## CURRICULUM

### I SEMESTER

<table>
<thead>
<tr>
<th>Subject Code</th>
<th>Subjects</th>
<th>Category</th>
<th>Periods</th>
<th>Marks</th>
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<td>Probability and Stochastic Process</td>
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**Total Credits** 26

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**Total Credits** 27
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A representative list of professional development courses is given below:

- a) Industrial Training (Limited to one credit)
- b) Specific Field Knowledge Training (Limited to a maximum of two credits)
- c) Seminar related with directed study (Limited to a maximum of two credits)
- d) Paper Publication in SCI Journals (Limited to one credit)

CA- Continuous Assessment, SE-Semester Examination, TM- Total Marks, TY-Theory, TCM-Theory with a Mini Project, LB-Laboratory, PR- Practice
## LIST OF ELECTIVES

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<td>ECE52</td>
<td>Wireless Sensor Networks</td>
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<td>Modelling and Simulation of Communication Networks</td>
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<td>7.</td>
<td>ECE74</td>
<td>Microwave Integrated Circuits</td>
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<td>ECE78</td>
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<td>ECE85</td>
<td>Digital Communication Receivers</td>
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<td>ECE86</td>
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<td>MA155</td>
<td>Probability and Stochastic Process</td>
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Prerequisite: Basic Probability and Statistics.

Objectives:
- To introduce Moment Generating function, Probability generating function, Characteristic function
- To familiarize students with Discrete and continuous distributions and stochastic Process
- To introduce Queuing Theory

Outcome:
- Knowledgeable in Distributions and Stochastic processes
- Ability to demonstrate the application of stochastic processes and Queuing theory

UNIT – I
Random Variables-Discrete Random Variables

UNIT – II
Continuous Random Variables
Continuous Random Variables and their Distributions Normal, Log - Normal, Multivariate Normal, Gamma, Exponential, Chi-square, Weibull, Rayleigh distributions. Relationship between continuous distributions.

UNIT – III
Stochastic Processes

UNIT – IV
Queueing Models

UNIT – V
Continuous Parameter Markov Chain
Introduction, Little’s formula, M/G/1 queueing model, Continuous Parameter Markov Chain: The Birth and Death process: M/M/1, M/M/c, M/M/1/N, M/M/c/N (c<N), M/M/c/c, M/M/∞ models only - derivation of mean number of customer in the system, in the queue and waiting time - Simple applications, Special case of Birth and Death model (Pure Birth and Pure Death Processes).

Total contact Hours: 45  Total Tutorials: 15  Total Practical Classes: -  Total Hours: 60
Text Books:

Reference Books:
### Department: Electronics and Communication Engineering  
**Programme:** M.Tech. (Wireless Communication)  
**Category:** TY

<table>
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<td>Advanced Digital Communication</td>
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#### Prerequisite
- To understand the concept of different digital modulation schemes
- To study optimum receivers suitable for communication channels
- To understand the concepts of Pulse shaping and equalization
- To have an in depth knowledge on concepts and theoretical limits set by Information theory
- To learn the various coding schemes in detail

#### Objectives
- Ability to select an appropriate modulation scheme when the transmitted signal is corrupted by AWGN in the channel
- Knowledgeable in equalization techniques
- Ability to set the limit for compression and transmission of information
- Ability to use appropriate channel coding scheme to improve the performance of communication system over noisy channel

#### Outcome
- Ability to select an appropriate modulation scheme when the transmitted signal is corrupted by AWGN in the channel
- To study optimum receivers suitable for communication channels
- To understand the concepts of Pulse shaping and equalization
- To have an in depth knowledge on concepts and theoretical limits set by Information theory
- To learn the various coding schemes in detail

#### UNIT – I  
**Information Theory**  
Hours: 9

- Information Measure and Entropy, Source coding and Shannon’s Theorem, Source coding for Discrete Memoryless Sources, Discrete Memoryless Channels, Mutual Information and Channel capacity, Channel Coding Theorem, Continuous Sources and Differential Entropy.

#### UNIT – II  
**Channel Coding**  
Hours: 9

- Introduction to linear block codes, Convolution coding, Systematic, Non-recursive and recursive codes, Maximum likelihood decoding, Viterbi algorithm, Punctured convolutional codes, Dual-k codes, Concatenated codes, MAP and BCJR algorithms, Iterative decoding, Factor graphs, LDPC codes and Trellis coded modulation.

#### UNIT – III  
**Digital Modulation Schemes**  
Hours: 9

- Elements of digital communication system, Representation of Digitally Modulated Signals, Memory less modulation methods, Signaling Scheme with memory, Power spectrum of digitally modulated signals. Synchronization.

#### UNIT – IV  
**Receivers for AWGN Channel**  
Hours: 9

- Waveform and vector Channel models, Waveform and vector AWGN Channel, Optimum detection and error probability for band limited signaling and power limited signaling- Non Coherent detection, A comparison of digital signaling methods, Optimum receiver for CPM.

#### UNIT – V  
**Band Limited Channels**  
Hours: 9

- Characterization of Band Limited Channels, ISI, Nyquist Criterion, Controlled ISI channel with ISI and AWGN, Pulse Shaping for optimum transmission and reception, MLSE, Linear Equalization, Decision feedback equalization, ML detectors, Turbo and Blind Equalization methods.

**Total contact Hours:** 45  
**Total Tutorials:** 15  
**Total Practical Classes:** -  
**Total Hours:** 60

#### Text Books:

#### Reference Books:

#### Website
1. www.nptel.ac.in
Department: Electronics and Communication Engineering  Programme: M.Tech. (Wireless Communication)

Semester: One  Category: TY

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<td>Advanced Digital Signal Processing</td>
<td>3 1 - 4</td>
<td>40</td>
<td>60</td>
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</table>

Prerequisite:
- To learn about random signals and their processing techniques
- To study the parametric and non-parametric methods of spectrum estimation
- To understand the concepts of linear prediction and estimation
- To design adaptive filters for non-stationary processes
- To study and understand the multirate signal processing techniques

Objectives:
- Knowledgeable in random signals, random processes and filtering techniques for random processes
- Knowledgeable in spectrum estimation methods
- Ability to design predictors and estimators
- Knowledgeable in adaptive filtering for non-stationary processes
- Knowledgeable in multirate signal processing techniques

Outcome:
- Knowledgeable in random signals, random processes and filtering techniques for random processes
- Knowledgeable in spectrum estimation methods
- Ability to design predictors and estimators
- Knowledgeable in adaptive filtering for non-stationary processes
- Knowledgeable in multirate signal processing techniques

UNIT – I  Discrete Time Random Signal Processing  Hours: 9

UNIT – II  Spectrum Estimation  Hours: 9

UNIT – III  Linear Estimation and Prediction  Hours: 9
Linear prediction- Forward and backward predictions, Solutions of the Normal equations- Levinson-Durbin algorithms. Least mean square error criterion -Wiener filter for filtering and prediction, FIR Wiener filter and Wiener IIR filters, Discrete Kalman filter.

UNIT – IV  Adaptive Filters  Hours: 9

UNIT – V  Multirate Digital Signal Processing  Hours: 9
Mathematical description of sampling rate conversion - Interpolation and Decimation, Decimation by an integer factor - Interpolation by an integer factor, Sampling rate conversion by a rational factor, Filter implementation for sampling rate conversion- direct form FIR structures, Polyphase filter structures. Multistage implementation of sampling rate conversion. Applications – Phase shifters – Interfacing of digital systems with different sampling rates - Sub band coding.

