Course Structure and Syllabus

For

M. Tech. (Wireless Communication and Computing)

Two Year (Four Semester) Course

(w.e.f. July 2017)
M.Tech. (Wireless Communication and Computing)

Objectives

I. To serve the society and nation, by providing high quality engineering educational programs to the students, engaging in research and innovations that will enhance the skill and knowledge and assisting the economic development of the region, state, and nation through technology transfer.

II. To equip the postgraduate students with the state of the art education through research and collaborative work experience/culture to enable successful, innovative, and life-long careers in Electronics and Telecommunication.

III. To encourage the post-graduates students, to acquire the academic excellence and skills necessary to work as Electronics and Telecommunication professional in a modern, ever-evolving world.

IV. To provide the broad understanding of social, ethical and professional issues of contemporary engineering practice and related technologies, as well as professional, ethical, and societal responsibilities.

V. To inculcate the skills for perusing inventive concept to provide solutions to industrial, social or nation problem.

Outcomes

I. Students of this program will have ability to apply knowledge of mathematics, sciences and engineering to Electronics and Telecommunication problems.

II. Postgraduate students will gain an ability to design and conduct experiments, as well as to analyze and interpret data/results.

III. Learners of this program will built an ability to design and develop a system, components, devices, or process to meet desired needs.

IV. Masters students of this program will have an ability to work on multi-disciplinary teams and also as an individual for solving issues related to Electronics and Telecommunication.

V. Learners of this program will have an ability to identify, formulate, and solve Engineering problems by applying mathematical foundations, algorithmic principles, and Electronics and Telecommunication theory in the modeling and design of electronics systems in a way that demonstrates comprehension of the tradeoffs involved in design choices.

VI. Postgraduate students will have an ability to communicate effectively orally and in writing and also understanding of professional and ethical responsibility.

VII. Postgraduate students will have an ability to use the techniques, skills, and modern engineering EDA tools necessary for Electronics and Telecommunication practices.

VIII. Learners of this program will have an ability to evaluate Electronics and Telecommunication Engineering problems with cost effectiveness, features, and user friendliness to cater needs for innovative product development.

IX. Postgraduate students will have an ability to solve contemporary social and industrial problems by engaging in life-long learning.
<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Course Code</th>
<th>Name of the course</th>
<th>Hours/Week</th>
<th>Credit</th>
<th>Examination scheme</th>
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### First Semester

| 01 | MTWCC101  | Ad-hoc Wireless Network | 03 | 03 | 04 | 60 | 20 | 20 | 100 |
| 02 | MTWCC102  | Wireless Communication Network | 03 | 03 | 04 | 60 | 20 | 20 | 100 |
| 03 | MTWCC103  | Mobile Computing       | 03 | 03 | 04 | 60 | 20 | 20 | 100 |
| 04 | MTWCE114  | Elective-I             | 03 | 03 | 03 | 60 | 20 | 20 | 100 |
| 05 | MTWCE125  | Elective-II            | 03 | 03 | 03 | 60 | 20 | 20 | 100 |
| 06 | MTWCC106  | Communication Skills   | 02 | 02 | 02 | -- | -- | 25 | 50  |
| 07 | MTWCL107  | PG Lab-I*              | -- | 03 | 02 | -- | -- | 25 | 50  |

**Total for Semester I**: 17 03 03 22 300 100 150 50 600

### Second Semester

| 01 | MTWCC201  | Multimedia Communication | 03 | 03 | 04 | 60 | 20 | 20 | 100 |
| 02 | MTWCC202  | Wireless Sensor Network  | 03 | 03 | 04 | 60 | 20 | 20 | 100 |
| 03 | MTWCE233  | Elective-III            | 03 | 03 | 03 | 60 | 20 | 20 | 100 |
| 04 | MTWCE244  | Elective-IV             | 03 | 03 | 03 | 60 | 20 | 20 | 100 |
| 05 | MTWCE255  | Elective-V- (Open to all) | 03 | 03 | 03 | 60 | 20 | 20 | 100 |
| 06 | MTWCS206  | Seminar-I               | -- | 04 | 02 | -- | -- | 50 | 100 |
| 07 | MTWCP207  | Mini-Project            | -- | 04 | 02 | -- | -- | 50 | 100 |

**Total for Semester II**: 15 08 02 21 300 100 200 100 700

### Third Semester

| 1   | MTWCC301  | Project Management & Intellectual Property Rights (Self Study)# | -- | -- | 02 | -- | -- | 50 | 100 |
| 2   | MTWCP302  | Project-I              | -- | -- | 10 | -- | -- | 50 | 100 |

**Total for Semester III**: -- -- 12 -- -- 100 100 200

### Fourth Semester

| 1   | MTWCP401  | Project-II            | -- | -- | 20 | -- | -- | 100 | 200 |

**Total for Semester IV**: -- -- 20 -- -- 100 100 200

**GRAND TOTAL**: 1700

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* PG Lab-I – Practical shall be based on courses of first semester.
# Student has to choose this course either from NPTEL/MOOC pool and submission of course completion certificate is mandatory.
Elective-I

A. Telecommunication Network Planning and Management
B. MIMO Wireless Communication Systems
C. CMOS VLSI Design
D. Software Defined Radio
E. Cryptography & Network Security

Elective-II

A. Resource Management In Wireless Communications
B. Ultra Wide Band Communication System
C. VLSI for Wireless Communication
D. Cognitive Radio Communications
E. Distributed Operating System

Elective-III

A. Cloud Computing
B. Mobile Broadband Communication
C. Network Planning and Optimization
D. Cooperative Communications and Networking
E. Soft Computing

Elective-IV

A. Signal Processing and Smart Antennas for Wireless Communication
B. Advanced Digital Image Processing
C. Electromagnetics, Antenna And Propagation
D. Free Space Optical Communication
E. Advanced Satellite Communication

Elective-V (Open)

A. TCP/IP and Internet
B. High Performance Communication Networks
C. Multirate Signal Processing
D. Research Methodology
E. Internet of Things
AD-HOC WIRELESS NETWORK

Weekly Teaching Hours
TH: 03  Tut: 01

Scheme of Marking
TH :60  Tests : 20  IA: 20  Total : 100

Course Objectives:

| A | To provide advanced research-oriented course designed for graduate students with computer and wireless networks background. |
| B | To give an exposure to a cutting-edge technology, namely, Wireless Ad Hoc Networks, which include Mobile Ad Hoc Networks (MANETs), Wire-less Sensor Networks (WSNs) and Wireless Mesh Networks (WMNs). |
| C | To give students the state of art of wireless adhoc networks research, and enhance their potential to do research in this exciting area. |

Course Outcomes:

| CO1 | Learner will be able in-depth networking materials to students in networking research. |
| CO2 | Learner will be able to discuss the challenges in designing routing and transport protocols for wireless Ad-hoc/sensor networks. |
| CO3 | Learner will be able to describe the unique issues in wireless ad-hoc networks. |
| CO4 | Learner will be able to describe current technology trends for the implementation and deployment of wireless ad-hoc networks. |
| CO5 | Learner will be able to discuss the challenges in designing MAC, routing and transport protocols for wireless ad-hoc networks. |

UNIT I

UNIT II

UNIT III

UNIT IV
classification of multicast routing protocols, Tree based multicast routing protocol, Mesh based multicast routing protocol.

UNIT V

UNIT VI
Energy management in Ad Hoc wireless networks: Need for energy management, classification of energy management, battery management schemes, transmission power management schemes, system power management schemes. Wireless sensor networks: Sensor network architecture, data dissemination, data gathering, MAC protocol sensor networks, Location discovery.

Textbooks/References:
WIRELESS COMMUNICATION NETWORKS

Weekly Teaching Hours
TH : 03    Tut:  01

Scheme of Marking
TH :60    Tests : 20    IA: 20    Total : 100

Course Objectives:

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<tr>
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<tbody>
<tr>
<td>A</td>
<td>To provide in-depth understanding and overview of Wireless Communication networks area and its applications in communication engineering</td>
</tr>
<tr>
<td>B</td>
<td>To understand the various terminology, principles, devices, schemes, concepts, algorithms and different methodologies used in Wireless Communication Networks.</td>
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</table>

Course Outcomes:

<table>
<thead>
<tr>
<th>CO</th>
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<tbody>
<tr>
<td>CO1</td>
<td>Learner will be able to articulate basics of Wireless Communication Networks.</td>
</tr>
<tr>
<td>CO2</td>
<td>Learner will be able to analyze Wireless Communication Networks.</td>
</tr>
<tr>
<td>CO3</td>
<td>Learner will be able to simulate wireless networks and analyze the simulation results</td>
</tr>
<tr>
<td>CO4</td>
<td>Learner will be able to Understand the techniques of radio spectrum allocation in multi-user systems and their impact on networks capacity.</td>
</tr>
<tr>
<td>CO5</td>
<td>Learner will be able to pursue research in the area of wireless communication networks.</td>
</tr>
<tr>
<td>CO6</td>
<td>Learner will be able to analyze wireless network and apply the different security measures for the wireless network.</td>
</tr>
</tbody>
</table>

