KERALA TECHNOLOGICAL UNIVERSITY

SCHEME AND SYLLABI FOR M. Tech in APPLIED ELECTRONICS AND COMMUNICATION SYSTEM

(2015 Admission onwards)
## SEMESTER 1

<table>
<thead>
<tr>
<th>Sl No</th>
<th>Course No</th>
<th>Name</th>
<th>Hours / Week</th>
<th>Marks</th>
<th>Duration (hrs)</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>09EC61</td>
<td>Mathematics for Communication Engineering</td>
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<td>60</td>
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<td>2.</td>
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<td>DSP System Design</td>
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<td>3.</td>
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L-Lecture; T-Tutorial; P-Practical;

**Elective I**
- 09EC6115 : Information Theory
- 09EC6125 : Adaptive Signal Processing
- 09EC6135 : System Design using Embedded Processors
- 09EC6145 : Advanced Optical Communication Systems
- 09EC6155 : Microwave Components and Networks
SEMMESTER II

<table>
<thead>
<tr>
<th>Sl No</th>
<th>Course No</th>
<th>Name</th>
<th>Hours / Week</th>
<th>Internal marks</th>
<th>End Semester Exam</th>
<th>Credits</th>
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<tr>
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L-Lecture; T-Tutorial; P-Practical

+ Elective II
09EC6116 : Multirate Signal Processing
09EC6126 : Spread Spectrum and CDMA Systems
09EC6136 : Speech and Audio Processing
09EC6146 : Ad Hoc & Sensor Networks
09EC6156 : Global positioning systems

++Elective III
09EC6166 : Power Electronics
09EC6176 : Electronics System design
09EC6186 : ASIC Design
09EC6196 : Nano Electronics

SEMMESTER III

<p>| Sl | Hours / Week | Internal | End Semester |
|----|--------------|----------|--------------|--------------|
| 3  | 116          |          |              |              |</p>
<table>
<thead>
<tr>
<th>No</th>
<th>Course No</th>
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<th>Weeks</th>
<th>Marks</th>
<th>Exam</th>
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<tr>
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L-Lecture; T-Tutorial; P-Practical

**ELECTIVE IV**

09EC7117: Signal Compression Techniques
09EC7127: Biomedical Signal Processing
09EC7137: Markov Modeling and Queuing Theory
09EC7147: DSP Algorithms and Architectures
09EC7157: High Performance Networks

**ELECTIVE V**

09EC7167: Linear Systems Theory
09EC7177: Optimization Techniques
09EC7187: Secure Communication
09EC7197: Information Hiding and Data Encryption

**SEMESTER IV**

<table>
<thead>
<tr>
<th>Sl</th>
<th>Course No</th>
<th>Name</th>
<th>Hours / Week</th>
<th>Internal marks</th>
<th>End Semester Exam</th>
<th>Credits</th>
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<tr>
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**EXAMINATION PATTERN**

1. **Theory Subjects**

The examination pattern for all theory subjects is as given below.
Internal Continuous Assessment: 40 marks

Internal continuous assessment is in the form of periodical tests, assignments, seminars or a combination of all whichever suits best. There will be two tests per subject. The assessment details are to be announced to the students, right at the beginning of the semester by the teacher.

End Semester Examination: 60 marks

2. Laboratory Subjects

The details of the internal assessment for each laboratory subject are as given below.

<table>
<thead>
<tr>
<th>Assessment Type</th>
<th>Marks</th>
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<tbody>
<tr>
<td>Mid Term Internal Test</td>
<td>40</td>
</tr>
<tr>
<td>Laboratory Experiments &amp; Viva Voce</td>
<td>10</td>
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<tr>
<td>Final Internal Test</td>
<td>50</td>
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<td><strong>Total</strong></td>
<td><strong>100</strong></td>
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</table>

3. Seminar/ Mini Projects

Seminar shall be evaluated by the evaluation committee based on the relevance of topic, content depth and breadth, communication skill, question answering etc on the power point presentation of the topic by the student.

Mini Projects shall be evaluated by the evaluation committee based on the demonstration of the project as well as power point presentation of the same.
SEMESTER I

Course No: 09EC6111
Course Title: MATHEMATICS FOR COMMUNICATION ENGINEERING
Credits: 4-0-0: 4 Year: 2015
Pre-requisites: Nil

Objective: This course is intended to provide the necessary Mathematical foundation needed for the subjects to be dealt with in the program. After the completion of the course, the student should have a thorough understanding of Linear Algebra, Random Processes and their applications.

Syllabus:


Course Outcome:

The student will have a thorough understanding of Linear Algebra, Random Processes and their applications.