Total contact Hours: 45  Total Tutorials: 15  Total Practical Classes: -  Total Hours: 60

Reference Books:

Website:
1. www.nptel.ac.in
### Subject Information

**Department:** Electronics and Communication Engineering  
**Programme:** M.Tech. (Wireless Communication)  
**Semester:** One  
**Category:** TY

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<td>Emerging Wireless Technologies</td>
<td>L 3 T 1 P -</td>
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<td>CA 40 SE 60 TM 100</td>
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**Prerequisite:** -

**Objectives:**
- To understand the basic concepts of emerging technologies
- To gain knowledge on LTE and Femtocell
- To study the performance of Intelligent Autonomous communication systems
- To acquire knowledge about Smart devices and content delivery networks

**Outcome:**
- Knowledgeable in Emerging Wireless technologies
- Able to demonstrate the architecture and reference model of LTE
- Ability to examine the concepts of intelligent system
- Knowledgeable in future wireless technologies

### Units

**UNIT – I Emerging Technologies Hours: 9**

- Bluetooth
- Radio frequency Identification
- Wireless Broadband (WiMax)
- IP and Mobile IP
- Packet delivery and Handover management
- Location management
- Registration
- Tunnelling and Encapsulation
- Cellular IP
- Internet Protocol Version_4
- Internet Protocol Version_6

**UNIT – II Long Term Evolution Hours: 9**

- Overview – LTE Evolution - Architecture - Reference Model - Functional Description of LTE Network
- Reference Points - Control and User Planes – LTE advanced

**UNIT – III Femtocell Hours: 9**

- Femtocell Technology - Femtocell Benefits - User Benefits - Operator Benefits - LTE Femtocell Design Issues

**LTE Femtocell Challenges and Technical Issues:** Interference - Spectrum Allocation - Access Mode Impact - Security and Privacy Challenges - Synchronization - Mobility

**UNIT – IV Intelligent Autonomous Communications Hours: 9**

- Introduction – Basic Autonomous Intra-acting systems - Limitations- Intelligent Systems – Self aware systems- Self describing – Self explaining – Self modifying – Self management and Autonomic computing- Internet of Things(IoT)

**UNIT – V Future Technologies Hours: 9**


**Total contact Hours:** 45  
**Total Tutorials:** 15  
**Total Practical Classes:** -  
**Total Hours:** 60

**Text Books:**

**Websites:**
3. [http://www.saitechnology.com/index.php/saiproducts/sai-m2m/sai-4g-femto-pico-cell](http://www.saitechnology.com/index.php/saiproducts/sai-m2m/sai-4g-femto-pico-cell)
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**Programme:** M.Tech (Wireless Communication)  
**Semester:** One  
**Category:** LB  

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**Prerequisite:** -

**Objectives:**
- To understand the working of communication system models
- To understand and implement application using embedded development board
- To simulate the different channel models for wireless networks

**Outcome:**
- Ability to demonstrate the design of modulator and antenna used for wireless communication
- Ability to implement the GSM and HTTP data transfer using Qualnet software and study the different parameters of the network
- Ability to design simple digital systems using Spartan6 FPGA board
- Ability to design filters suitable for wireless channel

**LIST OF EXPERIMENTS**

1. Design of GMSK modulator for GSM system.
2. Study of wireless sensor network using NI Labview.
3. Study and comparison of various wireless channel models.
4. Call establishment using different entities of GSM network using Qualnet.
5. Development of a network to run HTTP application using Qualnet.
6. Developing any one network topology, establishing a routing protocol and analysing using NS2.
7. Study of serial data transfer using HCS959 module.
8. Designing Yagi antenna and study the Return loss magnitude and phase characteristics.
9. FFT of real time input signals using DSP trainer kits.
10. Simulation of OFDM transmitter and receiver in Matlab.
11. Study of Spartan6 FPGA and perform the following operations
   i. Activating the traffic light controller interface
   ii. Enabling the Keypad Matrix interface with LEDs.
   iii. Enabling the graphic LCD interface in Spartan6 FPGA.
   iv. Design and implementation of Manchester encoder.

**Total contact Hours:** -  
**Total Tutorials:** -  
**Total Practical Classes:** 45  
**Total Hours:** 45
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**Objectives**

- To address resource allocation, sharing, control and management for CDMA and OFDM based systems
- To understand call establishment, call processing, traffic management
- To address uplink and downlink interference management, scheduling issues and capacity evaluation
- To analyze the system and channel requirements for OFDM system
- To study system description of OFDM based resource allocation schemes

**Outcome**

- Ability to demonstrate the impact of spread spectrum techniques on forward link and reverse link
- Ability to characterize resource handling in terms of capacity in real time scenario
- Ability to demonstrate call processing and traffic states by link budget and traffic analysis
- Ability to illustrate the choice of modulation, channel estimation in time and frequency domain, and synchronization in OFDM/OFDMA systems

**UNIT – I**  
Principles of Code Division Multiple Access  
Spread spectrum technique – Direct sequence and frequency hopping spread spectrum communication system – PN codes and Walsh codes – Rake receiver – Capacity – Effects of loading, sectorization and voice activity – Power control – Hand off – Link structure – Forward link – Pilot, synchronization, paging and traffic channels – Reverse Link – access and traffic channel.

**UNIT – II**  
Call Processing and Traffic  
Call processing states – Initialization, idle, access and traffic states – Forward link and Reverse link analysis - Calculation of Ec/I0 and Eb/N0 – Traffic intensity – Grade of Service – Erlang-B and C models.

**UNIT – III**  
OFDM Basics  

**UNIT – IV**  
Coding, Modulation and Channel Estimation  
Timing and Frequency offset in OFDM –Synchronization – Synchronization using cyclic extension and special training symbols – Coherent detection – One and two dimensional channel estimation – Special training symbols – Decision directed channel estimation – Differential detection in the time and frequency domain.

**UNIT – V**  
OFDMA and MC-CDMA  
Frequency hopping in OFDMA - OFDMA system description – Channel coding, modulation, time and frequency synchronization, Combination of OFDM and CDMA - MC-CDMA, MT-CDMA and MC-DSCDMA systems - Difference between OFDMA and MC-CDMA

**Text Books:**

**Reference Books:**
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**Prerequisite**

- To understand the evolution trends involved in mobile wireless systems.
- To enable the postgraduates to distinguish and quantify the various fading effects and propagation models along with Channel measurements.
- To know and compare the various antennas and diversity reception techniques adopted in wireless communication systems.
- To analyze the overall system performance of wireless communication system and to introduce the emerging advanced wireless standards.

**Objectives**

- Ability to track the growth trend of the Wireless Communication Systems
- Ability to Characterize and measure the mobile channel quantitatively
- Design and demonstrate mobile antennas and reception techniques for any specific application
- Ability to carry out the system performance for both in-door and out-door wireless communications
- Ability to demonstrate the knowledge of present day and advanced wireless communication technologies befitting for a potential researcher

**Outcome**

- Ability to track the growth trend of the Wireless Communication Systems
- Ability to Characterize and measure the mobile channel quantitatively
- Design and demonstrate mobile antennas and reception techniques for any specific application
- Ability to carry out the system performance for both in-door and out-door wireless communications
- Ability to demonstrate the knowledge of present day and advanced wireless communication technologies befitting for a potential researcher

**UNIT – I**  
Trends In Mobile Wireless  
Hours: 9


**UNIT – II**  
Propogation and Shadowing  
Hours: 9


**UNIT – III**  
Fading Channel Characterisation  
Hours: 9


**UNIT – IV**  
Performance Evaluation  
Hours: 9

Performance evaluation, signalling evaluation, measurement of average received level and level crossings, spectral efficiency, OFDMA Vs CDMA Evaluation, Evaluation of data services, WiMAX Vs 3G for mobile broadband wireless.

**UNIT – V**  
Quality Improvement  
Hours: 9


**Mini Project**  
Hours: 30

PG students will be motivated to carry out the Mini Project in

- Design, fabrication/analytical modeling/simulation of OFDM, CDMA 2000, WCDMA networks,
• Design and simulation of AIN and IP networks, Modeling/Simulation of propagation models,
• Performance evaluation of different traffic for various propagation models.
• Performance evaluation of OFDMA/CDMA/3G/Mobile WiMAX service, Design, fabrication and testing of antennas for different applications
• Performance improvement through MIMO/Receive diversity/Transmit diversity and coding.