UNIT I


UNIT II


UNIT III

UNIT IV


UNIT V


UNIT VI


Textbooks/References:
MOBILE COMPUTING

Weekly Teaching Hours
TH: 03  Tut:  01

Scheme of Marking
TH: 60  Tests: 20  IA: 20  Total: 100

Course Objectives:

| A | To introduce wireless communication and networking principles, that support connectivity to cellular networks, wireless internet and sensor devices. |
| B | To understand the use of transaction and e-commerce principles over such devices to support mobile business concepts. |
| C | To appreciate the social and ethical issues of mobile computing, including privacy. |
| D | To provide guidelines, design principles and experience in developing applications for small, mobile devices, including an appreciation of context and location aware services |
| E | To introduce wireless communication and networking principles, that support connectivity to cellular networks, wireless internet and sensor devices. |

Course Outcomes:

| CO1 | Learner will be able to understand of the characteristics and limitations of mobile hardware devices including their user-interface modalities. |
| CO2 | Learner will be able to develop applications that are mobile-device specific and demonstrate current practice in mobile computing contexts. |
| CO3 | Learner will be able to comprehension and appreciation of the design and development of context-aware solutions for mobile devices. |
| CO4 | Learner will be able to understand the operational characteristics of mobile computing |
| CO5 | Learner will be able to Demonstrate an awareness of professional and ethical issues, in particular those relating to security and privacy of user data and user behavior. |

UNIT I

Mobile Computing Introduction

UNIT II

Mobile Technologies

Bluetooth, Radio frequency identification (RFID), Wireless Broadband, Mobile IP: Introduction, Advertisement, Registration, TCP connections, two level addressing, abstract mobility management model, performance issue, routing in mobile host, Adhoc networks, Mobile transport layer: Indirect TCP, Snooping TCP, Mobile TCP, Time out freezing, Selective retransmission, transaction oriented TCP, IPv6 Global system for mobile communication, Global system for mobile communication, GSM architecture, GSM entities, call routing in GSM, PLMN interface, GSM addresses and identifiers, network aspects in GSM, GSM frequency allocation, authentication and security, Short message services, Mobile computing over SMS, SMS, value added services through SMS, accessing the SMS bearer

UNIT III

Mobile Network Layer:

Mobile IP (Goals, assumptions, entities and terminology, IP packet delivery, agent advertisement and discovery, registration, tunneling and encapsulation, optimizations), Dynamic Host Configuration Protocol (DHCP).

UNIT IV


UNIT V


UNIT VI

Data Dissemination: Communications asymmetry, classification of new data delivery mechanisms, push based mechanisms, pull-based mechanisms, hybrid mechanisms, selective tuning (indexing) techniques.
Textbooks/References:
10. Professional Android 2 Application development, Reto Meier, Wrox, Wiley India.
ELECTIVE I
TELECOMMUNICATION NETWORK PLANNING AND MANAGEMENT

Weekly Teaching Hours
TH: 03  Tut: --

Scheme of Marking
TH: 60  Tests: 20  IA: 20  Total: 100

Course Objectives:

A  To understand the general concepts and architecture behind standards based network management

B  To understand advanced information processing techniques such as distributed object technologies, software agents and internet technologies used for network management.

C  To provide an advanced technical knowledge of applied telecommunications integrated with a solid grounding in business management techniques.

D  To impart professional knowledge in creating cost models for new technology implementations, calculating return on investment, and in the organizational and user implications of networking systems.

Course Outcomes:

CO1  Learner will be able to analyze modern large-scale networks into their component networks

CO2  Learner will be able to develop a network strategy for upgrading an existing network or the build of a new network, taking due consideration of the company’s objectives, service, and operational requirements

CO3  Learner will be able to select the appropriate technology for broadband deployment in the access Network

CO4  Learner will be able to outline the process and techniques for planning the deployment of a mobile network, including coverage and capacity planning

CO5  Learner will be able to describe the principles of design and dimensioning of circuit-switched networks, and the core transmission network

UNIT I

UNIT II
A Bayesian data mining approach for modeling the physical condition of copper access networks: Introduction, taking a Bayesian viewpoint, forming the problem space and data description, constructing the Bayesian network, application of Bayesian network models.
UNIT III
Emergent properties of the BT SDH network: Introduction, multi-layer and large scale networks, emergent properties, self-organizing criticality and multi-layered feedback. Performance modeling: Introduction, modeling techniques, validation of models, drivers to models, Voice over ATM, overall GoS.

UNIT IV

UNIT V

UNIT VI

Textbooks/References:
ELECTIVE I
MIMO WIRELESS COMMUNICATION SYSTEMS

Weekly Teaching Hours

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Scheme of Marking

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<th>TH : 60</th>
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<th>Total : 100</th>
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</table>

Course Objectives:

<table>
<thead>
<tr>
<th>A</th>
<th>To understand the MIMO wireless communications systems and its importance.</th>
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<tr>
<td>B</td>
<td>To understand the different encoding and decoding technique used for the MIMO wireless communication system.</td>
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<tr>
<td>C</td>
<td>To understand the importance of the multiple antenna and multicarrier communication system for delivering the high data rate.</td>
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<tr>
<td>D</td>
<td>To understand the importance of the MIMO systems for implementing the mobile broadband communication system.</td>
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</table>

Course Outcomes:

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<tr>
<th>CO1</th>
<th>Learner will be able to explain and differentiate the SISO and MIMO wireless communication system</th>
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<tbody>
<tr>
<td>CO2</td>
<td>Learner will be able to explain and differentiate the single carrier and multicarrier communication system.</td>
</tr>
<tr>
<td>CO3</td>
<td>Learner will be able to model and simulate the MIMO communications system to demonstrate its efficiency.</td>
</tr>
<tr>
<td>CO4</td>
<td>Learner will be able to demonstrate how to improve the throughput and efficiency of the MIMO system over SISO system using different coding techniques.</td>
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</table>

UNIT I


UNIT II

Preceding Design: Transmit channel side information, Information - theoretic foundation for exploiting CSIT, A transmitter structure, Preceding design criteria, Linear precoder design, Precoder performance results and discussion, Application in practical systems. Space-time coding for wireless communications: Introduction, background, Space - time coding principles, Applications, Discussion and future challenges.
UNIT III
Fundamentals of Receiver design: Introduction, Reception of uncoded signals, Factor graphs and iterative processing, MIMO receiver for uncoded signals, MIMO receiver for coded signals. Multi-user Receiver design: Introduction, Multiple access MIMO systems, Iterative space-time multi-user detection, Multi-user detection in space-time coded system, adaptive linear space-time multi-user detection.

UNIT IV
Forward Error Correction Coding: Linear Block Codes, Convolutional Codes, Soft-Output Decoding of Binary Codes, Performance Evaluation of Linear Codes, Concatenated Codes, Low Density Parity Check (LDPC) Codes.

UNIT V
Space-time coding: Space-time coding introduction, Space-time code design criteria, Orthogonal space-time block codes, Space-time trellis codes.

UNIT VI
Spatial multiplexing: Overview of spatial multiplexing, BLAST encoding architectures, Demultiplexing methods for H-BLAST and V-BLAST, Multi-group space-time coded modulation (MGSTC)

Textbooks/References:

ELECTIVE I

CMOS VLSI DESIGN

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

Course Objectives:

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<tbody>
<tr>
<td>A</td>
<td>To understand the concept behind ASIC (Application Specific Integrated Circuits) design and the different implementation approaches used in industry.</td>
</tr>
<tr>
<td>B</td>
<td>To understand the concept behind ASIC (Application Specific Integrated Circuits) design and the different implementation approaches used in industry.</td>
</tr>
<tr>
<td>C</td>
<td>To design digital systems for a variety of applications, including microcomputers and special purpose computing systems.</td>
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<tr>
<td>D</td>
<td>To understand the static and dynamic behavior of MOSFETs (Metal Oxide Semiconductor Field Effect Transistors) and the secondary effects of the MOS transistor model.</td>
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Course Outcomes:

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<tbody>
<tr>
<td>CO1</td>
<td>Learner will be able to use different analysis and verification tools, implementation and synthesis methodologies and testability techniques that will enable them to design high performance and efficient digital systems.</td>
</tr>
<tr>
<td>CO2</td>
<td>Learner will be able to prepare Layout, Stick diagrams, Fabrication of digital system, and learn Static and Switching characteristics of inverters.</td>
</tr>
<tr>
<td>CO3</td>
<td>Learner will be able to synthesis of digital VLSI systems from register-transfer or higher level descriptions in hardware design languages and demonstrate the MOS transistor as a switch and its capacitance.</td>
</tr>
<tr>
<td>CO4</td>
<td>Learner will be able to design high performance digital systems with operating speed in the multiple hundreds of MHZ and even the GHz range using BiCMOS, ECL and Gallium Arsenide design techniques.</td>
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UNIT I

Basics of CMOS :VLSI Design: History, Trends, Principles, Metrics, CMOS transistors (n-channel and p-channel), The CMOS Switch model, CMOS Inverter mode, Logic devices and interconnect, CMOS circuit analysis: transistors, inverters, interconnect modeling, CMOS parasitic, CMOS Process and Layout, CMOS Devices: SPICE and deep sub-micron issues.

