignments for TV Broadcasting; and
- Scenarios for the analogue to digital switch-over.

10. **Opportunistic spectrum access**

- Flexible/Dynamic SM;
- Authorized/licensed shared access vs license-exempt secondaries; and
- TV “white space” devices.

SIGNAL THEORY

Weekly Teaching Hours	TH: 03	Tut: 01		
Scheme of Marking	TH: 60	Tests : 20	IA: 20	Total : 100

Course Objectives:

A	To provide in depth understanding of random nature of a signal using probability and random experiments.
B	To prepare mathematical background for communication signal analysis.
C	To provide in depth understanding of random processes.

Course Outcomes:

CO1	Learner will be able to apply knowledge of basic probability theory.
CO2	Learner will be able to understand concept of Random Variable.
CO3	Learner will be able to estimate different aspects of Random Variable like Mean, Variance, Moments , distribution function, density function etc.
CO4	Learner will be able to distinguish multiple Random Variable and its properties..
CO5	Learner will be able to hypothesize nature of different Random Processes.
CO6	Learner will be able to adapt basic concepts of estimation on multiple and repeated data measurement.

UNIT I

Probability

The meaning of probability, the axioms of probability, repeated trials, conditional probabilities, total probability theorem.

UNIT II

The Concept of a Random Variable

Introduction, Distribution and density functions, Specific random variables, Conditional distributions, Various types of distributions and density functions, Asymptotic approximations for Binomial random variables.

UNIT III

Functions of One Random Variable

The Random Variable g(X), The Distribution of g(X), Mean and variance, Moments, Characteristic functions, different inequalities.

UNIT IV

Two Random Variables

Bi-variable distribution, One function of two random variables, Two function of two random variables, Joint moments, Joint characteristic functions, Conditional distributions, Conditional expected values.

UNIT V

Stochastic Processes

Introduction, Discrete time and Continuous time Stochastic processes, Stationary and Non-Stationary Processes, mean and correlation ergodic and non-ergodic processes, correlation and its properties, Power spectral densities and its properties.

UNIT VI

Modeling of Stochastic Processes

MA,AR and ARMA models of stochastic processes, their parameter estimation, generation these processes, comparisons of these models and Wiener filter and its parameter estimation and Wiener Hopff equations.

Textbooks / References:

1. Papoulis, S. Pillai, Probability, Random Variables and Stochastic Processes, Tata McGraw Hill
2. T Veerajan, Probability, Statistics and Random Processes
3. R.P.Singh, S.D. Sapre, Communication Systems,Analog &Digital
4. B.P.Lathi, Modern Digital and Anolog Communication Systems, Third Ed

SIGNAL PROCESSING ALGORITHMS AND APPLICATIONS

Weekly Teaching Hours	TH : 03	Tut: 01		
Scheme of Marking	TH :60	Tests : 20	IA: 20	Total : 100

Course Objectives:

A	To instill research skills and bring in optimal solutions and novel products to signal processing and allied application areas using modern technology and tools that are technically sound, economically feasible and socially acceptable.
B	To enable the graduates to engage in signal processing and its broad range of applications to understand the challenges of the rapidly changing environment and adapt their skills through reflective and continuous learning.
C	To provide graduates strong mathematical skills and in depth knowledge in signal theory to analyze and solve complex problems in the domain of signal processing

Course Outcomes:

CO1	Learner will be able to analyze the time and frequency response of discrete time system.
CO2	Learner will be able to design digital filters for various application .
CO3	Learner will be able to design FIR and IIR filters for various applications
CO4	Learner will be able to understand the fundamentals of multi rate signal processing and its application
CO5	Learner will be able to understand signal representation in terms of dimension, orthogonality etc.
CO6	Learner will be able to analyze least square method for power spectrum estimation

UNIT I

Introduction

Review of discrete time signals and systems, review of Different transforms, Filtering, Use of DFT in linear filtering, Filtering of long data sequences, Spectrum, Algorithm for convolution and DFT.

UNIT II

LTI DT System in Transform Domain and Digital Filter Structures

Transfer function classification based on magnitude characteristics, Transfer function classification based on phase characteristics, Types of Linear Phase transfer functions, simple digital filters, complementary transfer functions, inverse systems, system

identifications, Block diagram representation, equivalent structures, Basic FIR and IIR digital filter structures**,** All Pass, FIR cascaded lattice structures, computational complexity of digital filter structures.