<table>
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<tr>
<th>Total contact Hours: 45</th>
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<th>Total Practical Classes: 30</th>
<th>Total Hours: 75</th>
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**Text Books:**


**Reference Books:**

1. David Tse and Prasad Viswanath, Fundamentals of Wireless Communications, Cambridge

**Website:**

**Department:** Electronics and Communication Engineering  
**Programme:** M.Tech. (Wireless Communication)  

<table>
<thead>
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<tr>
<td>EC165</td>
<td>Mini project</td>
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<td>-</td>
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</table>

**Prerequisite**: -

**Objectives**
- To apply engineering concepts in order to come out with a technical solution
- To analyze the outcomes and present the results in an appropriate way
- To prepare a technical report of the project
- To move from competitive learning to collaborative learning

**Outcome**
- Ability to undertake a piece of research work
- Ability to extend the project to find an application for society

**MINI PROJECT**
In the course of the degree Programme each group of not more than three students has to identify a mini project work in the area of their specialization and the mini project will be implemented under the supervision of a faculty. The progress of the work will be monitored and assessed internally. A project report has to be submitted at the end of the semester after completion of the project work. The semester examination will be evaluated by a panel of examiners.

<table>
<thead>
<tr>
<th>Total contact Hours:</th>
<th>Total Tutorials:</th>
<th>Total Practical Classes:</th>
<th>Total Hours:</th>
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</thead>
<tbody>
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<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>
Subject code: EC158 Subject: Research Methodology

Prerequisite: -

Objectives:
- To educate students to methods of selection of research problems
- To expose students to different research methods

Outcomes:
- Students will be capable to identify and narrow down to the area of research on the basis the requirements of industrial and global requirements
- Students will exhibit the domain skill to choose suitable research methods to execute research effectively
- Students will possess knowledge to further their academic program, namely, Ph.D program.

- **Characteristics of research:** Various functions that describe characteristics of research such as systematic, valid, verifiable, empirical and critical approach.
- **Types of research:** Pure and applied research. Descriptive and explanatory research. Qualitative and quantitative approaches.
- **Research procedure:** Formulating the Research Problem, Literature Review, Developing the objectives, Preparing the research design including sample. Design, Sample size.
- **Considerations in selecting research problem:** Relevance, interest, available data, choice of data, Analysis of data, Generalization and interpretation of analysis.
- **Outcome of research:** Significance of report writing – Layouts of the research report – Types of reports – Oral presentation – Mechanics of writing research report – Precautions for writing research reports – Plagiarism and copy right violation – Patent writing and filing.

Reference books:
1. Dawson, Catherine, Practical Research Methods, UBS Publishers and Distributors, New Delhi, 2002
Department: Electronics and Communication Engineering
Programme: M.Tech. (Wireless Communication)

Semester: Three  Category: PR

<table>
<thead>
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<th>Subject Code</th>
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<tr>
<td>EC166</td>
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<td>-</td>
<td>9</td>
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</table>

Prerequisite: -

Objectives:
- To identify a research problem
- To develop an abstract model that addresses the research problem
- Build a prototype system or constrained implementation of the system that acts as a proof
- Understanding the evaluation of the system
- To present a critical analysis and present it as a report

Outcome:
- Ability to transform knowledge into an experimental process
- Ability to demonstrate the motivation to extend the work to a research
- Ability to identify and apply appropriate tools to solve a problem
- Ability to examine hypotheses

Each student will do an exhaustive literature survey and identify an experimental and / or a theoretical project to be carried out under a supervision of a guide. The phase I of the project work has to be completed by the end of third semester. The progress of the work will be monitored and assessed internally for 150 marks by a committee comprising departmental faculty members and project guide. A project report has to be submitted at the end of the semester after completion of the phase I of the project work. The external assessment will be carried out for 150 marks as per regulations.
<table>
<thead>
<tr>
<th><strong>Department:</strong> Electronics and Communication Engineering</th>
<th><strong>Programme:</strong> M.Tech. (Wireless Communication)</th>
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<td><strong>Semester</strong> : Four</td>
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<tbody>
<tr>
<td>EC167</td>
<td>Project Phase II</td>
<td>-</td>
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</table>

**Prerequisite**

- To identify a research problem
- To develop an abstract model that addresses the research problem
- Build a prototype system or constrained implementation of the system that acts as a proof
- Understanding the evaluation of the system
- To present a critical analysis and present it as a report

**Objectives**

- Ability to transform knowledge into an experimental process
- Ability to demonstrate the motivation to extend the work to a research
- Ability to identify and apply appropriate tools to solve a problem

The phase II of the project work has to be completed by the end of the fourth semester. The progress of the work will be monitored and assessed internally for 200 marks by a committee comprising departmental faculty members and project guide. A project report summarizing the entire project work has to be submitted at the end of the semester after completion of the phase II of the project work. The external evaluation will be carried out as per regulations for 200 marks.
<table>
<thead>
<tr>
<th>Subject Code</th>
<th>Subject</th>
<th>Hours / Week</th>
<th>Credit</th>
<th>Maximum Marks</th>
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<tbody>
<tr>
<td>ECE51</td>
<td>Cryptography and Wireless Security</td>
<td>3 1 -</td>
<td>4</td>
<td>40 60 100</td>
</tr>
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</table>

**Prerequisite**: -

**Objectives**
- To understand Security Services, Attacks and Mechanisms as well as Symmetric Key Cryptographic techniques
- To gain knowledge on number theory and public key management schemes
- To understand the various Authentication Techniques
- To study about system security and security blueprint
- To analyze the basic concepts on wireless security and threats

**Outcome**
- Ability to develop different symmetric key algorithms
- Ability to develop application oriented PKC protocols
- Ability to develop authentication schemes pertaining to system requirements
- Ability to demonstrate the evaluation of security among different network configurations by implementing security mechanisms and meeting out efficient security standards
- Ability to implement efficient cryptosystems for Wireless systems

**UNIT – I**
**Introduction and Symmetric Key Encryption**
- Attacks-Services-Mechanisms-OSI Security architecture-Model for Network Security- Symmetric Cipher Model-
- Substitution and Transposition Techniques- Simplified DES-DES Block Cipher Principles-The Strength of DES-
- Differential and Linear Cryptanalysis-Block Cipher Design Principles- Block Cipher Modes of Operation-
- Groups, Rings and Fields-Modular Arithmetic- Euclid’s Algorithm- Finite Fields of the Form GF(p)- Polynomial Arithmetic-
- Finite Fields of the Form GF(2n)-AES cipher- Triple DES

**UNIT – II**
**Number Theory and Public Key Encryption and Authentication Schemes**
- Authentication Requirements- Authentication functions-message Authentication Codes- Hash Functions-

**UNIT – III**
**Network Security**

**UNIT – IV**
**System Security and its Blueprint**
- Intruders- Intrusion Detection-Password Management-Viruses and Related Threats- Viruses Counter Measures-
- Firewall Design Principles-Types of Firewalls-Firewalls Configurations-Trust Systems- Blue Print for Security-

**UNIT – V**
**Wireless Threats and Security**

<table>
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<tr>
<th>Total contact Hours: 45</th>
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**Text Books:**


**Reference Books:**

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<tbody>
<tr>
<td>ECE52</td>
<td>Wireless Sensor Networks</td>
<td>4</td>
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<td>40</td>
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</tbody>
</table>

**Prerequisite**

- To expose the students to the fundamentals of wireless communication technologies
- To introduce the ideas and need for Sensor networks
- To study the Architecture and Middleware of WSN
- To teach the role of MAC and Routing protocols
- To introduce energy management in network protocols
- To expose the students to the Applications of WSN
- Enable the students to know techniques involved in network management