UNIT II

CMOS: Design Issues: Design of FSM, Moore & Mealy machines, Metastability, Solutions to metastability, Synchronization methods, VHDL codes for complex sequential machines,
Hazards, Types of hazards, Method to eliminate hazards, case studies. Design calculations for different logic circuits, Calculations for Area on chip, Power dissipation, PDP, Transmission gate, Domino logic, NORA logic, CMOS layout techniques, Transient response, Advance trends of elements & Alloys for ultra-fast logic clock, CMOS Inverter: speed, power and scaling, Static CMOS Gates, Dynamic CMOS Gates, Power Estimation and Optimization

UNIT III


UNIT IV

Circuits to Systems: VLSI circuits to systems, Circuit modeling and layout (demo using standard tools), CMOS design and layout tools, Nano-electronics circuits versus CMOS microelectronics circuits, Nano-computing techniques and device platforms

UNIT V

Digital IC Design: Digital CMOS IC design: Sequential Logic Circuits, Implementation Strategies for Digital ICs, Interconnects, Timing and Clocking, data path design, Memory Design, Capacitive parasitics, Resistive parasitics, Inductive parasitic

UNIT VI

Timing issues for Digital CMOS circuits: Timing Issues, Clock skew, clocking styles, Self-timed circuit design, Case study of Kitchen timer chip. ultra-fast VLSI circuits and systems with GaAs system

Textbooks/References:

3. Weste and Harris, “CMOS VLSI Design, a Circuits and Systems Perspective” (3rd edition)
ELECTIVE I
SOFTWARE DEFINED RADIO

Weekly Teaching Hours
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TH : 03  Tut:  --

Scheme of Marking
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TH : 60  Tests : 20  IA: 20  Total : 100

Course Objectives:

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<tr>
<td>A</td>
<td>To understand the fundamental and state-of-the-art concepts in software defined radio</td>
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<tr>
<td>B</td>
<td>To understand the Software radio, Software defined radio and software defined networking.</td>
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<tr>
<td>C</td>
<td>To understand the Evolution of the software Defined Radio.</td>
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<tr>
<td>D</td>
<td>To develop the model for the SDR and simulate using different simulation tools such as GNU radio and MATLAB</td>
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Course Outcomes:

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<tr>
<td>CO1</td>
<td>Learner will be able to make system-level decisions for software defined radio technology and products.</td>
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<tr>
<td>CO2</td>
<td>Learner will be able to explain analog RF components as front end block in implementation of SDR.</td>
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<tr>
<td>CO3</td>
<td>Learner will be able to design circuits at different multi-rate signaling technique for frequency conversion and sampling issues.</td>
</tr>
<tr>
<td>CO4</td>
<td>Learner will be able to demonstrate the software development methods for embedded wireless systems and understand the use of ADC and DAC in the implementation of SDR.</td>
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UNIT I
SDR concepts & history, Benefits of SDR, SDR Forum, Ideal SDR architecture, SDR Based End to-End Communication, Worldwide frequency band plans, Aim and requirements of the SCA.

UNIT II

UNIT III
Radio Frequency design, Baseband Signal Processing, Radios with intelligence, Smart antennas, Adaptive techniques, Phased array antennas, Applying SDR principles to antenna systems, Smart antenna architectures.

UNIT IV

**UNIT V**
Software Radio platforms: GNU radio- Python introduction, developing GNU Radio, signal processing blocks, scheduler, Basic GR development flow, case study- any application, Open source SCA implementations-Embedded , All other software radio framework- Microsoft research software radio, Frontend for Software radio- Sound card front ends, Universal Software radio peripherals (USRP), SDR front end for Navigation applications, Network based front ends.

**UNIT VI**
Development tools and flow: Requirement capture, System simulation, Firmware development: Electronics System level design, Block based system design, and Final Implementation, Software development: Real-time versus Non Real-time software, Optimization, and Automatic Code generation.

**Textbooks/References:**

2. Jefree Reed: Software Radio, Pearson Education.
Course Objectives:

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<tbody>
<tr>
<td>A</td>
<td>To understand lossless and lossy compression techniques for different types of data.</td>
</tr>
<tr>
<td>B</td>
<td>To understand data encryption techniques.</td>
</tr>
<tr>
<td>C</td>
<td>To understand Network security and ethical hacking.</td>
</tr>
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</table>

Course Outcomes:

| CO1 | Learner will be able to implement text, audio and video compression techniques. |
| CO2 | Learner will be able to understand symmetric and asymmetric key cryptography schemes. |
| CO3 | Learner will be able to understand network security and ethical hacking. |
| CO4 | Learner will be able to implement Digital Signature and Authentication Protocol. |
| CO5 | Learner will be able to understand Electronic Mail Security. |

UNIT I
Overview: Services, Mechanisms and attacks, OS1 security architecture, Model for network security.

UNIT II
Classical Encryption Techniques: Symmetric cipher model, Substitution techniques, Transposition techniques, Rotor machine, Steganography, Problems

UNIT III
DES (Data Encryption Standards): Simplified DBS, Block cipher principles, DES, Strength of DES, Block cipher design principles, Block cipher modes of operation, Problems

UNIT IV
Public Key Cryptography and RSA: Principles of public key cryptosystems, RSA algorithm, Problems. Other Public Key Crypto Systems and Key Management: Key management, Diffie Hellman key exchange, Elliptic curve arithmetic, Elliptic curve cryptography, Problems.

UNIT V

UNIT VI

**Textbooks/References:**

ELECTIVE II
RESOURCE MANAGEMENT IN WIRELESS COMMUNICATIONS

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

Course Objectives:

A  To understand Analysis, model and design of radio resource management mechanisms for wireless communications systems, with a focus on mobile communications.
B  To develop the concepts for designing and operating a mobile communication network, including the planning and dimensioning processes.
C  To understand different strategies for radio resource management and network optimization, including advanced concepts for automated network optimization
D  To develop models and strategies for managing the network and the spectrum.

Course Outcomes:

CO1  Learner will be able to model, design and evaluate strategies and mechanisms for the management of the radio resources and the flexible use of the spectrum in wireless networks
CO2  Learner will be able to deployment and resource management options for heterogeneous networks
CO3  Learner will be able to understand flexible spectrum management concepts: regulation, spectrum management components, spectrum sharing, dynamic spectrum access and cognitive radio
CO4  Learner will be able to understand heterogeneous networks, including deployment, interference management, load control and use of multiple radio interfaces.
CO5  Learner will be able to analyze, model and evaluate advanced resource management and optimization techniques for wireless networks.

UNIT I

UNIT II
Heterogeneous Wireless Networks: Optimal resource management and QoS Provisioning, Medium Access Control in Wireless Ad Hoc Networks, A Cost-Controlled Bandwidth
Adaptation Algorithm for Multimedia Wireless Networks, Advanced Radio resource management for future Mobile Networks

UNIT III

Mobility Management: Fractional resource reservation in mobile cellular systems, Fractional Guard channel schemes Mobility management for Mobile IP networks: Triangular routing, smooth handoffs in mobile IPv6.

UNIT IV

Location management in Wireless Networks: Issues and Technologies, Network Topologies, Time based location update. Network Mobility

UNIT V


UNIT VI


Textbooks/References:

ELECTIVE II
ULTRA WIDE BAND COMMUNICATION SYSTEM

Weekly Teaching Hours
TH : 03
tut: --

Scheme of Marking
TH : 60 Tests : 20 IA : 20 Total : 100

Course Objectives:

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<tbody>
<tr>
<td>A</td>
<td>To understand the Ultra-wideband (UWB) Communication Technology.</td>
</tr>
<tr>
<td>B</td>
<td>To understand the role of Ultra-wideband (UWB) in next generation wireless communications systems.</td>
</tr>
<tr>
<td>C</td>
<td>To study working principle of MIMO-OFDM Communications, MIMO Multiband OFDM System for UWB.</td>
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</table>

Course Outcomes:

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<tbody>
<tr>
<td>CO1</td>
<td>Learner will be able to understand the operational characteristics of UWB.</td>
</tr>
<tr>
<td>CO2</td>
<td>Learner will be able to understand the working principle UWB technologies.</td>
</tr>
<tr>
<td>CO3</td>
<td>Learner will be able to model and simulate Ultra Wide Band Wireless Channels</td>
</tr>
<tr>
<td>CO4</td>
<td>Learner will be able to model UWB interference and performance characterization.</td>
</tr>
</tbody>
</table>

UNIT I


UNIT II


UNIT III

UNIT IV


UNIT V


UNIT VI

UWB Wireless Locationing: Position Locationing Methods, Received Signal Strength (RSS), Angle of Arrival (AOA), Time of Arrival (TOA), Time of Arrival Estimation, Inverse Filtering Technique, ESPRIT Technique, CLEAN Technique, Super-Resolution Technique, Non-Coherent Technique, NLOS Location Error, Locationing with OFDM

Textbooks/References:

1. Uma Sankar Jha and Ramjee Prasad, OFDM Towards fixed and mobile Broadband Wireless Access, ARTECH House Publication.
ELECTIVE II

VLSI FOR WIRELESS COMMUNICATION

Weekly Teaching Hours

TH : 03  Tut:  --

Scheme of Marking

TH : 60  Tests : 20  IA: 20  Total : 100

Course Objectives:

A | To understand the RF front end and various types of mixers designed for wireless communication.
B | To introduce students to the fundamentals of VLSI signal processing and expose them to examples of applications.
C | To understand design and optimization of VLSI architectures for basic DSP algorithms for wireless communications.
D | To understand algorithm, architecture, and circuit design tradeoffs to jointly optimize for power, performance, and area.