References:

Internal continuous assessment: 40 marks
i) Two internal tests : 2 x 15 = 30 Marks
ii) Tutorials/Assignments = 10 Marks

End semester Examination: 60 marks

COURSE PLAN
### Course No: 09EC6111 Title: MATHEMATICS FOR COMMUNICATION ENGINEERING

(L-T-P): 4-0-0 Credits :4

<table>
<thead>
<tr>
<th>Module</th>
<th>Contact hours</th>
<th>% marks in ESE</th>
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</thead>
<tbody>
<tr>
<td>Module I: Linear Algebra: Vector spaces, subspaces, Linear dependence, Basis and Dimension, Inner product spaces, Gram-Schmidt Orthogonalization Procedure, Linear transformations, Kernels and Images, Matrix representation of linear transformation, Change of basis, Eigen values and Eigen vectors of linear operator, Quadratic form.</td>
<td>14</td>
<td>25</td>
</tr>
<tr>
<td>Module II: Operations on random variables: Random Variables, Distributions and Density functions, Moments and Moment generating function, Multivariate distributions,</td>
<td>7</td>
<td>12</td>
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</table>

#### FIRST INTERNAL TEST


#### SECOND INTERNAL TEST


<table>
<thead>
<tr>
<th>Module IV</th>
<th>Contact hours</th>
<th>% marks in ESE</th>
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<tbody>
<tr>
<td></td>
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#### END SEMESTER EXAMINATION

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Course No: 09EC6121  
Course Title: DSP SYSTEM DESIGN  
Credits: 4-0-0: 4 Year : 2015  
Pre-requisites: Nil
Objective: The aim of the paper is to introduce to the students the architectural features as well as the programming aspects of the latest DSPs available in the market. The students at the end of the course should be able to choose the appropriate processor for a given application environment and should be in a position to design stand alone systems based on DSPs, given a set of specifications.

Syllabus:

Course Outcome:
Students will have a familiarization of different DSP processors and its architectures. Current trends in MATLAB.

Text Books:
4. Rulf Chassaing, Digital Signal Processing and Application with C6713 and C6416 DSK, Wiley-Interscience Publication

References:
1. Rulph Chassaing, DSP Applications using ‘C’ and the TMS320C6X DSK, 1st Edition;

Internal continuous assessment: 40 marks
i) Two internal tests : 2 x 15 = 30 Marks
ii) Tutorials/Assignments = 10 Marks

End semester Examination: 60 marks
# COURSE PLAN

Course No: 09EC61 21 Title: DSP SYSTEM DESIGN

(L-T-P): 4-0-0 Credits :4

<table>
<thead>
<tr>
<th>Module</th>
<th>Contact hours</th>
<th>% marks in ESE</th>
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<tbody>
<tr>
<td>Module I</td>
<td>14</td>
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<table>
<thead>
<tr>
<th>Module II (14 Hours)</th>
<th>7</th>
<th>13</th>
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<tbody>
<tr>
<td>Sharc Digital Signal Processor: A popular DSP from Analog Devices - Sharc/ Tiger Sharc/ Blackfin (one of them) - Architecture - IOP Registers - Peripherals</td>
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</table>

FIRST INTERNAL TEST

- Synchronous Serial Port - Interrupts - Internal/External/Multiprocessor Memory Space - Multiprocessing - Host Interface - Link Ports.  

<table>
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<th>Module III (13 Hours)</th>
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SECOND INTERNAL TEST

<table>
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<th>Module IV (10 Hours)</th>
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<th>25</th>
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<tr>
<td>Current trends: Current trend in Digital Signal Processor or DSP Controller- Architecture and their applications.</td>
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END SEMESTER EXAMINATION
Course No: 09EC61 31
Course Title: ADVANCED DIGITAL COMMUNICATION
Credits: 4-0-0: 4 Year: 2015
Pre-requisites: Nil

Objective:

To provide in-depth treatment on methods and techniques in

- Representation of signals and spectra
- Formatting, baseband and M-ary modulation/demodulation
- Synchronization

Syllabus:

Digital communication system, Pulse amplitude modulation (binary and M-ary, QAM), Continuous phase modulation (QPSK and variants, MSK, GMSK), Coherent and non-coherent demodulation, Optimum rule for ML and MAP detection Performance, Pulse shape design for channels with ISI, Performance: Symbol by symbol detection and BER, Viterbi algorithm, synchronization techniques, Characteristics of fading channels, Rayleigh and Rician channels, receiver performance-average SNR, outage probability.

Course Outcome:

Students will be able to

- Understand the basic theory of digital communications and the most common digital communications techniques
- Understand the working principles of basic building blocks of a digital communication system.
- Identify methods of digital modulation and compare their performance using signal-space analysis.
- Understand and apply suitable digital modulation schemes for various engineering applications and measure the Error Probability
- Understand receiver techniques for detection of a signal in AWGN channel.

TEXTBOOKS:

REFERENCES:

8. Couch, Analog and Digital Communication, 5th Ed, PHI

Internal continuous assessment: 40 marks

i) Two internal tests : 2 x 15 = 30 Marks
ii) Tutorials/Assignments = 10 Marks

End semester Examination: 60 marks

Answer any 6 questions by choosing at least one question from each module.

COURSE PLAN

<table>
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<th>Course No: 09EC6131 Title: ADVANCED DIGITAL COMMUNICATION</th>
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<table>
<thead>
<tr>
<th>Module</th>
<th>Contact hours</th>
<th>% marks in end semester exam</th>
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<tbody>
<tr>
<td>Module I: Digital communication system (description of different modules of the block diagram), Complex baseband representation of signals, Gram-Schmidt orthogonalization procedure. M-ary orthogonal signals, bi-orthogonal signals, simplex signal waveforms. Pulse amplitude modulation (binary and M-ary, QAM), Pulse position modulation (binary and M-ary), Carrier modulation (M-</td>
<td>14</td>
<td>25</td>
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</tbody>
</table>
ary ASK, PSK, FSK, DPSK), Continuous phase modulation (QPSK and variants, MSK, GMSK).