**Objectives**

- Knowledgeable in the concept of Sensor network and its Protocols
- Ability to implement Wireless Sensor Network for various applications
- Ability to understand the challenges in coverage and routing for energy efficiency
- Ability to examine the possible node architectures for specific applications
- Ability to sense Global Phenomena

**Outcome**

- Knowledgeable in the concept of Sensor network and its Protocols
- Ability to implement Wireless Sensor Network for various applications
- Ability to understand the challenges in coverage and routing for energy efficiency
- Ability to examine the possible node architectures for specific applications
- Ability to sense Global Phenomena

**UNIT – I**

Introduction

**Hours:** 12

- Cellular and Ad hoc wireless Networks
- Mobile Ad-Hoc Networks
- Sensor Networks
- Comparison - Applications
- Categories
- Issues and challenges in designing a sensor network
- Operating environment
- Architecture
- Sensor node technology
- Hardware and Software
- Performance Metrics
- Taxonomy

**UNIT – II**

Middleware And Transmission Technologies

**Hours:** 12

- Middleware - Functions
- Architecture
- Data management functions
- Operating Systems – Design issues
- Examples
- **Available wireless Technologies** - WSN Campus Applications
- Bluetooth
- WLAN
- Zigbee
- WiMax
- 3G and beyond
- Performance modeling of WSN
- Metrics
- Task-driven sensing
- Basic models
- Traffic model
- Energy model
- Node model
- Network models
- MAC model
- Routing model
- System model

**UNIT – III**

Mac Protocols for WSN

**Hours:** 12

- Fundamentals of MAC
- Requirements and design constrains
- MAC protocols for WSN
- Schedule-based protocols
- SMAC
- LEACH
- TRAMA
- Contention-based protocols
- CSMA
- PAMAS
- IEEE 802.15.4
- PHY layer
- MAC layer.

**Case study:** Sensor-MAC

**UNIT – IV**

Routing Protocols FOR WSN

**Hours:** 12

- Challenges and Issues
- Data Dissemination and Gathering
- Location Discovery
- Routing strategies
- Flooding and Gossiping
- SPIN
- PEGASIS
- Geographical routing
- Localized and globalized forwarding
- Greedy perimeter stateless routing
- GEAR
- **Attribute-based routing**
- Direct diffusion
- Rumor routing
- Geographic hash tables

**UNIT – V**

Transport Protocols and Applications of WSN

**Hours:** 12

- Design Issues
- Feasibility of using TCP/UDP for WSN
- Design Considerations
- CODA
- GARUDA
- Performance of Transport Control Protocols

**Case Study:** Sensing Global Phenomena

Total contact Hours: 60
Total Tutorials: -
Total Practical Classes: -
Total Hours: 60
<table>
<thead>
<tr>
<th>Text Books:</th>
</tr>
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<tbody>
<tr>
<td>2. C. Siva Ram Murthy and B. S. Manoj, Ad Hoc Wireless Networks Architectures and Protocols, Prentice Hall, PTR, 2004</td>
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<td>Reference Books:</td>
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<td>World Scientific Publishing Corporation.</td>
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<td>ECE53</td>
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**Prerequisite:**
- To understand the basics and vision of Ubiquitous computing
- To study the emerging technologies
- To study wireless LAN and security methods
- To analyze the performance of Intelligent systems and interworking
- To study different Ubiquitous communication networks

**Objectives**
- Ability to characterize the wireless LAN in terms of mobility and deployment
- Ability to demonstrate the performance of Ad hoc networks in terms of security issues
- Ability to examine the performance of IS systems and IN
- Knowledgeable in the types of Pervasive communication networks

**Outcome**
- Ability to characterize the wireless LAN in terms of mobility and deployment
- Ability to demonstrate the performance of Ad hoc networks in terms of security issues
- Ability to examine the performance of IS systems and IN
- Knowledgeable in the types of Pervasive communication networks

**UNIT – I**
**Ubiquitous Computing Basics and Vision**
Hours: 12
Ubiquitous or Pervasive computing-
Types of contexts-Enumeration based-Role based-Middleware and gateways-Core properties of UbiCom systems-Distributed ICT systems-Implicit Human-Computer Interaction-Autonomy-Architectural design for UbiCom systems-Ambient Computing-Elements of Pervasive Architecture-Requirements of Computational infrastructure-Ubiquitous computing applications-Standards

**UNIT – II**
**Human-Computer Interaction**
Hours: 12
Introduction- User interfaces and interaction for four widely used devices – Hidden UI via basic smart devices – Hidden UI via wearable and implanted devices – Human-centred design – User models

**UNIT – III**
**Context Aware Systems**
Hours: 12

**UNIT – IV**
**Intelligent Systems, Networks and Interworking**
Hours: 12
Introduction-Basic concepts-Types of IS-Use of intelligence in Ubiquitous Computing-IS Architectures-Types of IS models -IS Systems operation- Intelligence in Networks-IN Conceptual Model-Soft switch-Programmable Networks-Technologies and interfaces for IN.

**UNIT – V**
**Ubiquitous Communications**
Hours: 12
Audio Networks – Data Networks - Wireless data networks - Universal and Transparent Audio, Video and Alphanumeric Data Network Access-Ubiquitous Networks-Further Network Design Issues-Service Oriented Networks

**Text Books:**
2. Frank Adelstein, Sandeep K.S. Gupta,Golden G. Richard III, Loren Schweibert,

**Reference Books:**
<table>
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<tr>
<td>1. <a href="http://www.advaoptical.com">www.advaoptical.com</a></td>
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<td>2. <a href="http://www.opticsexpress.org">www.opticsexpress.org</a></td>
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<td>3. <a href="http://www.ciena.com">www.ciena.com</a></td>
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<td>4. <a href="http://www.lightreading.com">www.lightreading.com</a></td>
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<td>5. <a href="http://www.photonicsonline.com">www.photonicsonline.com</a></td>
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<td>6. <a href="http://www.tellabs.com">www.tellabs.com</a></td>
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<td>ECE72</td>
<td>VLSI for Wireless Communication</td>
<td>3</td>
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**Prerequisite**: -

### Objectives
- To introduce different receiver architectures used in wireless communication
- To introduce the design process involved in the receiver front-end
- To provide an overview of different types of mixer circuits suitable for VLSI implementation
- To introduce the different types of ADCs with reference to wireless communication
- To introduce the design process of frequency synthesizer and its blocks
- To provide an overview about the transmitter design process and architectures

### Outcome
- Ability to design the transmitter and receiver front-end
- Ability to design ADCs for wireless communication
- Ability to demonstrate the building blocks of frequency synthesizer

#### UNIT – I
**Receiver Architectures and Low Noise Amplifier**

**Receivers**: Heterodyne and Other Architectures, Filter Design, Band Selection Filter (BPF1), Image Rejection Filter (BPF2), Channel Filter (BPF3), Nonlinearity and Noise, Derivation of NF, IIP3 of Receiver FrontEnd Design: DC Bias, Gain and Frequency Response, Noise Figure, Narrowband LNA, Wideband LNA Design: Impedance Matching, Interpretation of Power Matching, Core Amplifier, Noise Figure, Power Dissipation, Trade-Off Between Noise Figure and Power, Noise Contribution from other Sources, Gain, Other Real-Life Design Considerations

**Low Noise Amplifier**
- Matching Networks, Comparisons of Narrowband and Wideband LNA, Wideband LNA
- Impedance Matching, Impedance Analysis of Narrowband Amplifier, A complete Active Mixer

#### UNIT – II
**Active Mixer**
- Unbalanced Mixer, Single Balanced Mixer, Double Balanced Mixer: Gilbert Mixer, Qualitative Description of the Gilbert Mixer, Conversion Gain, Distortion, Low Frequency and High Frequency Analysis of Gilbert Mixer, Distortion, Analysis of Noise in Unbalanced Mixer, A complete Active Mixer