Course Outcomes:

CO1 | Learner will be able to understand VLSI design methodology for signal processing systems.
CO2 | Learner will be able to understand VLSI algorithms for DUC, DDC and Filter bank.
CO3 | Learner will be able to understand scaling and round-off noise issues and their impact on performance of the system.
CO4 | Learner will be able to implement basic architectures for wireless communication system blocks using CAD tools.

UNIT I

Communication Concepts in terms circuit designer perspective: Introduction, Overview of Modulation schemes, Classic Channel, Wireless channel description, Path loss, Multipath fading (channel model and envelope fading, frequency selective). Receiver Architectures: Introduction, Receiver front end, Filter design, Rest of receiver front end, Receiver front end, Low Noise Amplifier: Introduction, Wideband LNA design, Narrowband LNA (Impedance matching and Core Amplifier)

UNIT II

Active Mixer: Introduction, balancing, Qualitative description of Gilbert Mixer, Conversion Gain, Distortion (Low frequency and high frequency case), Noise and a complete active mixer.
UNIT III

UNIT IV

UNIT V
Frequency Synthesizer: Phase/Frequency-Processing Components Introduction, PLL based Frequency Synthesizer, Phase Detector/Charge Pump, Dividers, VCO, LCO, Ring Oscillator, Phase noise

UNIT VI
Frequency Synthesizer: Loop Filter and System Design Introduction, Loop Filter (General description and design approaches), A case study of complete synthesizer

Textbooks/References:
ELECTIVE II
COGNITIVE RADIO COMMUNICATIONS

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

Course Objectives:

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<tbody>
<tr>
<td>A</td>
<td>To understand the use of the SDR</td>
</tr>
<tr>
<td>B</td>
<td>To understand the stages of the evolution of SDR.</td>
</tr>
<tr>
<td>C</td>
<td>To study the applications of the Cognitive Radio.</td>
</tr>
<tr>
<td>D</td>
<td>To develop the system model for the spectrum sensing and spectrum access techniques in CR.</td>
</tr>
</tbody>
</table>

Course Outcomes:

| CO1 | Learner will be able to differentiate between SDR and CR |
| CO2 | Learner will be able to evaluate the different spectrum sensing techniques for the cognitive radio. |
| CO3 | Learner will be able to develop the system model for single carrier and multicarrier cognitive radio system. |
| CO4 | Learner will be able to evaluate the different spectrum management techniques for cognitive radio system. |
| CO5 | Learner will be able to simulate and analyze the SDR and Cognitive radio systems |

UNIT I

UNIT II
Cooperative Communications and Networks - Information Theory for Cooperative Communications, Fundamental Network Information, Multiple-access Channel with Cooperative Diversity, Cooperative Communications, Three-Node Cooperative Communications, Multiple-Node Relay Network, Cooperative Wireless Networks, Benefits of Cooperation in Wireless Networks, Cooperation in Cluster-Based Ad-hoc Networks

UNIT III

**UNIT IV**


**UNIT V**


**UNIT VI**


**Textbooks/References:**

3. Qusay H. Mahmoud, Cognitive Networks, John Wiley & Sons Ltd.
ELECTIVE II
DISTRIBUTED OPERATING SYSTEM

Weekly Teaching Hours
TH : 03  Tut:  --

Scheme of Marking
TH :60  Tests : 20  IA: 20  Total : 100

Course Objectives:

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<table>
<thead>
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<tbody>
<tr>
<td>A</td>
<td>To learn the fundamentals of Operating Systems.</td>
</tr>
<tr>
<td>B</td>
<td>To gain knowledge on Distributed operating system concepts that includes architecture, Mutual exclusion algorithms, Deadlock detection algorithms and agreement protocols.</td>
</tr>
<tr>
<td>C</td>
<td>To gain insight on to the distributed resource management components viz. the algorithms for implementation of distributed shared memory, recovery and commit protocols.</td>
</tr>
<tr>
<td>D</td>
<td>To know the components and management aspects of Real time, Mobile operating Systems.</td>
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</table>

Course Outcomes:

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<tbody>
<tr>
<td>CO1</td>
<td>Learner will be able demonstrate the Mutual exclusion, Deadlock detection and agreement protocols of Distributed operating system.</td>
</tr>
<tr>
<td>CO2</td>
<td>Learner will be able to learn the various resource management techniques for distributed systems</td>
</tr>
<tr>
<td>CO3</td>
<td>Learner will be able to Identify the different features of real time and mobile operating systems.</td>
</tr>
<tr>
<td>CO4</td>
<td>Learner will be able to Modify existing open source kernels in terms of functionality or features used.</td>
</tr>
</tbody>
</table>

UNIT I
Architectures of Distributed Systems: Issues in Distributed operating System, Communication Networks, Communication Primitives, Limitations of Distributed Systems

UNIT II
Physical and Logical Clocks, Lamport’s Logical Clock, Vector Clocks, Casual Ordering of Messages, Global State, Cuts of Distributed Computation

UNIT III
Distributed Mutual Exclusion: Classification, Preliminaries, A Simple Solution to Distributed Mutual Exclusion, Non-Token-Based Algorithms, The Ricart Agrawala Algorithm, A Generalized Non-Token-Based Algorithms, Token-Based Algorithms, SuzukiKasami’s Broadcast Algorithm, Raymond’s Tree-Based Algorithm, A Comparative Performance Analysis, Distributed Deadlock Detection: Preliminaries, Deadlock Handling Strategies in

UNIT IV


UNIT V


UNIT VI


Textbooks/References:

COMMUNICATION SKILLS

Weekly Teaching Hours

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<tr>
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<th>Practical: --</th>
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Scheme of Marking

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<th>TH: --</th>
<th>IA: 25</th>
<th>PR/OR: 25</th>
<th>Total: 50</th>
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**Course Objectives:**

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<tbody>
<tr>
<td>A</td>
<td>To become more effective confident speakers and deliver persuasive presentations</td>
</tr>
<tr>
<td>B</td>
<td>To develop greater awareness and sensitivity to some important considerations in interpersonal communication and learn techniques to ensure smoother interpersonal relations</td>
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**Course Outcomes:**

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<tr>
<td>CO1</td>
<td>Learner will be able to understand the fundamental principles of effective business communication</td>
</tr>
<tr>
<td>CO2</td>
<td>Learner will be able to apply the critical and creative thinking abilities necessary for effective communication in today's business world</td>
</tr>
<tr>
<td>CO3</td>
<td>Learner will be able to organize and express ideas in writing and speaking to produce messages suitably tailored for the topic, objective, audience, communication medium and context</td>
</tr>
<tr>
<td>CO4</td>
<td>Learner will be able to demonstrate clarity, precision, conciseness and coherence in your use of language</td>
</tr>
<tr>
<td>CO5</td>
<td>Learner will be able to become more effective confident speakers and deliver persuasive presentations</td>
</tr>
</tbody>
</table>

**UNIT I**

Introduction to communication, Necessity of communication skills, Features of good communication, Speaking skills, Feedback & questioning technique, Objectivity in argument

**UNIT II**

Verbal and Non-verbal Communication, Use and importance of non-verbal communication while using a language, Study of different pictorial expressions of non-verbal communication and their analysis

**UNIT III**

Academic writing, Different types of academic writing, Writing Assignments and Research Papers, Writing dissertations and project reports

**UNIT IV**

Presentation Skills: Designing an effective Presentation, Contents, appearance, themes in a presentation; Tone and Language in a presentation, Role and Importance of different tools for effective presentation
UNIT V
Motivation/ Inspiration: Ability to shape and direct working methods according to self-defined criteria; Ability to think for oneself, Apply oneself to a task independently with self-motivation, Motivation techniques: Motivation techniques based on needs and field situations

UNIT VI
Self-management, Self-evaluation, Self-discipline, Self-criticism, Recognition of one’s own limits and deficiencies, dependency etc. Self-awareness, Identifying one’s strengths and weaknesses, Planning & Goal setting, Managing self-emotions, ego, pride leadership & Team dynamics