UNIT III

Design of Analog and Digital Filters

General consideration, Design of FIR filters, Different methods of FIR filter design. Design of Analog IIR Butterworth and Chebyshev filters, Conversion of Analog filters into Digital filters using BLT and IIT, design of IIR digital filters via analog filter design, spectral transformation.

UNIT IV

Multirate Signal Processing

Filter banks, Interpolators, Decimators, Polyphase decomposition, Analysis and synthesis, Bi-orthogonal and orthonormal filter banks.

UNIT V

Signal Representation

Representation of deterministic signals, orthogonal representation of signals, Dimensionality of signal spaces, Construction of orthogonal basis functions, Time-bandwidth relationship, RMS duration and bandwidth, Uncertainty relations, Multiresolution Analysis and Wavelet Transform.

UNIT VI

Linear Prediction and Optimum Filter Design

Forward, Backward and Central predictions, MMSE and Least square approach for parameter estimation, Adapter filters, and realization of two channel bi-orthogonal filter bank using estimation of high-pass filter.

Textbooks / References:

1. Digital Signal Processing A Computer-Based Approach, SanjitMitra, MCG
2. Discrete Time Signal Processing; *A V Oppenheim, Schafer*; PHI.
3. Advanced Digital Signal Processing; *Proakis*; McMillan.
4. Multirate systems and Filter Banks; *P PVaidyanathan*; Prentice Hall Eaglewood.
5. Digital Signal Processing: Principles, Algorithms and Applications; *John D Proakis*; PHI.
6. Adaptive Filter Theory; *S Hykin*; PHI.

ESTIMATION AND DETECTION THEORY

Weekly Teaching Hours	TH : 03	Tut: 01		
Scheme of Marking	TH :60	Tests : 20	IA: 20	Total : 100

Course Objectives:

A	To provide in-depth understanding basics of detection and estimation theory.
B	To be able to design and analyze optimum detection schemes

Course Outcomes:

CO1	Learner will have basic knowledge of linear algebra.
CO2	Acquire basics of statistical decision theory used for signal detection and estimation.
CO3	Examine the detection of deterministic and random signals using statistical models.
CO4	Examine the performance of signal parameters using optimal estimators.
CO5	Study different estimation schemes such as ML and MMSE estimators.

UNIT I

Vector Space

Groups, Field, Vector space, Vector subspace, Linearly dependent and independent vectors, Basis and dimension of vector space, Linear Transformation, change of basis, orthogonal and unitary transformation,

UNIT II

Inner Product

Definition, Inner product spaces, orthonormal basis, Gram-Schmidt Process of orthogonalisation, computation of linear dependence, linear transformation and matrices, norms and properties of norms,

UNIT III

Binary Decision: Single Observation

Introduction to structure of decision and estimation problems.Maximum Likelihood decision criterian, Neyman-person criterian, Probability of error criterian, Bays risk criterian, Min-Max criterion, problems releted to Gaussian case and non-Gaussian problems ,

UINT III

Binary Decision: Multiple Observations

Vector observation, The general Gaussion problem, Waveform observation and additive Gaussion noise, problems

Multiple Decision: Bays risk, Probability of error: General case, Probability of error: Gaussion case, Erasure decision problems.

UNIT V

Composite and Nonparametric Decision Theory

Composite decisions, Sign test, Wilcoxon test, problems

UNIT VI

Fumdamentals of Estimation

Maximum likelihood method, Bays cost method, Relationship of Estimators, Linear minimum, Variance and Least-square methods. Properties of Estimations: Unbiased estimators, Efficient estimators, Asymphotic properties.

Textbooks / References:

1. James Melsa and David Cohn, Decision and Estimation Theory, Mc-Graw Hill
2. Harry L, Van Trees, Detection, Estimation, and Modulation Theory , John Wiley and Sons Inc

INFORMATION THEORY AND CODING

Weekly Teaching Hours	TH: 03	Tut: 01		
Scheme of Marking	TH: 60	Tests : 20	IA: 20	Total : 100

Course Objectives:

A	To provide in-depth understanding of principles and applications of information theory.
B	To provide in-depth understanding of how information is measured in terms of probability and entropy and how these are used to calculate the capacity of a communication channel.
C	To provide in-depth understanding of different coding techniques for error detection and correction.