**Passive Mixer**

#### UNIT – III
**Analog-To-Digital Converters**


#### UNIT – IV
**Phase/Frequency Processing Components, Loop Filter and System Design**

Phase/Frequency Processing Components: PLL-Based Frequency Synthesizer, Phase Detector/Charge Pump, Phase Frequency Detector, EXOR Phase Detector, Charge Pump, Spur, Kpd, Dividers, Survey of Different Types of Divider, A Complete Divider for DECT Application, VCO, LC Oscillators, Ring Oscillators, Phase Noise, Basic Phase Noise Models

<table>
<thead>
<tr>
<th>UNIT – V</th>
<th>TRANSMITTER ARCHITECTURES AND POWER AMPLIFIER</th>
<th>Hours: 9</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Transmitter Back End</strong>: General Discussion, Motivations and General Design Philosophy, Direct Conversion and Other Architectures, Quadrature LO Generator, Single Ended RC, Single Ended LC, R-C with Differential Stages, Polyphase I/Q Generator, Divider Based Generator <strong>Power Amplifier Design</strong>: Power Output Control, PA Design Issues, Class A Amplifiers, Class AB/B/C Amplifiers, Choice of Class A vs AB/C Amplifiers, Class E Amplifiers.</td>
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**Text Books:**


**Reference Books:**

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<tbody>
<tr>
<td>ECE73</td>
<td>Modeling and Simulation of Communication Networks</td>
<td>3 L 1 T - P 4 C 40 CA 60 SE 100 TM</td>
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</table>

**Prerequisite**
- To understand the concept of modeling
- To generate and perform the parameter estimation
- To analyze the source coding theorem
- To analyze the performance of wireless communication system
- To analyze the performance of CDMA cellular radio system

**Objectives**
- Knowledgeable in steps involved in simulation study
- Ability to demonstrate the methodology for simulating communication system operating over fading channels
- Ability to demonstrate the cellular concept of Wireless Communication Systems

**Outcome**

**UNIT – I**  
*Introduction to Modeling and Simulation*  

**UNIT – II**  
*Monte Carlo Simulation*  
Fundamental concepts, Application to communication systems, Monte Carlo Integration, Semi analytic techniques, Case study: Performance estimation of a wireless system.

**UNIT – III**  
*Lower Layer and Link Layer Wireless Modeling*  

**UNIT – IV**  
*Channel Modeling and Mobility Modeling*  

**UNIT – V**  
*Higher Layer Modeling and Modeling the Network Topology*  

**Total contact Hours: 45**  
**Total Tutorials: 15**  
**Total Practical Classes: -**  
**Total Hours: 60**

**Reference Books:**
Department: Electronics and Communication Engineering  
Programme: M.Tech. (Wireless Communication)

<table>
<thead>
<tr>
<th>Subject Code</th>
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<td>ECE74</td>
<td>Microwave Integrated Circuits</td>
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| Prerequisite | -                                      |

<table>
<thead>
<tr>
<th>Objectives</th>
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</thead>
<tbody>
<tr>
<td>To understand different technologies in MICs</td>
</tr>
<tr>
<td>To analyze the performance of planar transmission lines</td>
</tr>
<tr>
<td>To design different types of lumped elements</td>
</tr>
<tr>
<td>To study several non-reciprocal components</td>
</tr>
<tr>
<td>To study various amplifier and oscillator designs</td>
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<table>
<thead>
<tr>
<th>Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>Knowledgeable in design and fabrication of microwave devices</td>
</tr>
<tr>
<td>Ability to analyze and design various planar micro strip lines</td>
</tr>
<tr>
<td>Ability to examine different types of Microwave Integrated Circuits</td>
</tr>
<tr>
<td>Ability to characterize various non reciprocal components and active devices</td>
</tr>
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</table>

UNIT – I  
Introduction to Microwave Integrated Circuits  
Hours: 9  
MMIC technology- advantages and applications-Active device technologies-design approaches-multichip module technology-Dielectric substrates.

UNIT – II  
Lumped Elements and Non Reciprocal Components  
Hours: 9  

UNIT – III  
Analysis of Microstrip Line, Slot Line and Coplanar Waveguides  
Hours: 9  
Transmission lines-Characteristics of conventional transmission structures-Characteristics of planar transmission lines-microstrip line suspended and inverted microstrip lines-slot lines-coplanar lines-Comparison of various MIC transmission media-coupled line-discontinuities.

UNIT – IV  
Amplifiers  
Hours: 9  
Monolithic low distortion variable gain amplifier-Stability & Gain analysis-matching techniques-reactively matched amplifier design-Low Noise Amplifiers-Power amplifiers-Driver

UNIT – V  
Oscillators  
Hours: 9  
Design principles, active device CAD techniques for large signal oscillators design- phase noise-VCO-mixers-Phase detectors

Total contact Hours: 45 | Total Tutorials: 15 | Total Practical Classes: - | Total Hours: 60

Text Books:

Reference Books:
### Objectives
- To understand the integration of different traffic in one flexible network
- To distinguish the services, protocols and access schemes between different networks
- To analyze traffic management in convergent networks
- To explore the network and security management in convergent networks

### Outcome
- Ability to examine the need for convergence
- Knowledgeable in the compatibility issues among different networks
- Ability to manage the traffic in convergent networks
- Ability to implement security in convergent networks

#### UNIT – I
**Introduction**
Hours: 12

#### UNIT – II
**Network Services and Protocol Layering**
Hours: 12

#### UNIT – III
**Communication Network Functions**
Hours: 12
Addressing techniques- classification of addressing techniques- addressing structure in Internet- addressing structure in Telecom Networks. Signaling complexity in Different Networks, Classification of signaling techniques- signaling issues- Signaling models- point to multipoint signaling- ISDN signaling, Routing protocols/techniques- core routing concepts. Traffic Management: Concept of traffic, concept of service, Network capabilities, Types of traffic, Traffic Management, Traffic contract management, traffic policing, priority control, Flow control versus congestion control, Traffic Management in ATM.

#### UNIT – IV
**Network Management**
Hours: 12

#### UNIT – V
**Convergence Technologies for 3G and 4G networks**
Hours: 12

### Total contact Hours: 60 | Total Tutorials: - | Total Practical Classes: - | Total Hours: 60

### Text Books:
2. Jeffrey Bannister, Paul Mather, Sebastian Cooperative Convergence Technologies for 3G Networks: IP,
<table>
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<tr>
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</tr>
</thead>
<tbody>
<tr>
<td>2. Raj Pandya, Mobile &amp; Personal Communication system &amp; services, Prentice Hall of India.</td>
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<tr>
<th>Websites:</th>
</tr>
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<tbody>
<tr>
<td>1. <a href="http://www.informit.com">www.informit.com</a></td>
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<tr>
<td>Department:</td>
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<td>Subject Code</td>
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<tr>
<td>ECE76</td>
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<tr>
<td>Prerequisite</td>
</tr>
<tr>
<td>Objectives</td>
</tr>
<tr>
<td>Outcome</td>
</tr>
<tr>
<td>UNIT – I</td>
</tr>
<tr>
<td>- Radio Over Fiber – applications, advantages, limitations, Microwave properties of optical links, Direct modulated optical links, external modulators, types, modulation transfer in microwave fiber optic links nonlinearities.</td>
</tr>
<tr>
<td>UNIT – II</td>
</tr>
<tr>
<td>- Sub carrier Optical fiber transmission systems, Fiber optic transmission of 64-QAM, 256-QAM signals, Capacity of coaxial and fiber optic links, LASER diode and Photodiode</td>
</tr>
<tr>
<td>UNIT – III</td>
</tr>
<tr>
<td>- Analog modulation of LASER diode, LASER diode fundamentals, Rate equation analysis, Intensitymodulation, Frequency modulation, Low cost LASER diode driver, LASER diode noise and their influence on link performance.</td>
</tr>
<tr>
<td>UNIT – IV</td>
</tr>
<tr>
<td>- 3G cellular systems, cellular architecture, UMTS architecture, WCDMA ROF systems, Micro diversity, Traffic estimation, Spectral efficiency, power level, multiple user interference, ROF for Hiper LAN2, Micro cellular communication networks</td>
</tr>
<tr>
<td>UNIT – V</td>
</tr>
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<td>Total contact Hours: 60</td>
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<tr>
<td>Subject Code</td>
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<td>ECE77</td>
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</table>