Module II: Coherent and non-coherent demodulation: Matched filter, Correlator demodulator, square-law, and envelope detection.

**FIRST INTERNAL TEST**
Detector: Optimum rule for ML and MAP detection
Performance: Bit-error-rate, symbol error rate for coherent and non-coherent schemes.

Module III: Pulse shape design for channels with ISI: Nyquist pulse, Partial response signaling (duo binary and modified duo binary pulses), demodulation; Channel with distortion: Design of transmitting and receiving filters for a known channel and for time varying channel (equalization); Performance: Symbol by symbol detection and BER, symbol and sequence detection, Viterbi algorithm

**SECOND INTERNAL TEST**
Module IV: Different synchronization techniques (Early-Late Gate, MMSE, ML and spectral line methods). Characteristics of fading channels, Rayleigh and Rician channels, receiver performance-average SNR, outage probability, amount of fading and average bit/symbol error rate.

**END SEMESTER EXAMINATION**

Course No: 09EC61 41
Course Title: COMMUNICATION NETWORKS
Credits: 3-0-0: 3 Year : 2015
Pre-requisites: Nil

Objective:

*This course provides a deep knowledge on Internet architecture, Quality of service issues in broad band networks, and Statistical multiplexing of communication networks.*

Syllabus:

Internet Architecture: Application layer, Transport layer, Network layer, Link Layer-protocol stack. Broadband services and Quality of Service issues in networks-Queuing Disciplines - Weighted Fair Queuing - Random Early Detection - Differentiated Services - Multi protocol Label switching - Discrete time and continuous time Markov chains- Poisson process- Queuing models for Datagram networks- M/M/1 queuing systems- M/M/m/m queuing models- M/G/1 queue- Mean value analysis, Statistical Multiplexing in Communication Networks.
Course Outcome:

After completing this course the student must demonstrate the knowledge and ability to:

- Independently understand basic computer network technology.
- Understand and explain Data Communications System and its components.
- Identify the different types of network topologies and protocols.
- Enumerate the layers of the OSI model and TCP/IP. Explain the function(s) of each layer.
- Identify the different types of network devices and their functions within a network
- Understand and building the skills of subnetting and routing mechanisms.

Familiarity with the basic protocols of computer networks, and how they can be used to assist in network design and implementation

References:


Internal continuous assessment: 40 marks

i) Two internal tests : 2 x 15 = 30 Marks
ii) Tutorials/Assignments = 10 Marks

End semester Examination: 60 marks

Answer any 6 questions by choosing at least one question from each module.
## Course Plan

<table>
<thead>
<tr>
<th>Course No: <strong>09EC6141</strong></th>
<th>Title: <strong>COMMUNICATION NETWORKS</strong></th>
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<tr>
<th>Module</th>
<th>Contact hours</th>
<th>% marks in end semester exam</th>
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</thead>
<tbody>
<tr>
<td>Module I: Internet Architecture: Architectural concepts in ISO’s OSI layered model, layering in the Internet. TCP/IP protocol stack. Transport layer - TCP and UDP. Network layer - IP, routing, internetworking. Data link layer - ARQ schemes, multiple access, LANs.</td>
<td>9</td>
<td>25</td>
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<tr>
<td>Module II: Broadband services and QoS issues: Quality of Service issues in networks- Integrated service architecture- Queuing Disciplines- Weighted Fair Queuing - RandomEarly Detection.</td>
<td>6</td>
<td>13</td>
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<tr>
<td><strong>FIRST INTERNAL TEST</strong></td>
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<tr>
<td>Differentiated Services- Protocols for QS support-Resource reservation-RSVP- Multi protocol Label switching- Real Time transport protocol.</td>
<td>5</td>
<td>12</td>
</tr>
<tr>
<td>Module III: Introduction to Queuing theory: Markov chain- Discrete time and continuous timeMarkov chains- Poisson process- Queuing models for Data gram networks- Little’s theorem- M/M/1 queuing systems- M/M/m/m queuing models- M/G/1 queue- Mean value analysis.</td>
<td>12</td>
<td>25</td>
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**SECOND INTERNAL TEST**
Module IV:
Statistical Multiplexing in Communication Networks:

END SEMESTER EXAMINATION

ELECTIVE I

Course No: 09EC6115
Course Title: INFORMATION THEORY
Credits: 3-0-0: 3       Year : 2015
Pre-requisites: Nil

Objective:

*Gives a detailed concept in Information Theory. Upon completion of this course, the student will have a deep understanding of*

- Information and its measurement
- Various source coding schemes
- Concept of Channel capacity for both discrete and continuous channels and Shannon’s theorems
- Rate distortion theory and its applications

Syllabus:

Information and source, Entropy, Mutual and conditional mutual information, source coding techniques, channel capacity, continuous sources and channels, information measures, Rate Distortion Theory, properties.