Textbooks/References:

PG LAB-I

Weekly Teaching Hours          TH: --          Practical: 03

Scheme of Marking               TH: --          IA: 25          PR/OR: 25          Total: 50

Practical’s of the Lab - I shall be based on the courses of first semester. The lab work shall consists of hands on experiments on the different software and hardware platforms related to the syllabus.
MULTIMEDIA COMMUNICATION

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

Course Objectives:

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<tbody>
<tr>
<td>A</td>
<td>To understand the multimedia communications systems, application and basic principles</td>
</tr>
<tr>
<td>B</td>
<td>To provide in-depth understanding for multimedia communication standards and compression techniques</td>
</tr>
<tr>
<td>C</td>
<td>To provide in-depth understanding for representation of image, video.</td>
</tr>
<tr>
<td>D</td>
<td>To understand the basics of analog and digital video: video representation and transmission and perform the analysis of the multimedia streaming.</td>
</tr>
</tbody>
</table>

Course Outcomes:

| CO1 | Learner will be able to understand different multimedia communication devices. |
| CO2 | Learner will be able to analyze different multimedia compression techniques. |
| CO3 | Learner will be able to analyze fundamental concepts of multimedia building blocks. |
| CO4 | Learner will be able to demonstrate a diverse portfolio that reflects multimedia aesthetic proficiency. |
| CO5 | Learner will be able to demonstrate a set of professional skills and competencies in their practice of multimedia communication. |

UNIT I

Introduction to Multimedia, Multimedia Information, Multimedia Objects, Multimedia in business and work. Convergence of Computer, Communication and Entertainment products Stages of Multimedia Projects Multimedia hardware, Memory & storage devices, Communication devices, Multimedia software's, presentation tools, tools for object generations, video, sound, image capturing, authoring tools, card and page based authoring tools.

UNIT II

Multimedia Building Blocks Text, Sound MIDI, Digital Audio, audio file formats, MIDI under windows environment Audio & Video Capture.

UNIT III

Data Compression Huffman Coding, Shannon Fano Algorithm, Huffman Algorithms, Adaptive Coding, Arithmetic Coding Higher Order Modelling, Finite Context Modelling, Dictionary based Compression, Sliding Window Compression, LZ77, LZW compression, Compression, Compression ratio loss less & lossy compression.
UNIT IV

Speech Compression & Synthesis Digital Audio concepts, Sampling Variables, Loss less compression of sound, loss compression & silence compression.

UNIT V

Images Multiple monitors, bitmaps, Vector drawing, lossy graphic compression, image file format, animations Images standards, JPEG Compression, Zig Zag Coding, Multimedia Database, Content based retrieval for text and images, Video: Video representation, Colors, Video Compression, MPEG standards, MHEG Standard Video Streaming on net, Video Conferencing, Multimedia Broadcast Services, Indexing and retrieval of Video Database, recent development in Multimedia.

UNIT VI


Textbooks/References:

WIRELESS SENSOR NETWORK

Weekly Teaching Hours
TH : 03  Tut: 01

Scheme of Marking
TH : 60  Tests : 20  IA: 20  Total : 100

Course Objectives:

| A | To understand the use of wireless sensor network for sensor data transmission. |
| B | To interpret and get familiarity to the different wireless transmission and reception technologies and topologies for sensor data. |
| C | To illustrate the different wireless protocols for the wireless sensor nodes. |
| D | To understand the different tiny OS and also able to choose the appropriate tiny OS for the sensor node. |

Course Outcomes:

| CO1 | Learner will be able to identify the appropriate wireless transceiver for the different sensor data transmission and reception. |
| CO2 | Learner will be able to design, develop and deploy the wireless sensor node. |
| CO3 | Learner will be able to implement the tiny operating system on the sensor node. |
| CO4 | Learner will be able to identify the energy consumption of the nose and to provide appropriate solution for energy optimization. |

UNIT I

Introduction and overview: Overview of the course; overview of sensor network protocols, architecture, and applications; simulation and experimental platforms; main features of WSNs; research issues and trends. Enabling technologies Fundamentals of 802.15.4, Bluetooth, and UWB; Physical and MAC layers. Sensor node hardware and Software, Hardware: mica2, micaZ, telosB, cricket, Imote2, tmote, btnode, and Sun SPOT.

UNIT II

Software (OS): tinyOS, MANTIS, Contiki, MagnetOS, OSPM, PicOS, SenOS, and RetOS. Programming tools: C, OMNET++, NS-2, J-Sim, GloMoSim, nesC, Mate Localization, connectivity, and topology: Sensor deployment mechanisms; coverage issues; node discovery protocols. Network layer protocols Data dissemination and processing; multi-hop and cluster based protocols; routing.

UNIT III

Exchange, Message Passing, IEEE 802.15.4 LR-WPANs Standard Case Study, PHY Layer, MAC Layer.

UNIT IV


UNIT V

Middleware and application layers: Data dissemination; data storage; query processing; sensor Web; sensor Grid. Open issues for future research Energy preservation and efficiency; security challenges; fault-tolerance;

UNIT VI


Textbooks/References:

ELECTIVE III  
CLOUD COMPUTING

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

Course Objectives:

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<tbody>
<tr>
<td>A</td>
<td>To analyze the components of cloud computing showing how business agility in an organization can be created.</td>
</tr>
<tr>
<td>B</td>
<td>To evaluate the deployment of web services from cloud architecture.</td>
</tr>
<tr>
<td>C</td>
<td>To evaluate the consistency of services deployed from a cloud architecture.</td>
</tr>
<tr>
<td>D</td>
<td>To compare and contrast the economic benefits delivered by various cloud models based on application requirements, economic constraints and business requirements.</td>
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Course Outcomes:

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<tbody>
<tr>
<td>CO1</td>
<td>Learner will be able to analyze the trade-offs between deploying applications in the cloud and over the local infrastructure.</td>
</tr>
<tr>
<td>CO2</td>
<td>Learner will be able to compare the advantages and disadvantages of various cloud computing platforms.</td>
</tr>
<tr>
<td>CO3</td>
<td>Learner will be able to deploy applications over commercial cloud computing infrastructures such as Amazon Web Services, Windows Azure, and Google App Engine.</td>
</tr>
<tr>
<td>CO4</td>
<td>Learner will be able to analyze the performance, scalability, and availability of the underlying cloud technologies and software.</td>
</tr>
<tr>
<td>CO5</td>
<td>Learner will be able to solve a real-world problem using cloud computing through group collaboration.</td>
</tr>
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</table>

UNIT I


UNIT II

Cloud Applications: Technologies and the processes required when deploying web services; Deploying a web service from inside and outside a cloud architecture, advantages and disadvantages.
UNIT III

Cloud Services Management: Reliability, availability and security of services deployed from the cloud. Performance and scalability of services, tools and technologies used to manage cloud services deployment;

UNIT IV

Cloud Economics: Cloud computing infrastructures available for implementing cloud based services. Economics of choosing a Cloud platform for an organization, based on application requirements, economic constraints and business needs (e.g Amazon, Microsoft and Google, Salesforce.com, Ubuntu and Redhat)

UNIT V

Application Development: Service creation environments to develop cloud based applications. Development environments for service development; Amazon, Azure, Google App.

UNIT VI

Best Practice Cloud IT Model: Analysis of Case Studies when deciding to adopt cloud computing architecture. How to decide if the cloud is right for your requirements. Cloud based service, applications and development platform deployment so as to improve the total cost of ownership (TCO)

Textbooks/References:

MOBILE BROADBAND COMMUNICATION

Weekly Teaching Hours
TH: 03  Tut: --

Scheme of Marking
TH: 60  Tests: 20  IA: 20  Total: 100

Course Objectives:

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<tbody>
<tr>
<td>A</td>
<td>To study the different components of high speed wireless communication system.</td>
</tr>
<tr>
<td>B</td>
<td>To understand the design and development methodology for WiMAX network.</td>
</tr>
<tr>
<td>C</td>
<td>To understand the concept of the All-IP Networking.</td>
</tr>
<tr>
<td>D</td>
<td>To understand the Fundamental Constraints of the Higher Data Rates in wireless</td>
</tr>
<tr>
<td></td>
<td>Communications.</td>
</tr>
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</table>

Course Outcomes:

| CO1 | Learner will be able to understand the different concept of the high speed wireless communication systems. |
| CO2 | Learner will be able to work with IPv4 and IPv6 addressing and the IP transmission protocols.     |
| CO3 | Learner will be able to understand the 4G, LTE, LTE advanced and its evolution toward 5G.       |
| CO4 | Learner will be able to understand the use of multimedia broadcast/multicast services and its architecture. |

UNIT I

Introduction to Mobile Broadband: Introduction, Before 3G and Broadband, Cellular Communication, Broadband and WLAN/WiFi, 3G and Broadband Wireless, 3GPP2 Family, Broadband Wireless Access, Mobile WiMAX and 4G.