**Prerequisite**

- To gain deep knowledge about satellite networks
- To understand the working of navigation, tracking and safety in satellite systems
- To comprehend the knowledge about sensors in remote sensing
- To study about the different broadcast satellite services
- To understand the IPv4 and IPv6 satellite networking systems

**Objectives**

- Knowledgeable in differentiating satellites based on their coverage and services.
- Ability to examine the necessary parameters for design of Navigation and tracking satellite systems
- Ability to develop image processing tools to process the signals from different sensors
- Knowledgeable in establishing a broadcast satellite networks for different services
- Knowledgeable in on-board processing on satellite for different data oriented networks

**Outcome**

- Knowledgeable in differentiating satellites based on their coverage and services.
- Ability to examine the necessary parameters for design of Navigation and tracking satellite systems
- Ability to develop image processing tools to process the signals from different sensors
- Knowledgeable in establishing a broadcast satellite networks for different services
- Knowledgeable in on-board processing on satellite for different data oriented networks

**UNIT – I**

**Introduction**

- Configuration of satellite communication systems – Radio regulations – useful orbit for satellite communication
- Overall link performance of Monobeam, Multibeam and Intersatellite links – Characteristics of payload
- Satellite installation in orbit - Vacuum, Mechanical environment, Radiation flux of high energy particles, Environment during installation.

**UNIT – II**

**Navigation, Tracking and Safety Systems**


**UNIT – III**

**Remote Sensing Systems and Techniques**


**UNIT – IV**

**Broadcast Systems**


**UNIT – V**

**Satellite Networking System**

- Architecture and characteristics of satellite networks – IPv6 Infrastructure - Routing and Route Management- IP networking with satellite links –On board processing - VSAT systems – TCP state machine for three way handshake connection - Use of IPv6 for satellite based access to remote WSN.

**Total contact Hours:** 60  
**Total Tutorials:** -  
**Total Practical Classes:** -  
**Total Hours:** 60

**Text Books:**

5. VASAT Networks G. Maral, John Wiley and sons.

**Reference Books:**

<p>| | |</p>
<table>
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**Websites:**

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**Department**: Electronics and Communication Engineering

**Programme**: M.Tech. (Wireless Communication)

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<tr>
<td>ECE78</td>
<td>ASIC and FPGA Design</td>
<td>3</td>
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<td></td>
<td></td>
<td></td>
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</table>

**Prerequisite**
- To study the design flow of different types of ASIC
- To familiarize with different types of programming technologies and logic devices
- To learn the architecture of different types of FPGA
- To gain knowledge about partitioning, floor planning, placement and routing including circuit extraction of ASIC
- To synthesis, simulate and test systems
- To understand the design issues of SoC
- To know about different high performance algorithms and their applications in ASICs

**Objectives**
- Ability to programme the various PLDs based on the required digital system
- Knowledgeable in the nuances of ASIC design
- Ability to design, analyse and test a digital system
- Ability to design filters and equalizers
- Knowledgeable in SoC design

**Outcome**
- To study the design flow of different types of ASIC
- To familiarize with different types of programming technologies and logic devices
- To learn the architecture of different types of FPGA
- To gain knowledge about partitioning, floor planning, placement and routing including circuit extraction of ASIC
- To synthesis, simulate and test systems
- To understand the design issues of SoC
- To know about different high performance algorithms and their applications in ASICs

**UNIT – I**

**Overview of Asic and Pld**

Types of ASICs - Design flow – CAD tools used in ASIC Design – Programming Technologies - Antifuse – static RAM – EPROM and EEPROM technology, Programmable Logic Devices: ROMs and EPROMs – PLA – PAL. Gate Arrays – CPLDs and FPGAs

**UNIT – II**

**ASIC Physical Design**


**UNIT – III**

**Logic Synthesis, Simulation and Testing**


**UNIT – IV**

**FPGA**

Logic blocks, routing architecture, Design flow technology - mapping for FPGAs, Xilinx XC4000 - ALTERA’s FLEX 8000/10000, ACTEL’s ACT-1,2,3 and their speed performance Case studies: Altera MAX 5000 and 7000 - Altera MAX 9000 – Spartan II and Virtex II FPGAs - Apex and Cyclone FPGAs

**UNIT – V**

**SOC Design**


**Reference Books**


Websites:
1. http://nptel.ac.in/courses/117106092/
2. http://staff.fit.ac.cy/com.tk/MSc-Digital/
<table>
<thead>
<tr>
<th>Course Code</th>
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<tr>
<td>ECE79</td>
<td>UMTS</td>
<td>L 4 T - P  - C 4 CA 40 SE 60 TM 100</td>
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</table>

**Prerequisite**

- To understand the trend involved in UMTS networks
- To learn about the radio network architecture and terminal features used in UMTS environment
- To comprehend the protocol aspects at different layers, services and security associated with it
- To learn and compare the various operating techniques and technology adopted in UMTS
- To gain knowledge on perspective 4G systems and its features with case studies

**Objectives**

- Ability to appreciate the features of physical layer issues pertaining to UMTS systems
- Ability to identify the technological advances in the layered architecture of the network and end user UMTS terminals
- Ability to examine the performance of protocols at different layers and security features in-built in UMTS
- Knowledgeable in operational techniques for enhancing capacity and flexibility
- Knowledgeable in forthcoming advanced technologies so as to contribute towards research

**Outcome**

**UNIT – I**  Basics of UMTS  Hours: 12


**UNIT – II**  UMTS Network and User Terminal  Hours: 12

UTRAN - UTRAN Architecture, UMTS Base Station, Radio network Controller. UMTS Core Network – Core network architecture in 3GPP, Mobility management, Communication management, Architecture aspects in 3GPP R4 and R5. UMTS Terminal – terminal architecture, Terminal capabilities, subscription and user interface.

**UNIT – III**  UMTS Protocols, services and Security Issues  Hours: 12


**UNIT – IV**  Additional Techniques for Capacity and Flexibility Enhancement  Hours: 12


**UNIT – V**  Perspective Systems of 4G and Related Topics  Hours: 12

<table>
<thead>
<tr>
<th>Mobile Virtual Network Enabler.</th>
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<td><strong>Total contact Hours:</strong> 60</td>
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**Text Books:**


**Reference Books:**

### Subject Code: ECE80

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<tr>
<td>ECE80</td>
<td>Reconfigurable Computing</td>
<td>3 1 - 4 40 60 100</td>
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</table>

**Prerequisite:**

- To understand the need for reconfigurable computing
- To learn about various device architectures
- To examine the various reconfigurable computing systems.
- To understand the different types of computing models for programming reconfigurable architectures
- To expose the students to HDL programming and familiarize with the development environment
- To understand the various placement and routing protocols
- To develop applications with FPGAs

#### Objectives

- Knowledge in device architectures used for reconfigurable computing
- Knowledgeable in HDL Programming for the Programming Reconfigurable systems
- Ability to map designs to reconfigurable platforms
- Ability to do application development with FPGAs

#### Outcome

- Case Studies of FPGA Applications – System on a Programmable Chip (SoPC) Designs.