Course Outcome:

The students will be able to:

- Understand and apply fundamental concepts in information theory such as probability, entropy, information content and their inter-relationships.
- Understand the principles of data compression.
- Compute entropy and mutual information of random variables.
- Implement and analyse basic coding and compression algorithms.
• Understand the relationship of information theoretical principles and Bayesian inference in data modelling and pattern recognition.

• Understand some key theorems and inequalities that quantify essential limitations on compression, communication and inference.

• Know the basic concepts regarding communications over noisy channels.

References:
1. T. Cover and Thomas, “Elements of Information Theory”, John Wiley & Sons
4. T. Bergu, “Rate Distortion Theory a Mathematical Basis for Data Compression” PH Inc.

Internal continuous assessment: 40 marks

   ii) Two internal tests : 2 x 15 = 30 Marks

   iii) Tutorials/Assignments = 10 Marks

End semester Examination: 60 marks

Answer any 6 questions by choosing at least one question from each module.
## COURSE PLAN

<table>
<thead>
<tr>
<th>Module</th>
<th>Contact hours</th>
<th>% marks in end semester exam</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Module I:</strong> Information and Sources: Zero Memory sources- Concepts of entropy-Extension of a Zero memory source-Markov information sources- Entropy calculation- Entropy of a discrete Random variable- Joint, conditional and relative entropy- Mutual Information and conditional mutual information.</td>
<td>10</td>
<td>25</td>
</tr>
<tr>
<td><strong>Module II:</strong> Source Coding: Uniquely decodable codes- Instantaneous codes- Kraft’s inequality– McMillan’s inequality-Average length of a code- Optimal codes- Shannon codes - Fano codes.</td>
<td>5</td>
<td>13</td>
</tr>
<tr>
<td><strong>FIRST INTERNAL TEST</strong> Huffman Coding –Optimality of Huffman Codes-Lempel Ziv codes-Shannon’s source coding theorem–Arithmetic coding.</td>
<td>4</td>
<td>12</td>
</tr>
<tr>
<td><strong>Module III:</strong> Channel Capacity: Properties-Data transmission over Discrete Memoryless Channels-Capacity of Binary symmetric and Binary Erasure channels-Computing channel capacity-Arimoto-Blahut algorithm-Fano’s inequality- Shannon’s Channel Coding Theorem</td>
<td>11</td>
<td>25</td>
</tr>
<tr>
<td><strong>SECOND INTERNAL TEST</strong> Module IV: Continuous Sources and Channels: Information measure for Continuous sources and channels-Differential Entropy- Joint, relative and conditional differential entropy- Mutual information- Waveform channels- Gaussian channels- Mutual information and Capacity calculation for Band limited Gaussian channels- Shannon limit.</td>
<td>12</td>
<td>25</td>
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<tr>
<td>Rate Distortion Theory: Rate Distortion Function - Properties – Calculation of Rate Distortion Function for binary source Gaussian</td>
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</table>
Course No: 09EC6125
Course Title: ADAPTIVE SIGNAL PROCESSING
Credits: 3-0-0: 3 Year: 2015
Pre-requisites: Nil

Objective:

- To introduce adaptive systems
- To understand the filter design related to adaptive signal processing
- To introduce different algorithms to implement adaptive signal processing
- Application of adaptive signal processing

Syllabus:

Introduction to Adaptive systems; Wiener – Hopf equation; Searching performance surface-stability and rate of convergence LMS algorithm convergence of weight vector; lattice structure; adaptive filters with orthogonal signals; Applications of filters.

Course Outcome:

Students who successfully complete this course will have demonstrated ability to understand the fundamental concepts of adaptive systems; apply the concepts in filter design related to adaptive signal processing.

References:

2. Simon Haykin, Adaptive Filter Theory, Pearson Education.

Internal continuous assessment: 40 marks
i) Two internal tests : 2 x 15 = 30 Marks
ii) Tutorials/Assignments = 10 Marks

End semester Examination: 60 marks

Answer any 6 questions by choosing at least one question from each module.
# COURSE PLAN

<table>
<thead>
<tr>
<th>Course No: 09EC6125</th>
<th>Title: ADAPTIVE SIGNAL PROCESSING</th>
<th>(L-T-P): 3-0-0 Credits :3</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Module</th>
<th>Contact hours</th>
<th>% marks in end semester exam</th>
</tr>
</thead>
<tbody>
<tr>
<td>Module II: Searching performance surface-stability and rate of convergence - learning curve- gradient search - Newton's method</td>
<td>5</td>
<td>12</td>
</tr>
<tr>
<td><strong>FIRST INTERNAL TEST</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Method of steepest descent - comparison - gradient estimation - performance penalty - variance - excess MSE and time constants - maladjustments</td>
<td>5</td>
<td>13</td>
</tr>
<tr>
<td><strong>SECOND INTERNAL TEST</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Module IV: Applications-adaptive modelling and system identification-adaptive modelling for multipath communication channel, geophysical exploration, FIR digital filter synthesis, inverse adaptive modelling, equalization, and deconvolution-adaptive equalization of telephone channels-adapting poles and zeros for IIR digital filter synthesis</td>
<td>11</td>
<td>25</td>
</tr>
</tbody>
</table>

---

**Course No: 09EC6135**  
**Course Title: SYSTEM DESIGN USING EMBEDDED PROCESSORS**  
**Credits: 3-0-0: 3**  
**Year : 2015**  
**Pre-requisites: Nil**  

**Objective:**
- To introduce embedded systems
- To understand the Overview of embedded system architecture
- To introduce Cortex-M3/M4 Programming:
- Application of embedded systems

**Syllabus**


**Course Outcome:**

Students who successfully complete this course will have embedded system and its architecture concepts.