UNIT II

UNIT III
High Data Rates in Mobile Communication: High Data Rates: Fundamental Constraints, Higher Data Rates within a Limited Bandwidth: Higher-Order Modulation, Variations in Instantaneous Transmit Power, Wider Bandwidth Including Multi-Carrier Transmission

UNIT IV

UNIT V

UNIT VI

Textbooks/References:
1. Mustafa Ergen, Mobile Broadband Including WiMAX and LTE, Springer Publication.
ELECTIVE III

NETWORK PLANNING AND OPTIMIZATION

Weekly Teaching Hours
TH : 03  Tut:  --

Scheme of Marking
TH :60  Tests : 20  IA: 20  Total : 100

Course Objectives:

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<tbody>
<tr>
<td>A</td>
<td>To understand the need of the Radio Network Planning and Optimization.</td>
</tr>
<tr>
<td>B</td>
<td>To study the transmission network planning and optimization for cellular communication and adhoc networks.</td>
</tr>
<tr>
<td>C</td>
<td>To study the 3G and WCDMA network planning and deployment stages.</td>
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Course Outcomes:

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<tbody>
<tr>
<td>CO1</td>
<td>Learner will be able to analyze the need of the network planning and able to optimize the required resources.</td>
</tr>
<tr>
<td>CO2</td>
<td>Learner will be able to prepare the optimized plan for the 2G wireless network.</td>
</tr>
<tr>
<td>CO3</td>
<td>Learner will be able to prepare the optimized plan for the 3G wireless network.</td>
</tr>
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</table>

UNIT I

Radio Network Planning and Optimization: Radio Network Detailed Planning, Radio Network Optimization

UNIT II


UNIT III


UNIT IV


UNIT V

UNIT VI

3G Core Network Planning and Optimisation: Basics of Core Network Planning, Detailed Network Planning, Core Network Optimisation.

Textbooks/References:

ELECTIVE III
COOPERATIVE COMMUNICATIONS AND NETWORKING

Weekly Teaching Hours TH: 03  Tut: --

Scheme of Marking TH: 60  Tests: 20  IA: 20  Total: 100

Course Objectives:

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<tbody>
<tr>
<td>A</td>
<td>To study the need of the cooperative communication networks.</td>
</tr>
<tr>
<td>B</td>
<td>To understand the different techniques for the cooperative communication.</td>
</tr>
<tr>
<td>C</td>
<td>To study and understand the energy consumption in the network and energy efficiency improvement using cooperative communication.</td>
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Course Outcomes:

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<tbody>
<tr>
<td>CO1</td>
<td>Learner will be able to analyze the requirements of the cooperative communication systems.</td>
</tr>
<tr>
<td>CO2</td>
<td>Learner will be able to prepare the model for the multi-node cooperative communication.</td>
</tr>
<tr>
<td>CO3</td>
<td>Learner will be able to understand the differential modulation for cooperative communications.</td>
</tr>
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</table>

UNIT I

Relay channels and protocols: Cooperative communications, Cooperation protocols, Hierarchical cooperation, Cooperative communications with single relay: System model, SER analysis for DF protocol, SER analysis for AF protocol, Comparison of DF and AF cooperation gains, Trans-modulation in relay communications.

UNIT II

Multi-node cooperative communications: Multi-node decode-and-forward protocol, Multi-node amplify-and-forward protocol, Distributed space–time and space–frequency coding: Distributed space–time coding (DSTC), Distributed space–frequency coding (DSFC), Relay selection: Motivation and relay-selection protocol, Performance analysis, Multi-node scenario Optimum power allocation

UNIT III

UNIT IV

Cognitive multiple access via cooperation: System model, Cooperative cognitive multiple access (CCMA) protocols, Stability analysis, Throughput, Delay analysis, Content-aware cooperative multiple access: System model, Content-aware cooperative multiple access protocol, Dynamic state model, Performance analysis, Access contention–cooperation tradeoff

UNIT V


UNIT VI

Asymptotic performance of distortion exponents: Systems setup for source–channel diversity, Multi-hop channels, Relay channels, Coverage expansion with cooperation: System model, Relay assignment: protocols and analysis, Relay assignment algorithms, Numerical results, Broadband cooperative communications: System model, Cooperative protocol and relay-assignment scheme, Performance analysis, Performance lower bound, Optimum relay location, Network lifetime maximization via cooperation: Introduction, System models, Lifetime maximization by employing a cooperative node, Deploying relays to improve device lifetime

Textbooks/References:

1. K.J.Rayliu, Ahmed K. Sadek, Weifeng Su, Andres Kwasinski, Cooperative Communications and Networking, CAMBRIDGE UNIVERSITY PRESS
2. Gerhard Kramer, Ivana Maric´, and Roy D. Yates, Cooperative Communications, now Publishers Inc.USA.
ELECTIVE III
SOFT COMPUTING

Weekly Teaching Hours
TH: 03 Tut: --

Scheme of Marking
TH: 60 Tests: 20 IA: 20 Total: 100

Course Objectives:

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<tbody>
<tr>
<td>A</td>
<td>To provide in-depth understanding of fundamental theory and concepts of computational intelligence methods</td>
</tr>
<tr>
<td>B</td>
<td>To understand the fundamental theory and concepts of neural networks, neuro-modeling, several neural network paradigms and its applications.</td>
</tr>
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Course Outcomes:

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<tbody>
<tr>
<td>CO1</td>
<td>Learner will be able to articulate analogy of human neural network for understanding of artificial learning algorithms.</td>
</tr>
<tr>
<td>CO2</td>
<td>Learner will be able to analyze radial basis function network.</td>
</tr>
<tr>
<td>CO3</td>
<td>Learner will be able to analyze neural network architecture &amp; basic learning algorithms.</td>
</tr>
<tr>
<td>CO4</td>
<td>Learner will be able to understand mathematical modeling of neurons, neural networks.</td>
</tr>
<tr>
<td>CO5</td>
<td>Learner will be able to analyze training, verification and validation of neural network models</td>
</tr>
<tr>
<td>CO6</td>
<td>Learner will be able to design Engineering applications that can learn using neural networks</td>
</tr>
</tbody>
</table>

UNIT I
Neural Networks: Introduction to Biological Neural Networks: Neuron physiology, Neuronal diversity, specification of the brain, the eye’s Neural Network. Artificial Neural Network Concepts: Neural attributes, modeling learning in ANN, characteristics of ANN, ANN topologies, learning algorithm.

UNIT II
Neural Network Paradigm: McCulloch-Pitts, Model, the perception, Back-propagation networks. Associative Memory, Adaptive Resonance (ART) paradigm, Hopfield Model, Competitive learning Model, Kohonen Self-Organizing Network.

UNIT III

UNIT IV
UNIT V

UNIT VI
Swarm Intelligence: Introduction to swarm intelligence and key principles (e.g. self organization, stigmergy), neural and artificial examples, Computational and embedded SI, Foraging, trail lying, Open space, multi-source foraging experiments: biological data, microscopic experiments. Recent trends in soft computing

Textbooks/References:

ELECTIVE IV

SIGNAL PROCESSING AND SMART ANTENNAS FOR WIRELESS COMMUNICATION

Weekly Teaching Hours
TH: 03    Tut: --

Scheme of Marking
TH: 60    Tests: 20  IA: 20    Total: 100

Course Objectives:

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<tbody>
<tr>
<td>A</td>
<td>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.</td>
</tr>
<tr>
<td>B</td>
<td>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.</td>
</tr>
<tr>
<td>C</td>
<td>To provide graduates strong mathematical skills and in depth knowledge in signal theory to analyze and solve complex problems in the domain of emerging wireless systems.</td>
</tr>
<tr>
<td>D</td>
<td>To get an understanding of signal processing techniques for emerging wireless systems.</td>
</tr>
</tbody>
</table>

Course Outcomes:

| CO1 | Learner will be able to discuss the wireless signaling environment and Performance issues. |
| CO2 | Learner will be able to analyze the channel modeling and multiuser detection. |
| CO3 | Learner will be able to analyze the Adaptive array processing and turbo coded CDMA. |
| CO4 | Learner will be able to analyze Linear and nonlinear predictive techniques. |
| CO5 | Learner will be able to analyze the Signal Processing Techniques for wireless reception. |

UNIT I

Overview of wireless and mobile: Cellular system concepts, standards and Evolution of mobile & wireless communication technologies.

UNIT II

Wireless channel characterization: Attenuation, Shadowing, Fading, Doppler Shift, Delay Spread, Co-channel, Adjacent Channel and other forms of interferences. Modulation techniques: QAM, Multitone, MSK, OMSK, CPM, TFM and OFDM.

UNIT III
Receiver architecture and algorithms: Digital IF receivers, Sub-sampling digital receivers, I & Q channel sampling, Noncoherent and Coherent techniques, Rake receiver. Equalization and Synchronization: MLSE, Adaptive Equalization: LMS, RLS & Blind adjustment, Timing recovery and carrier

UNIT IV

Smart Antennas systems: Generalized array signal processing, Beam forming concepts: DOB, TRB & SSBF, Switched beam antennas, spatial diversity, and fully adaptive antennas for enhanced coverage, range extension & improvement in frequency refuse, interference Nulling for LOS & Multipath systems.