**Reference Books:**


**Websites:**

<table>
<thead>
<tr>
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<td>ECE81</td>
<td>Cognitive Radio</td>
<td>4</td>
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<td>40 60 100</td>
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</table>

Prerequisite: -

Objectives:
- To understand essential background of SDR and CR technologies
- To discuss the relevant radio propagation channel models
- To focus on the fundamentals of spectrum management
- To study about radio spectrum regulatory policies and fundamentals of digital communication
- To know about networking aspects of CRs and security issues

Outcome:
- Ability to demonstrate the fundamental capacity limits and associated transmission techniques for different cognitive radio network paradigms
- Ability to examine the fundamental tradeoffs in spectrum sensing
- Ability to demonstrate the fundamental constraints and properties of a digital communication system of a cognitive radio
- Ability to implement cognitive radio network (CRN) architectures
- Ability to demonstrate security threats to CR networks

UNIT – I  
Cognitive Radio Technology  

UNIT – II  
Propagation Issues for Cognitive Radio  
Introduction - Generic channel response - path loss - Path loss models - Small-scale fading and the RiceanK-factor - Small-scale fading and the Doppler spectrum - Delay dispersion - Angle dispersion - Polarization - Special environments - key model parameters

UNIT – III  
Spectrum Management  

UNIT – IV  
Cognitive Radio Communication Techniques  

UNIT – V  
Cognitive Radio Network Architectures and Security  

Total contact Hours: 60  
Total Tutorials: -  
Total Practical Classes: -  
Total Hours: 60

Text Books:
**Reference Books:**

2. Bruce A. Fette *Cognitive Radio Technology* Newnes publications

Department: Electronics and Communication Engineering
Programme: M.Tech. (Wireless Communication)

Semester: Category: TY

<table>
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<td>ECE82</td>
<td>Multimedia Communication Systems</td>
<td>3 1 -</td>
<td>4</td>
<td>40 60 100</td>
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</table>

Prerequisite: -

Objectives:
- To learn the Techniques, Applications, Multimedia Networking, Multimedia characteristics-Protocols and Standards-bandwidth and compression issues in Multimedia communication
- To understand the BMP, PNG, TIFF, JPEG, DFX, AVI, MPEG Audio/ Video Standards and Compression Techniques
- To introduce the Protocols of Multimedia communication
- To understand Media on Demand
- To understand Applications of Multimedia communication

Outcome:
- Knowledgeable in Multimedia Networking, Multimedia characteristics, Protocols, and Standards-Bandwidth and compression issues
- Ability to characterize BMP, PNG, TIFF, JPEG, DFX, AVI, MPEG audio/video standards and compression techniques
- Knowledgeable in protocols of multimedia communication
- Ability to demonstrate media on demand and its applications

UNIT – I Introduction

UNIT – II Multimedia Representation and Compression Techniques

UNIT – III Protocols
Multicast over shared media network, multicast routing and addressing, scaping multicast and NBMA networks, Reliable transport protocols, TCP adaptation algorithm, RTP, RTCP.

UNIT – IV Media on Demand
IPV6, High speed switching, resource reservation, Buffer management, traffic shaping, caching, scheduling and policing, Storage and media servers, voice and video over IP, MPEG-2 over ATM/IP, indexing synchronization of requests, recording and remote control.

UNIT – V Applications
MIME, Peer-to-peer computing, shared application, video conferencing, centralized and distributed conference control, distributed virtual reality, light weight session.

Total contact Hours: 45  Total Tutorials: 15  Total Practical Classes: -  Total Hours: 60

Text Books:


### Reference Books:


### Websites:

1. [http://multimediacommunication.blogspot.in/](http://multimediacommunication.blogspot.in/)
2. [cmc.rice.edu/](http://cmc.rice.edu/)
### Subject Details

**Department:** Electronics and Communication Engineering  
**Programme:** M.Tech. (Wireless Communication)  
**Semester:**  
**Category:** TY  

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<tr>
<td>ECE83</td>
<td>Network Management</td>
<td>4 - - 4</td>
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<td>60 100</td>
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</table>

**Prerequisite:** -

**Objectives**
- To learn about the fundamentals of wireless communication  
- To study the architectures of different wireless networks  
- To understand the concepts of LTE and Femtocells  
- To gain knowledge on ubiquitous computing  
- To be aware of the emerging technologies in wireless communication

**Outcome**
- Ability to analyze the concepts of different emerging wireless technologies  
- Knowledgeable in Femtocell concepts and LTE evolution  
- Knowledgeable in the concepts of ubiquitous computing  
- Knowledgeable in concepts of intelligent system and its application  
- Ability to demonstrate the ideas of smart devices and their interoperability

#### UNIT – I
**Emerging Technologies**  
Hours: 12
- Bluetooth  
- Radio frequency Identification  
- Wireless Broadband (WiMAX)  
- Mobile IP  
- Internet Protocol Version 6  
- Wireless Application Protocol  
- MMS  
- GPRS and Packet Data Networks  
- Architecture – Operations and Services

#### UNIT – II
**LTE and Femtocell**  
Hours: 12

#### UNIT – III
**Ubiquitous Communication**  
Hours: 12
- Wireless Networks – Power line communication – Personal Area Networks – Mobile user networks – Ad hoc networks – Sensor Networks – Service Oriented networks – Content based Networks – Overlay Networks – Heterogeneous networks

#### UNIT – IV
**Intelligent Autonomous Communication**  
Hours: 12

#### UNIT – V
**Future Trends**  
Hours: 12

**Text Books:**
1. Stefan Poslad, Ubiquitous Computing, John Wiley & Sons, 2010  

**Websites**
<table>
<thead>
<tr>
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<th>Subject</th>
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<th>Credit</th>
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<tr>
<td>ECE84</td>
<td>Ultra Wide Band Communication</td>
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</table>

**Prerequisite**
- 

**Objectives**
- To learn about the basics of UWB Technology
- To understand the signal processing in UWB communication
- To be aware of UWB applications

**Outcome**
- Knowledgeable in UWB channel modeling
- Ability to examine UWB signal processing technology
- Ability to design UWB antennas
- Knowledgeable in UWB regulations

**UNIT – I**  
**Introduction to UWB**  
Hours: 9  
History, Definition, FCC Mask, UWB features, UWB Interference: IEEE 802.11.a Interference, Signal to Interference ratio calculation, Interference with other wireless services. Impulse Radio, Pulsed Multiband, Multiband OFDM, features: Complexity, Power Consumption,

**UNIT – II**  
**UWB Technologies and Channel Models**  
Hours: 9  

**UNIT – III**  
**UWB Signal Processing**  
Hours: 9  
Data Modulation schemes, UWB Multiple Access Modulation, BER, Rake Receiver, Transmit-Reference (T-R) Technique, UWB Range- Data Rate Performance, UWB Channel Capacity UWB Wireless Locationing: Position Locationing Methods, Time of Arrival Estimation, NLOS Location Error, Locationing with OFDM.

**UNIT – IV**  
**UWB Antennas**  
Hours: 9  
Antenna Requirements, Radiation Mechanism of the UWB Antennas, Types of Broadband antennas, Parameters, Analysis of UWB Antennas, Link Budget for UWB System. Design examples of broadband UWB antennas.

**UNIT – V**  
**UWB Applications and Regulations**  
Hours: 9  
Wireless Ad hoc Networking, UWB Wireless Sensor, RFID, Consumer Electronics and Personal, Asset Location, Medical applications UWB Regulation and standards in various countries, UWB Regulation in ITU, IEEE Standardization

**Total contact Hours:** 45  
**Total Tutorials:** 15  
**Total Practical Hours:** -  
**Total Hours:** 60

**Text Books:**

**Reference Books:**
### Department: Electronics and Communication Engineering  
**Programme:** M.Tech. (Wireless Communication)

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<td></td>
<td>TY</td>
<td>ECE85</td>
<td>Digital Communication Receivers</td>
<td>3 1 - 4</td>
<td>40 60 100</td>
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**Prerequisite:** -

**Objectives**
- To gain knowledge in receivers under AWGN and fading channels
- To understand the significance of synchronization and adaptive equalization

**Outcome**
- Ability to design and demonstrate the performance of receivers in AWGN and fading channels
- Ability to demonstrate any synchronization technique
- Knowledgeable in various algorithms used for adaptive equalization

**UNIT – I**  
**Review of Digital Communication Techniques**  
**Hours:** 9

- Base band communication; signal space representation, linear and nonlinear modulation techniques, Error tracking and Spectral characteristics of digital modulation.