**TEXT BOOKS:**


**REFERENCES:**


**Internal continuous assessment: 40 marks**

i) Two internal tests : 2 x 15 = 30 Marks

ii) Tutorials/Assignments = 10 Marks

**End semester Examination: 60 marks**

Answer any 6 questions by choosing at least one question from each module.

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**COURSE PLAN**

<table>
<thead>
<tr>
<th>Course No: <strong>09EC6135</strong></th>
<th>Title: <strong>SYSTEM DESIGN USING EMBEDDED PROCESSORS</strong></th>
</tr>
</thead>
<tbody>
<tr>
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<td>(L-T-P): 3-0-0 Credits :3</td>
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<table>
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<tr>
<th>Module</th>
<th>Contact hours</th>
<th>% marks in end semester exam</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Module I</strong> Embedded Concepts: Introduction to embedded systems, Application Areas, Categories of embedded systems, Overview of embedded system architecture, Specialties of embedded systems, recent trends in embedded systems,</td>
<td>11</td>
<td>25</td>
</tr>
</tbody>
</table>

### Module II

### FIRST INTERNAL TEST
NVIC: Nested Vectored Interrupt Controller Overview, Basic Interrupt Configuration, Software Interrupts and SYSTICK Timer. Interrupt Behavior: Interrupt/Exception Sequences, Exception Exits, Nested Interrupts, Tail-Chaining Interrupts, Late Arrivals and Interrupt Latency.

### Module III

### SECOND INTERNAL TEST
Module IV
Cortex-M3/M4 Microcontroller, STM32L15xxx ARM Cortex M3/M4 Microcontroller: Memory and Bus Architecture, Power Control, Reset and Clock Control. STM32L15xxx Peripherals: GPIOs, System Configuration Controller, NVIC, ADC, Comparators, GP Timers, USART. Development & Debugging Tools: Software and Hardware tools like Cross Assembler, Compiler, Debugger, Simulator, In-Circuit Emulator (ICE), Logic Analyzer etc.

### END SEMESTER EXAMINATION
Course No: 09EC6145
Course Title: ADVANCED OPTICAL COMMUNICATION SYSTEMS
Credits: 3-0-0: 3 Year: 2015
Pre-requisites: Nil

Objectives:

- To introduce the terminology used in optical fibers
- To describe the building blocks of an Optical Fiber system and to give clear understanding of various components such as Optical fibers, Optical sources, Photo-detectors and fiber amplifiers
- To introduce loss and dispersion management
- To introduce coherent and multichannel systems

Syllabus:

Introduction to optical communication: Evolution of Light wave systems, system components, Dispersion in fibers, fiber losses non-linear effects, Optical Transmitters and Receivers: Transmitters basic concepts, LED's structures, Spectral distributions, semiconductor lasers, Modulation, Transmitter design, PIN and APD diode structures, Advanced Lightwave Systems: Homodyne and heterodyne detectors, Multichannel Systems.
Course Outcome:
Fundamentals, advantages and advances in optical communication system. Types, basic properties and transmission characteristic of optical fibers. Knowledge of working and analysis of optical amplifiers and important parts at the transmitter (Semiconductor lasers/LEDs, modulators etc) as well as at the receiver sides (optical detector etc.) of the optical communications system. Configuration and architecture of coherent optical communication, advanced system techniques and nonlinear optical effects and their applications.

References:


Internal continuous assessment: 40 marks

i) Two internal tests : 2 x 15 = 30 Marks
ii) Tutorials/Assignments = 10 Marks

End semester Examination: 60 marks

Answer any 6 questions by choosing at least one question from each module.
# Course Plan

<table>
<thead>
<tr>
<th>Course No: 09EC6145</th>
<th>Title: ADVANCED OPTICAL COMMUNICATION SYSTEMS</th>
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<tr>
<th>Module</th>
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<tr>
<td><strong>Module I</strong></td>
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<tr>
<td><strong>INTRODUCTION TO OPTICAL COMMUNICATION</strong></td>
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</tr>
<tr>
<td>Evolution of Light wave systems, System components, Optical fibers - Step Index &amp; Graded index - Mode theory, Fiber modes – Dispersion in fibers, Limitations due to dispersion - Fiber Losses Non-linear effects</td>
<td>10</td>
<td>25</td>
</tr>
<tr>
<td><strong>Module II</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>OPTICAL TRANSMITTERS AND RECEIVERS</strong></td>
<td></td>
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</tr>
<tr>
<td>Transmitter’s basic concepts - LED's structures - Spectral Distribution - Semiconductor lasers -Threshold conditions – Single mode semiconductor laser –Laser Characteristics-Modulation</td>
<td>5</td>
<td>12</td>
</tr>
<tr>
<td><strong>FIRST INTERNAL TEST</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Transmitter design Receiver’s basic Concepts - PIN and APD diodes structures- Photo detector Noise- Receiver sensitivity – BER and quantum limit - Receiver design.</td>
<td>5</td>
<td>13</td>
</tr>
<tr>
<td><strong>Module III:</strong></td>
<td></td>
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</tr>
<tr>
<td><strong>ADVANCED LIGHTWAVE SYSTEMS</strong></td>
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</tr>
<tr>
<td>Homodyne and heterodyne detectors – Advanced modulation formats - Demodulation schemes - BER in synchronous receivers - Sensitivity degradation –Systems with the DBPSK format and DQPSK – System employing Orthogonal FDM.</td>
<td>11</td>
<td>25</td>
</tr>
<tr>
<td><strong>SECOND INTERNAL TEST</strong></td>
<td></td>
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</tr>
<tr>
<td><strong>Module IV</strong></td>
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</tr>
<tr>
<td><strong>MULTICHANNEL SYSTEMS</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