Course Outcomes:

CO1	Learner will be able to formulate equations for entropy mutual information and channel capacity for all types of channels.
CO2	Learner will be able to distinguish between different types error correcting codes based on probability of error
CO3	Learner will be able to design a digital communication system by selecting an appropriate error correcting codes for a particular application.
CO4	Learner will be able to explain various methods of generating and detecting different types of error correcting codes
CO5	Learner will be able to formulate the basic equations of linear block codes.
CO6	Learner will be able to compare the performance of digital communication system by evaluating the probability of error for different error correcting codes

UNIT I

Theory of Probability and Random Processes

Concept of probability, Conditional probability and statistical independence, Bay's theorem, Central limit theorem, Continuous and discrete random variables, Distribution models for continuous and discrete random variables, Classification of random processes.

UNIT II

Information Theory

Measure of information, Joint entropy and conditional entropy, Relative entropy and mutual information, Source encoding, Shannon-Fano coding and Huffman coding, Shannon-Hartley theorem, Shannon's first and second fundamental theorems, Channel capacity theorem.

UNIT III

Linear Block Codes and Cyclic Codes

Introduction, Types of errors and codes, Linear Block Codes: Matrix description, Error detection and correction, Standard arrays and table look up for decoding, Hamming codes: encoding, decoding and syndrome calculator, Cyclic codes: Polynomial representation of codewords, Generator polynomial, Systematic and non-systematic codes, Generator matrix, Syndrome calculation and error detection, Decoding of cyclic codes.

UNIT IV

BCH and RS Codes

BCH Code: encoding and decoding techniques. RS Codes: encoding and decoding techniques.

UNIT V

Convolutional Codes and ARQ Strategies

Structure and properties of convolutional codes, Convolutional encoder representation, Tree, Trellis, and State diagrams, Distance properties of convolutional codes, Decoding of convolutional codes, Maximum likelihood detection, The Viterbi algorithm, Automatic Repeat Request strategies: Basic techniques, Hybrid ARQ

UNIT VI

Cryptography and Information Security

Introduction to number theory, overview of cryptographic algorithms, Symmetric and asymmetric cryptography, Single key cryptography, Cryptogram (cipher text); Concept of cipher, Block Cipher code, Stream ciphers, Diffie-Hellman key exchange algorithm, Data encryption standards, Triple data encryption standards, Advanced encryption standards,

Kryptanalysis, The Rivest- Shamin Adelman (R-S-A) system for public keycryptography, Digital Signature.

Textbooks / References:

1. B. P. Lathi; Modern Digital and Analog Communication Systems; Oxford Publication.
2. Proakis; Digital Communication, TMH Publication.
3. M. Kulkarni, K. S. Shivaprakasha; Wiley Publication.
4. R.P. Singh, S.D. Sapre; Communication systems : Analog and Digital; TMH Publication.

ELECTIVE-III

MULTIRATE DIGITAL SIGNAL PROCESSING

Weekly Teaching Hours	TH : 03	Tut: --		
Scheme of Marking	TH :60	Tests : 20	IA: 20	Total : 100

Course Objectives:

A	To master the fundamentals of multirate signal processing and demonstrate the ability to solve problems in sample rate conversion, filter banks, and transmultiplexers.

Course Outcomes:

CO1	Learner will be able to develop efficient realizations for up sampling and down sampling of signals using the polyphase decomposition
CO2	Learner will be able to design and implement Finite Impulse Response (FIR) and Infinite Impulse Response (IIR) digital filters to meet specifications
CO3	Learner will be able to design digital filter banks based on the techniques presented
CO4	Learner will be able to analyze fundamental concepts of wavelets.
CO5	Learner will be able to distinguish between wavelets and multirate filter banks, from the point of view of implementation.

UNIT I

Fundamentals of Multirate Systems

Introduction, Basic multirate operations, Interconnection of building blocks, Polyphase representation, Mulstage implementation, Some application of multirate systems, Special filter and filter banks.

UNIT II

Maximally Decimaled Filter Banks

Introduction, Errors created in the QMF bank, A simple alias free QMF system, Power symmetric QMF banks, M-channel filter banks, Polyphase representation, Perfect reconstruction system, alias free filter banks, Tree structured filter banks, Transmultiplexer.

UNIT III

Paranitary Perfect Reconstruction Filter Banks

Introduction, Lossless transfer matrices, Filter banks properties induced by paraunitariness, Two channel FIR paraunitary QMF banks, Two channel paraunitary QMF lattice, M - channel FIR paraunitary filter banks, Tranform coding and LOT.

UNIT IV

Linear Phase and Cosine Modulated Filter Banks

Introduction, Some necessary conditions, Lattice structure for linear phase FIR PR banks, formal synthesis of linear phase FIR PR QMF Lattice. Pseudo QMF banks, Design of the pseudo QMF bank, Efficient polyphase structure, Cosine modulated perfect reconstruction system.