**UNIT – II**  
**Optimum Receivers for AWGN Channel**  
**Hours:** 9

- Correlation demodulator, matched filter, maximum likelihood sequence detector, optimum receiver for CPM signals, M-ary orthogonal signals, envelope detectors for M-ary and correlated binary signals.

**UNIT – III**  
**Receivers for Fading Channels**  
**Hours:** 9

- Characterization of fading multiple channels, statistical models, flat and frequency selective fading, diversity technique, Optimal receivers for data detection and synchronization parameter estimation, coded waveform for fading channel.

**UNIT – IV**  
**Synchronization Techniques**  
**Hours:** 9

- Carrier and signal synchronization, carrier phase estimation-PLL, Decision directed loops, symbol timing estimation, maximum likelihood and non-decision directed timing estimation, joint estimation.

**UNIT – V**  
**Adaptive Equalization**  
**Hours:** 9


**Total contact Hours:** 45  
**Total Tutorials:** 15  
**Total Practical Classes:** -  
**Total Hours:** 60

### Reference Books:
**Subject Code**: ECE86  
**Subject**: Space Time Wireless Communication  
**Hours / Week**: 3 1 -  
**Credit**: 4  
**Maximum Marks**: 40 60 100

### Prerequisite
-  

### Objectives
- To understand multiple antenna propagation  
- To learn about MIMO channels  
- To gain knowledge on spatial diversity  
- To understand the significance of coding and MIMO techniques

### Outcome
- Knowledgeable in fading and MIMO channels  
- Ability to examine antenna diversity  
- Ability to demonstrate the antenna coding and multiuser detection

#### UNIT – I
**Multiple Antenna Propagation and St Channel Characterization**  
**Hours**: 9

Wireless channel, Scattering model in macrocells, Channel as a ST random field, Scattering functions, Polarization and field diverse channels, Antenna array topology, Degenerate channels, reciprocity and its implications, Channel definitions, Physical scattering model, Extended channel models, Channel measurements, sampled signal model, ST multiuser and ST interference channels, ST channel estimation.

#### UNIT – II
**Capacity of Multiple Antenna Channels**  
**Hours**: 9

Capacity of frequency flat deterministic MIMO channel: Channel unknown to the transmitter, Channel known to the transmitter, capacity of random MIMO channels, Influence of ricean fading, fading correlation, XPD and degeneracy on MIMO capacity, Capacity of frequency selective MIMO channels.

#### UNIT – III
**Spatial Diversity**  
**Hours**: 9

Diversity gain, Receive antenna diversity, Transmit antenna diversity, Diversity order and channel variability, Diversity performance in extended channels, Combined space and path diversity ,Indirect transmit diversity, Diversity of a space-time-frequency selective fading channel.

#### UNIT – IV
**Multiple Antenna Coding and Receivers**  
**Hours**: 9

Coding and interleaving architecture, ST coding for frequency flat channels, ST coding for frequency selective channels, Receivers(SISO,SIMO,MIMO),Iterative MIMO receivers, Exploiting channel knowledge at the transmitter: linear pre-filtering, optimal pre-filtering for maximum rate, optimal pre-filtering for error rate minimization, selection at the transmitter, Exploiting imperfect channel knowledge.

#### UNIT – V
**ST OFDM, Spread Spectrum and MIMO Multiuser Detection**  
**Hours**: 9


### Total contact Hours: 45  
### Total Tutorials: 15  
### Total Practical Classes: -  
### Total Hours: 60

### Reference Books:
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<tr>
<td>PHE51</td>
<td>Nanotechnology and its Applications</td>
<td>4 - - 4</td>
<td>40</td>
<td>60 100</td>
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</table>

**Prerequisite**

- To understand the size effect
- To introduce the changes in the dimension of the material from 3D to zero dimension
- To study the latest characterisation techniques and instrumentation
- To analyse the changes in microelectronics to nano electronics
- To apply size effect for nano sensors and nano devices

**Objectives**

- Quantum mechanical knowledge about reduced size, wave nature and discrete energy of nano system
- Ability to analyse dimensional changes from three dimension to zero dimension in the energy and density of states
- Understanding of spectroscopic, optical and electroanalytical Characterization
- techniques of nanomaterials
- Analysis of basic principles of micro electronics to nano electronics
- Application of size effect to devices and sensor
- Ability to implement the construction and working of devices based on size effect

**Outcome**

UNIT – I

**Basic Properties of Nanoparticles**

Introduction -Size effect and properties of nanoparticles - particle size - particle shape - particle density - melting point, surface tension, wettability - specific surface area and pore size – Reason for change in optical properties, electrical properties, and mechanical properties – advantages.

UNIT – II

**Nanostructures-One Dimension and Zero Dimension**

Nanotube properties- Single walled and Multi walled Nanotubes (SWNT and MWNT) - synthesis and purification -pyrolysis and arc discharge method- Quantum dots-Nanolithography and Lithography techniques.

UNIT – III

**Mobile Data Networks**


UNIT – IV

**Nanoelectronics**

Overview of basic nanoelectronic technologies-single electron devices-quantum mechanical tunnelling devices-spin nanoelectronics (spintronics)-Molecular electronics-molecular devices-Transistor from micro to nano and Nano-MOSFETS

UNIT – V

**Nanodevices**

Nano sensors-Molecular nano machines-Micro-electro mechanical systems(MEMS) &NEMS-Nanotechnology for data storage-Magnetic storage-High density quantised magnetic disks-MRAMS.

**Text Books:**

3. Nanostructured materials and nanotechnology, Concise Edition, Editor:- Hari Singh Nalwa; Academic


6. Textbook of Nanoscience and Nanotechnology, B.S. Murty, P. Shankar, BaldevRaj,


**Reference Books:**

**Department**: Electronics and Communication Engineering  
**Programme**: M.Tech (Wireless Communication)  

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<th>Credit</th>
<th>Maximum Marks</th>
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<tr>
<td>EC162</td>
<td>Wireless Communication and Networking Laboratory</td>
<td>-</td>
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</table>

**Prerequisite**: -

**Objectives**:
- To understand the working of communication system models
- To understand and implement application using embedded development board
- To simulate the different channel models for wireless networks

**Outcome**:
- Ability to demonstrate the design of modulator and antenna used for wireless communication
- Ability to implement the GSM and HTTP data transfer using Qualnet software and study the different parameters of the network
- Ability to design simple digital systems using Spartan6 FPGA board
- Ability to design filters suitable for wireless channel

**LIST OF EXPERIMENTS**

13. Design of GMSK modulator for GSM system.
14. Study of wireless sensor network using NI Labview
15. Study and comparison of various wireless channel models
16. Call establishment using different entities of GSM network using Qualnet.
17. Development of a network to run HTTP application using Qualnet.
18. Developing any one network topology, establishing a routing protocol and analysing using NS2.
20. Designing Yagi antenna and study the Return loss magnitude and phase characteristics
21. FFT of real time input signals using DSP trainer kits.
22. Simulation of OFDM transmitter and receiver in Matlab.
23. Study of Spartan6 FPGA and perform the following operations
   - Activating the traffic light controller interface
   - Enabling the Keypad Matrix interface with LEDs.
   - Enabling the graphic LCD interface in Spartan6 FPGA.
   - Design and implementation of Manchester encoder.

**Total contact Hours**: -  
**Total Tutorials**: -  
**Total Practical Classes**: 45  
**Total Hours**: 45