25 /116
WDM systems, multiple access networks - WDM Components - XPM based and FWM based wavelength converters – Fiber based optical regenerator - Hetero wavelength linear crosstalk and homo wavelength Linear Crosstalk – TDM - Code-division multiplexing.

END SEMESTER EXAMINATION

Course No: 09EC6155
Course Title: MICROWAVE COMPONENTS AND NETWORKS

Credits: 3-0-0: 3 Year : 2015

Pre-requisites: Nil

Objectives:

• To introduce the terminology used in microwave engineering.
• To familiarize with microwave generations.
• To introduce Microwave Semiconductor Devices Microwave bipolar transistor

Syllabus

Introduction to microwaves and applications, advantages of microwaves, time varying electric and magnetic fields, electromagnetic field equations, maxwell’s equations for time-varying fields, Microwave Tubes Limitation of conventional tubes, microwave tubes, two cavity klystron, operation of magnetron, Microwave Semiconductor Devices Microwave bipolar transistor, Scattering Matrix Parameters of microwave networks Definition of scattering matrix, characteristics of S-matrix,

Course Outcome

Students will have idea about microwave range used in various applications, Advantages of microwave communication techniques. Microwave generation techniques.

References:
1.”Microwave Engineering” by Prof. GSN Raju, IK International Publishers, 2007
4.”Electronic communication systems” - Kennedy
5. “Electronic communications” - Roody and Coolen

Internal continuous assessment: 40 marks

i) Two internal tests : 2 x 15 = 30 Marks
ii) Tutorials/Assignments = 10 Marks

End semester Examination: 60 marks
Answer any 6 questions by choosing at least one question from each module.

**Course Plan**

| Course No: **09EC61 55** Title: **MICROWAVE COMPONENTS AND NETWORKS**  
(L-T-P): 3-0-0 Credits :3 |
<table>
<thead>
<tr>
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</thead>
<tbody>
<tr>
<td>Module</td>
<td>Contact hours</td>
<td>% marks in end semester exam</td>
</tr>
<tr>
<td><strong>Module I</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Introduction to microwaves and applications, advantages of microwaves, EM spectrum domain, electric and magnetic fields static electric and magnetic fields, time varying electric and magnetic fields, electromagnetic field equations, maxwell’s equations for time-varying fields, meaning of maxwell’s equations, characteristics of free space, power flow by microwaves, expression for propagation constant of a microwave in conductive medium, microwave applications, relation between dB, dBm, dBμ.</td>
<td>10</td>
<td>25</td>
</tr>
<tr>
<td><strong>Module II</strong></td>
<td></td>
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</tr>
<tr>
<td>Microwave Tubes Limitation of conventional tubes, microwave tubes, velocity modulation, method of producing the velocity modulation, principle of operation of two cavity klystron.</td>
<td>5</td>
<td>12</td>
</tr>
<tr>
<td><strong>FIRST INTERNAL TEST</strong></td>
<td></td>
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</tr>
<tr>
<td>Reflex klystron principle of operation, velocity modulation in reflex klystron, applegate diagram with gap voltage for a reflex klystron. Principle of operation of magnetron, hull cut-off condition, advantages of slow wave devices, principle of operation of TWT.</td>
<td>11</td>
<td>13</td>
</tr>
<tr>
<td><strong>Module III</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Microwave Semiconductor Devices Microwave bipolar transistor, FET, Principle of Operation and application of tunnel diode, Principle of operation of gunn diode, application of gunn diode advantages of gunn diode, salient features of IMATT and TRAPATT diodes, applications of IMATT and TRAPATT diodes, principle of operation of PIN diode, applications of PIN diode.</td>
<td>25</td>
<td></td>
</tr>
<tr>
<td><strong>SECOND INTERNAL TEST</strong></td>
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</tr>
<tr>
<td>WDM systems, multiple access networks - WDM Components - XPM based and FWM based wavelength converters – Fiber based optical regenerator - Hetero wavelength linear crosstalk and homo wavelength Linear Crosstalk – TDM - Code-division multiplexing.</td>
<td>11</td>
<td>25</td>
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</table>
Course No: 09EC6151
Course Title: RESEARCH METHODOLOGY
Credits: 0-2-0: 2 Year : 2015
Pre-requisites: Nil

Objective:

• To give students an insight into the steps to be followed in doing a research
• To provide an idea about technical report writing

Syllabus:
Introduction to Research Methodology; Formulating a Research Problem; Conceptualising a research design; Methods of Data Collection; Processing and Analysis of Data; Writing a Research Report; Ethical issues related to publishing; A study of the use of the following tools like Matlab and LaTeX.