UNIT V

The Wavelet Transform and its Relation to Multirate Filter Banks

Introduction, Background and outline, Short time fourier transform, The Wavelet transform, DT orthonomal Wavelets, Continuous time orthonormal Wavelet basis.

UNIT VI

Multidimensional, Multivariable and Lossless Systems

Introduction, Multidimensional signals, Sampling a multidimensional Signals, Multirate fundamentals. Review of discrete time multi-input multi-output LTI System, ParaUNITary and lossless system.

Textbooks / References:

1. P.P.Vaidyanathan , Multirate System and Filter Banks, PTR Prentice Hall, Englewood Cliffs , New Jersey,
2. N.J.Fliege, Multirate Digital Signal Processing , John Wiley & Sons
3. Raghuveer Rao, Ajit Bopardikar,Wavelet Transforms Introduction to Theory and Application, Pearson Education Asia
4. C. Sidney Burrus , R.A.Gopianath , Pretice Hall, Introduction to wavelet and wavelet Transform

ELECTIVE-II

RF AND MILLIMETER WAVE CIRCUIT DESIGN

Weekly Teaching Hours	TH : 03	Tut: --		
Scheme of Marking	TH : 60	Tests : 20	IA: 20	Total : 100

Course Objectives:

A	To provide an insight into various aspects of the RF, mm-wave.
B	To provide brief theoretical foundation of RF, and mm-wave
C	To provide an in-depth understanding of effects of the parasitic parameters introduced from layout of a block of CMOS circuit.

Course Outcomes:

CO1	Learner will be able to distinguish the type of network and application frequencies.
CO2	Learner will be able to interpret the behavior of passive network components at RF and Millimeter wave frequencies.
CO3	Learner will be able to analyze distributed transmission media and prepare a smith chart of the same.
CO4	Learner will be able to categorize noise and to predict the effects of it on circuit performance.
CO5	Learner will be able to construct microwave amplifiers, oscillators and Mixer circuit for given specifications at RF and Millimeter wave frequencies.
CO6	Learner will be able to perform frequency synthesis for the development of wireless communication systems and allied areas.

UNIT I

RF systems – basic architectures, Transmission lines and microwave networks: wave propagation in transmission lines, lossless transmission lines, Smith Chart, basic smith chart operations, microwave network analysis: impedance and admittance matrices, the scattering matrix, the transmission matrix (ABCD), impedance matching: single stub and double stub matching.

UNIT II

NOISE AND DISTORTION IN MICROWAVE CIRCUIT

Classification of noise, noise temperature and noise figure, noise in linear system, noise figure for passive networks, dynamic range and intermodulation distortion.

UNIT III

FILTER DESIGN

Filter design by insertion loss method, filter scaling and transformation, low pass and high pass filters using transmission line stubs

UNIT IV

AMPLIFIER DESIGN

Two port gain, stability, amplifier design using S-parameter, low noise amplifier design, power amplifier design.

UNIT V

MIXER DESIGN

Mixer characteristics, diode mixer circuit design.

UNIT VI

Receiver Design

Receiver architecture, dynamic range, frequency conversion and filtering, examples of practical receivers.

Textbooks / References:

1. Microwave and RF Design of Wireless system by D. M. Pozar, Wiley and Sons, Inc. 2005, ISBN:9780471322825
2. RF Microelectronics by Behzad Razavi. Prentice Hall, 1997.

ELECTIVE V

RESEARCH METHODOLOGY

Weekly Teaching Hours	TH: 03	Tut: --		
Scheme of Marking	TH: 60	Tests : 20	IA: 20	Total : 100

Course Objectives:

A	To develop a research orientation among the scholars and to acquaint them with fundamentals of research methods.
B	To develop understanding of the basic framework of research process.
C	To identify various sources of information for literature review and data collection.
D	To understand the components of scholarly writing and evaluate its quality.