UNIT V

SDMA concepts and Smart antennas implementation issues.

UNIT VI

RF Ics: LNA, IQ Lodulator, Mixers, DSPs & Micro-controllers in wireless communications, ASICs and FPGAs.

Textbooks/References:

ELECTIVE IV

ADVANCE DIGITAL IMAGE PROCESSING

Weekly Teaching Hours

<table>
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<th>TH</th>
<th>Tut</th>
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<tr>
<td>03</td>
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</table>

Scheme of Marking

<table>
<thead>
<tr>
<th>TH</th>
<th>Tests</th>
<th>IA</th>
<th>Total</th>
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</thead>
<tbody>
<tr>
<td>60</td>
<td>20</td>
<td>20</td>
<td>100</td>
</tr>
</tbody>
</table>

Course Objectives:

A  To instill research skills and bring in optimal solutions and novel products to Image 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 Image 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 image theory to analyze and solve complex problems in the domain of Image processing.

D  To design, analyze and implement algorithms for advanced image analysis like image compression, image segmentation etc.

Course Outcomes:

CO1  Learner will be able to develop and implement algorithms for digital image processing.

CO2  Learner will be able to examine various types of images, intensity transformations and applying various filtering techniques.

CO3  Learner will be able to develop critical thinking about shortcomings of the state of the art in image processing.

CO4  Learner will be able to identify the suitable image enhancement and restoration techniques based upon the application.

CO5  Learner will be able to show how higher-level image concepts such as edge detection, segmentation, representation can be implemented and used.

CO6  Learner will be able to manipulate both binary and grayscale digital images using morphological filters and operators to achieve a desired result.

UNIT I

UNIT II
Intensity Transformations and Filtering: Spatial intensity transformation functions, histogram processing, fundamentals of spatial filtering, smoothing filters, sharpening filters, fuzzy techniques for intensity transformations and spatial filtering. Frequency domain filtering sampling and Fourier transform of sampled functions, Discrete Fourier transform, properties of DFT, smoothing and sharpening in frequency domain.

UNIT III
Color Image Processing and Wavelets: Color models, intensity slicing, color transformations, fundamentals of wavelets- image pyramids, subband coding, Harr transform, multi-resolution expansion- series scaling and wavelet functions, 1D wavelet transform-wavelet series expansion, discrete wavelet transform, continuous wavelet transform, fast wavelet transform, 2D wavelet transform, wavelet packets

UNIT IV
Image Compression fundamentals- coding redundancy, spatial and temporal redundancy, image compression models, image formats and compression standards, compression methods- Huffman coding, Golomb coding, Arithmetic coding, LZW, Run Length coding, wavelet coding, digital image watermarking

UNIT V
Morphological operations- dilation, erosion, duality, opening, closing, hit/miss transformation, boundary extraction, hole filling, extraction of connected components, thinning, thickening, skeletons, pruning.

UNIT VI
Image Segmentation and Object Recognition: fundamentals, detection of isolated point, line and edge detection, edge linking and boundary detection, global thresholding basics, multiple thresholds, variable thresholding, multivariable thresholding, region growing, region splitting and merging, morphological watersheds- dam construction, watershed segmentation algorithm, markers, segmentation using motion- spatial techniques, frequency domain techniques. Patterns and patterns classes, matching, optimal statistical classifier, neural network, matching shape numbers, string matching.

Textbooks/Reference:
ELECTIVE IV

ELECTROMAGNETICS, ANTENNA AND PROPAGATION

Weekly Teaching Hours
TH: 03   Tut: --

Scheme of Marking
TH: 60   Tests: 20   IA: 20   Total: 100

Course Objectives:

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<tbody>
<tr>
<td>A</td>
<td>To provide in-depth understanding of the electromagnetics concepts such as Stoke's theorem, Coulomb's Laws, Gauss's Law, Poisson's and Laplace's Equations, Biot-Savart Law, Ampere's Circuital Law, with their applications.</td>
</tr>
<tr>
<td>B</td>
<td>To provide an insight into various aspects of the radiation and antenna theory.</td>
</tr>
<tr>
<td>C</td>
<td>To provide in-depth understanding, construction &amp; working of various microwave antennas, Identify and study the various parameters of microwave antenna.</td>
</tr>
</tbody>
</table>

Course Outcomes:

<p>| | |</p>
<table>
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<tr>
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<tbody>
<tr>
<td>CO1</td>
<td>Learner will be able to analyze concept of electromagnetics.</td>
</tr>
<tr>
<td>CO2</td>
<td>Learner will be able to Identify and study the various design and performance parameters of microwave antenna.</td>
</tr>
<tr>
<td>CO3</td>
<td>Learner will be able to design microwave antennas for given specifications at RF and Millimeter wave frequencies.</td>
</tr>
<tr>
<td>CO4</td>
<td>Learner will be able to analyze and design the planer antennas.</td>
</tr>
<tr>
<td>CO5</td>
<td>Learner will be able to analyze the antenna arrays.</td>
</tr>
<tr>
<td>CO6</td>
<td>Learner will be able to understand special antennas such as frequency independent and broad band antennas</td>
</tr>
</tbody>
</table>

UNIT I


UNIT II

Harmonic Fields, The Helmhotz Equation, Plane waves in Lossless medium, Plane waves in a lossy medium, Poynting Vector and Power Flow in Electromagnetic Fields, Polarisation of plane wave, Behaviour of Plane waves at the interface of two media

UNIT III

Introduction, Fundamentals of Radiation, Radiated field of an Herzian dipole, Basic Antenna Parameters, Half Wave Dipole Antenna, Quarter Wave Monopole Antenna, Small Loop Antennas, Introduction to Antenna Arrays, Finite difference Method, Basic Concepts of the Method of Moments, Method of Moment for Wire Antennas and Wire Scatterers

UNIT IV


Array theory- linear array: broad side and end fire arrays; self and mutual impedance of between linear elements, grating lobe considerations.

UNIT V

Planar Array- array factor, beam width, directivity. Example of microstrip patch arrays and feed networks electronics scanning.


UNIT VI


Antennas for mobile communication- handset antennas, base station antennas. Beam-steering and antennas for MIMO applications. Active and smart microstrip antennas. Design and analysis of microstrip antennas arrays.

Textbooks/References:

ELECTIVE IV
FREE SPACE OPTICAL COMMUNICATION

Weekly Teaching Hours
TH: 03 Tut: --

Scheme of Marking
TH: 60 Tests: 20 IA: 20 Total: 100

Course Objectives:

A. To expose the students to the basics of signal propagation through optical fibers, fiber impairments, components and devices and system design.

B. To provide an in-depth understanding needed to perform fiber-optic communication system engineering calculations, identify system tradeoffs, and apply this knowledge to modern fiber optic systems.

Course Outcomes:

<table>
<thead>
<tr>
<th>CO1</th>
<th>Learner will be able to recognize and classify the structures of Optical fiber and types.</th>
</tr>
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<tbody>
<tr>
<td>CO2</td>
<td>Learner will be able to demonstrate electromagnetic and mathematical analysis of light wave propagation.</td>
</tr>
<tr>
<td>CO3</td>
<td>Learner will be able to analyze fabrication techniques of different optical fibers.</td>
</tr>
<tr>
<td>CO4</td>
<td>Learner will be able to interpret behavior of pulse signal and various loss mechanism.</td>
</tr>
<tr>
<td>CO5</td>
<td>Learner will be able to interpret Dispersion compensation mechanism, Scattering effects and modulation techniques.</td>
</tr>
<tr>
<td>CO6</td>
<td>Learner will be able to interpret working of Fiber based devices.</td>
</tr>
</tbody>
</table>

UNIT I


UNIT II


UNIT III

UNIT IV
Optical Components for FSO: Optical waveguides – Optical Filters, Couplers, Amplifiers, Switches, Antennas, Interconnecting Equipment’s, etc. – Optical integrated circuits – semiconductor integrated optic devices,

UNIT V

UNIT VI
Advance trends and technologies in free space optical communication.