Course Outcome:
Students who successfully complete this course will have clear understanding about the steps to be followed in doing research.

Text Books:

Internal continuous assessment: 100 marks

Internal continuous assessment :
Test 1- 30 marks
Test 2- 30 marks
Assignment/Tutorial-40 marks
Total-100 marks
**Course Plan**

<table>
<thead>
<tr>
<th>Module</th>
<th>Contact hours</th>
<th>% marks Internal exam</th>
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</thead>
<tbody>
<tr>
<td><strong>Module I: Research Methodology: An Introduction</strong>&lt;br&gt;Meaning of Research, Objectives of Research, Motivation in Research, Applications of Research, Definition of Research, Characteristics of Research, Types of Research, Steps in Research Process&lt;br&gt;&lt;b&gt;Formulating a Research Problem&lt;/b&gt;&lt;br&gt;Reviewing the Literature, Formulating a Research Problem, Identifying Variables, Constructing Hypothesis</td>
<td>7</td>
<td>25</td>
</tr>
<tr>
<td><strong>Module II: Conceptualising a research design</strong>&lt;br&gt;Definition of a Research Design, Need for Research Design, Functions of Research Design, Features of a Good Design&lt;br&gt;&lt;b&gt;Methods of Data Collection&lt;/b&gt;&lt;br&gt;Collection of Primary Data, Observation Method, Interview Method, Collection of Data through Questionnaires, Collection of Data through Schedules</td>
<td>7</td>
<td>25</td>
</tr>
<tr>
<td><strong>FIRST INTERNAL TEST</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Module III: Processing and Analysis of Data</strong>&lt;br&gt;Processing Operations, Elements/Types of Analysis, Statistics in Research, Measures of Central Tendency, Measures of Dispersion, Measures of Asymmetry (Skewness)&lt;br&gt;&lt;b&gt;Writing a Research Report&lt;/b&gt;&lt;br&gt;Research writing in general, Referencing, Writing a Bibliography, Developing an outline&lt;br&gt;Writing about a variable</td>
<td>7</td>
<td>25</td>
</tr>
<tr>
<td>**Module IV: Interpretation of Data and Paper Writing – Layout of a Research Paper, Journals in Computer Science, Impact factor of Journals, When and where to publish ?&lt;br&gt;Ethical issues related to publishing, Plagiarism and Self-Plagiarism&lt;br&gt;&lt;b&gt;A study of the use of the following tools&lt;/b&gt;&lt;br&gt;Matlab / Simulink&lt;br&gt;LaTeX/ MS Office</td>
<td>7</td>
<td>25</td>
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<tr>
<td><strong>SECOND INTERNAL TEST</strong></td>
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</table>

**Course No: 09EC6161**<br>**Course Title: SEMINAR**
**Objective:**

This course is intended for

- Increasing the breadth of knowledge
- Enhancing the ability of self study
- Improving presentation and communication skills
- Augmenting the skill of Technical Report Writing.

Students have to register for the seminar and select a topic in consultation with any faculty member offering courses for the programme. A detailed write-up on the topic of the seminar is to be prepared in the prescribed format given by the Department. The seminar shall be of 30 minutes duration and a committee with the Head of the department as the chairman and two faculty members from the department as members shall evaluate the seminar based on the coverage of the topic, presentation and ability to answer the questions put forward by the committee.

**Course outcome:**

The students who successfully complete this course will have the capability to

- Understand technical articles in peer reviewed journals and conferences;

**Internal continuous assessment: 100 marks**

<table>
<thead>
<tr>
<th>Subject Relevance</th>
<th>:</th>
<th>10 marks</th>
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<tbody>
<tr>
<td>Concept/ Knowledge in the topic</td>
<td>:</td>
<td>20 marks</td>
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<tr>
<td>Presentation</td>
<td>:</td>
<td>40 marks</td>
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<tr>
<td>Report</td>
<td>:</td>
<td>30 marks</td>
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<tr>
<td>Total marks</td>
<td>:</td>
<td>100 marks</td>
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</table>
Objectives: *This course enables the students to explore the concepts of designing and implementing various systems using Embedded and DSP kits, Simulate and study various systems using suitable software tools.*

Tools:
Numerical Computing Environments – GNU Octave or MATLAB or any other equivalent tool, DSP Kits, Embedded Kits.

I. Signal Processing Experiments:
1. Generation of waveforms and observation of the output using the graphical display utility of integrated Development Environment (IDE)
2. Generation of a sine function and sampling of generated sine waveform. Observation of the spectrum and windowing effect.
3. Implementation of linear convolution on 1D and 2D signals.
4. Implementation of circular convolution on 1D and 2D signal
5. Implementation of FIR filter (Filter coefficients may be obtained from MATLAB)
6. Implementation of IIR filter (Filter coefficients may be obtained from MATLAB)
7. Verification of FIR and IIR filters by inputting a signal from the signal generator (configure the codec in the DSP development board)
8. Implementation of simple algorithms in audio and image processing
9. Mini Project- Related to the area of advanced communication /signal processing using the development kit.