Course Outcomes:

CO1	Learner will learn the meaning, objective , motivation and type of research
CO2	Learner will be able to formulate their research work with the help of literature review
CO3	Learner will be able to develop an understanding of various research design and techniques
CO4	Learner will have an overview knowledge of modeling and simulation of research work
CO5	Learner will be able to collect the statistical data with different methods related to research work
CO6	Learner will be able to write their own research work with ethics and non-plagiarized way

UNIT I

Introduction: Defining research, Motivation and Course Objectives:, Types of research

Meaning of Research, Course Objectives: of Research, Motivation in Research, Types of Research

UNIT II

Research Formulation: Formulating The research Problem, Literature Review, Development of Working Hypothesis

UNIT III

Research Design: Important Concept in Research Design, Research Life Cycle, Developing Research Plan

UNIT IV

Overview of Modeling and Simulation: Classification of models, Development of Models, Experimentation, Simulation. Statistical Aspects: Methods of Data Collection, Sampling Methods, Statistical analysis, Hypothesis testing.

UNIT V

Research Report: Research Ethics, Plagiarism, Research Proposal, Report Writing and Writing Research Papers.

UNIT VI

Research methodology for Electronics/Computer/IT Engineers: Motivation for research, objective of research, identification and definition of research problem, Ithical and social aspects of IT based research, role of ICT in research.

TEXTBOOKS / REFERENCES:

1. *J.P. Holman.,* Experimental Methods for Engineers
2. C.R. Kothari, Research Methodology, Methods & Techniques

ELECTIVE V

INTERNET OF THINGS

Weekly Teaching Hours	TH : 03	Tut: --		
Scheme of Marking	TH :60	Tests : 20	IA: 20	Total : 100

Course Objectives:

A	Students will be explored to the interconnection and integration of the physical world and the cyber space.
B	To provide ability to design and develop IOT devices.

Course Outcomes:

CO1	Learner will be able to understand the meaning of internet in general and IOT in terms of layers, protocols, packets peer to peer communication
CO2	Learner will be able to interpret IOT working at transport layer with the help of various protocols
CO3	Learner will be able to understand IOT concept at data link layer
CO4	Learner will be able to apply the concept of mobile networking to the internet connected devices
CO5	Learner will be able to measure and schedule the performance of networked devices in IOT
CO6	Learner will be able to analyze the challenges involve in developing IOT architecture

UNIT I

Introduction: What is the Internet of Things: History of IoT, about objects/things in the IoT, Overview and motivations, Examples of applications, IoT definitions, IoT Frame work, General observations, ITU-T views, working definitions, and basic nodal capabilities.

UNIT II

Fundamental IoT Mechanisms & Key Technologies : Identification of IoT objects and services, Structural aspects of the IoT, Environment characteristics, Traffic characteristics ,scalability, Interoperability, Security and Privacy, Open architecture, Key IoT Technologies ,Device Intelligence, Communication capabilities, Mobility support, Device Power, Sensor Technology, RFID technology, Satellite Technology.

UNIT III

Radio Frequency Identification Technology: Introduction, Principles of RFID, Components of an RFID system, Reader, RFID tags, RFID middleware, Issue. Wireless Sensor Networks: History

and context, node, connecting nodes, networking nodes, securing communication. Wireless technologies for IoT(Layrer1/2 connectivity).

UNIT IV

Layer 3 connectivity: IPV6 technologies for the IoT: Overview and Motivations, Address Capabilities: IPv4 Addressing and Issues, IPv6 Address Space. IPv6 Protocol Overview, IPv6 Tunneling, IPsec in IPv6, Header Compression Schemes, Quality of Service in IPv6, Migration Strategies to IPv6: Technical Approaches, Residential Broadband Services in an IPv6 Environment. Deployment Opportunities

UNIT V

Mobile IPv6 technologies for the IoT: Overview, Protocol Details: Generic Mechanisms, New IPv6 Protocol, Message Types, and Destination Option. Modifications to IPv6 Neighbor Discovery, Requirements for Various IPv6 Nodes, Correspondent Node Operation, HA Node Operation, Mobile Node Operation, Relationship to IPV4 Mobile IPv4 (MIP).

UNIT VI

IPv6 OVER LOW-POWER WPAN (6LoWPAN): Background/Introduction, 6LoWPANs Goals, Transmission of IPv6 Packets over IEEE 802.15.4. Applications of IoT: Smart City, Waste Management, Security and surveillance, Introduction to IoET and Big data analytics.

Textbooks / References:

1. Hakima Chaouchi, The Internet of Things, Connecting Objects to the Web, Wiley Publications
2. Daniel Minoli,Building the Internet of Things with IPv6 and MIPv6 The Evolving World of M2M Communications, Wiley Publications
3. Olivier Hersent, David Boswarthick, Omar Elloumi, The Internet of Things Key Applications and Protocols, ISBN 978-1-119-99435-0, Wiley Publications.