Textbooks/References:

ELECTIVE IV
ADVANCED SATELLITE COMMUNICATION

Weekly Teaching Hours
TH : 03  Tut: --

Scheme of Marking
TH : 60  Tests : 20  IA: 20  Total : 100

Course Objectives:

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<tbody>
<tr>
<td>A</td>
<td>To provide students with good depth of knowledge in radar and Satellite communication.</td>
</tr>
<tr>
<td>B</td>
<td>To prepare mathematical background for satellite communication signal analysis.</td>
</tr>
<tr>
<td>C</td>
<td>To provide the students for further studies and research knowledge of modern applications in Satellite communication.</td>
</tr>
</tbody>
</table>

Course Outcomes:

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<table>
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<tr>
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<tbody>
<tr>
<td>CO1</td>
<td>Learner will be able to apply knowledge of theory and practice related to Satellite communication</td>
</tr>
<tr>
<td>CO2</td>
<td>Learner will be able to identify, formulate and solve engineering problems related to radar and Satellite communication.</td>
</tr>
<tr>
<td>CO3</td>
<td>Learner will be able to analyze the various aspects of establishing a geo-stationary satellite communication link, etc.</td>
</tr>
<tr>
<td>CO4</td>
<td>Learner will be able to acquired knowledge about Satellite Navigation System.</td>
</tr>
</tbody>
</table>

UNIT I


UNIT II


UNIT III

UNIT IV

Operational Considerations: Subscriber and Gateway Commissioning, Radio Resource Management, Radio Frequency Monitoring, Quality of Service, Licensing Issues

UNIT V

Commercial Issues: System Planning, Service Distribution Model, Billing Issues, Regulatory Issues, Traffic Forecast, End-User Perspective – A Case Study

UNIT VI


Textbooks/References:

ELECTIVE V
TCP/IP AND INTERNET

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

Course Objectives:

<table>
<thead>
<tr>
<th></th>
<th>Description</th>
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<tbody>
<tr>
<td>A</td>
<td>To provide advanced design, operation, and challenges of the Internet as a global network.</td>
</tr>
<tr>
<td>B</td>
<td>To give an exposure to a student with advanced insight into addressing, routing, and performance on the Internet, and understand recent developments such as IPv6 and mobility.</td>
</tr>
<tr>
<td>C</td>
<td>To give students research in the area of internet engineering</td>
</tr>
</tbody>
</table>

Course Outcomes:

| CO1 | Learner will be able describe the architecture of the Internet. |
| CO2 | Learner will be able to describe the advanced functions performed by the Internet Protocol (IP) and supporting protocols (eg. ICMP, UDP). |
| CO3 | Learner will be able to describe IP addressing and are able to design an internetwork with assigned addresses and NAT. |
| CO4 | Learner will be able to describe current technology trends for the implementation and deployment of TCP/IP and Internet. |

UNIT I

UNIT II

UNIT III
UNIT IV


UNIT V

Introduction to Digital Audio, Audio compression, Streaming Audio, Internet Radio, Voice over IP, Introduction to video, Video compression

UNIT VI


Textbooks/References:

2. An Engineering approach to computer networking, S. Keshav, Addison Wesley, 2001
3. TCP/IP Illustrated Volume 1: The protocols, 1/e--, W. Richard Stevens,Pearson Education
ELECTIVE V
HIGH PERFORMANCE COMMUNICATION NETWORKS

Weekly Teaching Hours
TH : 03  Tut: --

Scheme of Marking
TH : 60  Tests : 20  IA: 20  Total : 100

Course Objectives:

<p>| | |</p>
<table>
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<tbody>
<tr>
<td>A</td>
<td>To understand the different terminologies of the broadband communication.</td>
</tr>
<tr>
<td>B</td>
<td>To study the different switching techniques used in the broadband communication system.</td>
</tr>
<tr>
<td>c</td>
<td>To understand the different concepts of the ATM and the optical communications.</td>
</tr>
</tbody>
</table>

Course Outcomes:

| CO1 | Learner will be able to describe the architecture of the Internet. |
| CO2 | Learner will be able to differentiate the different switching techniques and its applications. |
| CO3 | Learner will be able to explain the different functionalities of the ATM network. |

UNIT I
Packet switched networks: OSI & IP models – Ethernet (IEEE 802.3) – Token Ring (IEEE 802.5) Wireless LAN (IEEE 802.11), FDDI-DQDB-SMDS: Internetworking with SMDS

UNIT II
ISDN and broadband ISDN: Interfaces and functions- Layers and Services – Signaling System 7- Broadband ISDN architecture and protocols.

UNIT III
ATM and frame relay: Main features, addressing, signaling & routing, ATM header structure adaptation layer management & control ATM switching & transmission. Frame relay Protocols & services, congestion control, internetworking with ATM, Internet and ATM Frame relay via ATM

UNIT IV
Optical networks: Optical Links, WDM system, Optical cross-connects, Optical LANs, Optical paths and networks

UNIT V
Bluetooth technology: Overview, protocol stack, link manager, Host controller interface, Service discovery protocol, WAP Applications, encryption and security, QoS.
UNIT VI


Textbooks/References:

3. Jennifer Bray and Charles Sturman, Bluetooth connect without cables, Pearson education Asia, LPE.
**ELECTIVE V**

**MULTIRATE 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:**

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

**UNIT I**

**Fundamentals of Multirate Systems**

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

**UNIT II**

**Maximally Decimated 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, Transform 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


Textbooks/References:

1. P.P.Vaidyanathan, Multirate System and Filter Banks PTR Prentice Hall, Englewood Cliffs, New Jersey,
3. Raghuvleen Rao, Ajit Bopardikar, Wavelet Transforms Introduction to Theory and Application, Pearson Education Asia,
4. C. Sidney Burrus, R.A.Gopianath, Introduction to wavelet and wavelet Transform, Pretice Hall.
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 Framework, 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


UNIT IV

Wireless Technologies For IoT: Layer ½ Connectivity: WPAN Technologies for IoT/M2M, Zigbee /IEEE 802.15.4, Radio Frequency for consumer Electronics (RF4CE), Bluetooth and
its low-energy profile, IEEE 802.15.6 WBANS, IEEE 802.15 WPAN TG4j, MBANS, NFC, dedicated short range communication (DSRC) & related protocols. Comparison of WPAN technologies cellular & mobile network technologies for IoT/M2M.

UNIT V


UNIT VI

Internet of Things Application Examples: Smart Metering, advanced metering infrastructure, e-Health/Body area network, City automation, automotive applications. Home automation, smart cards, Tracking, Over-The-Air passive surveillance/Ring of steel, Control application examples.

Textbooks/References:

2. Daniel Minoli, Building the Internet of Things with IPv6 and MIPv6 The Evolving World of M2M Communications, Wiley Publications
ELECTIVE V
RESEARCH METHODOLOGY

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

Course Objectives:

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

Course Outcomes:

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

UNIT I

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

Meaning of Research, 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


UNIT IV

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

UNIT VI

Textbooks/References:

1. J.P. Holman, Experimental Methods for Engineers, Mcgraw-Hill publication.
2. C.R. Kothari, Research Methodology Methods & Techniques, New Age International publication.
SEMINAR I

Weekly Teaching Hours  TH: -  Practical:  04
Scheme of Marking     IA: 50  PR/OR: 50  Total: 100

The seminar shall be on the state of the art in the area of the wireless communication and computing and of student’s choice approved by an authority. The student shall submit the duly certified seminar report in standard format, for satisfactory completion of the work duly signed by the concerned guide and head of the Department/Institute.
MINI PROJECT

Weekly Teaching Hours  TH: -  Practical:  04
Scheme of Marking     IA: 50  PR/OR: 50  Total: 100

The mini project shall be based on the recent trends in the industry, research and open problems from the industry and society. This may include mathematical analysis, modelling, simulation, and hardware implementation of the problem identified. The mini project shall be of the student’s choice and approved by the guide. The student has to submit the report of the work carried out in the prescribed format signed by the guide and head of the department/institute.
PROJECT MANAGEMENT AND INTELLECTUAL PROPERTY RIGHTS

Weekly Teaching Hours
TH: - Practical: -

Scheme of Marking
IA: 50 PR/OR: 50 Total: 100

The Student has to choose this course either from NPTEL/MOOCs/SWAYAM pool. It is mandatory to get the certification of the prescribed course.
PROJECT-I

Weekly Teaching Hours
TH: -  Practical: -

Scheme of Marking
IA: 50  PR/OR: 50  Total: 100

Project-I is an integral part of the final project work. In this, the student shall complete the partial work of the project which will consist of problem statement, literature review, project overview, scheme of implementation that may include mathematical model/SRS/UML/ERD/block diagram/ PERT chart, and layout and design of the proposed system/work. As a part of the progress report of project-I work, the candidate shall deliver a presentation on progress of the work on the selected dissertation topic.

It is desired to publish the paper on the state of the art on the chosen topic in international conference/journal.

The student shall submit the duly certified progress report of project-I in standard format for satisfactory completion of the work duly signed by the concerned guide and head of the department/institute.
PROJECT-II

Weekly Teaching Hours
TH: - Practical: -

Scheme of Marking
IA: 100 PR/OR: 100 Total: 200

In Project - II, the student shall complete the remaining part of the project which will consist of the simulation/ analysis/ synthesis/ implementation / fabrication of the proposed project work, work station, conducting experiments and taking results, analysis and validation of results and drawing conclusions.

It is mandatory to publish the paper on the state of the art on the chosen topic in international conference/ journal.

The student shall prepare the duly certified final report of project work in standard format for satisfactory completion of the work duly signed by the concerned guide and head of the department/institute.