II. Embedded System Experiments (PIC 18F Series/ARM 7)
1. LCD Interfacing – Character/Graphic LED
2. RS 232C Serial Communication with PC
3. I2C Interfacing of memory
4. SPI Interfacing of peripheral IC
5. GPS Interfacing
6. GPRS Modem Interfacing
7. RTC Interfacing

Course Outcome:
Students who successfully complete this course will have demonstrated ability to practically implement the DSP algorithms on DSP processor.

Internal Continuous Assessment: 100 marks

<table>
<thead>
<tr>
<th>Subject Relevance</th>
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<tbody>
<tr>
<td>Concept/ Knowledge in the topic</td>
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<tr>
<td>Presentation</td>
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<tr>
<td>Report</td>
<td>30 marks</td>
</tr>
<tr>
<td>Total marks</td>
<td>100 marks</td>
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</table>
SEMESTER II

Course No: 09EC6112
Course Title: DIGITAL SYSTEM DESIGN
Credits: 4-0-0: 4 Year: 2015
Pre-requisites: Nil

Objective

- To introduce VHDL and Verilog coding.
- To familiarize with Programmable Logic Arrays - Programmable Array Logic.
- To introduce to Testing and Diagnosis, Fault modelling.

Syllabus
Introduction to VHDL - Behavioural Modeling- Simulation Deltas - Sequential Processing -
Analysis of Clocked sequential Networks - sequential parity checker - State tables and graphs - Programmable LSI Techniques - Programmable Logic Arrays - Programmable Array Logic - Sequential PLDs - Introduction to Testing and Diagnosis, Fault modeling: Logical fault models - Fault Detection and Redundancy - BIST Architectures, Compression Techniques - General aspects - Signature Analysis.

Course outcome
Students who successfully complete this course will have Digital system and its architecture concepts.
To familiarize with the system programming using VHDL and VERILOG.

References:
1. J. Bhasker; A VHDL Primer, Addison-Wesley.
2. VHDL for Programmable Logic - Kevin Skahill, Cypress Semiconductors
3. The Designer’s Guide to VHDL - Peter J Ashenden
4. VHDL - Douglas V. Perry
7. Randy H. Katz; Contemporary Logic Design, Benjamin/Cummings Publishing Co.
8. Weste and Eshraghian; CMOS VLSI Design, Addison-Wesley

Internal continuous assessment: 40 marks
i) Two internal tests : 2 x 15 = 30 Marks
ii) Tutorials/Assignments = 10 Marks

End semester Examination: 60 marks
Answer any 6 questions by choosing at least one question from each module.

COURSE PLAN

Course No: **09EC61 12**  Title: **DIGITAL SYSTEM DESIGN**
(L-T-P): 4-0-0 Credits : 4

<table>
<thead>
<tr>
<th>Module</th>
<th>Contact hours</th>
<th>% marks Internal exam</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Module I</strong>&lt;br&gt;Introduction to VHDL - Behavioural Modeling - Transport vs Inertial Delay - Simulation Deltas - Sequential Processing - Process Statement - Signal Assignment vs Variable Assignment - Sequential Statements - Data Types - Subprograms and Packages - Predefined Attributes - Configurations - Subprogram Overloading - VHDL synthesis - Design Examples.</td>
<td>14</td>
<td>25</td>
</tr>
<tr>
<td><strong>Module II</strong>&lt;br&gt;Analysis of Clocked sequential Networks - sequential parity checker - State tables and graphs - General models for sequential networks</td>
<td>7</td>
<td>12</td>
</tr>
</tbody>
</table>
Module III
Programmable LSI Techniques - Programmable Logic Arrays - Programmable Array Logic - Sequential PLDs - Sequential Circuit Design using PLDs - Complex Programmable Logic Devices and Field Programmable Gate Arrays - Altera Series FPGAs and Xilinx Series FPGAs.

Module IV

Course No: 09EC6122
Course Title: WIRELESS COMMUNICATION
Credits: 3-0-0: 3 Year: 2015
Pre-requisites: Nil

Objectives: This course gives a thorough treatment of the principles of Wireless Mobile communication. Upon completion of the course, the student will have knowledge about:
- Different types of fading in wireless channels and their mitigation
- Diversity schemes
- MIMO channels
- Cellular communication systems – GSM and CDMA
- Cellular communication standards

Syllabus
Fading and Diversity: Wireless Channel Models- path loss and shadowing models - statistical fading models - Selective diversity combining - Fading Channel Capacity: Capacity of Wireless Channels- Cellular Communication: Cellular Networks- Cell splitting and sectoring - Spread spectrum and CDMA:

Course Outcome
Students who successfully complete this course will have idea regarding GSM, CDMA and diversity schemes.
References:

Internal continuous assessment: 40 marks

i) Two internal tests : 2 x 15 = 30 Marks
ii) Tutorials/Assignments = 10 Marks

End semester Examination: 60 marks
Answer any 6 questions by choosing at least one question from each module.

COURSE PLAN

<table>
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<tr>
<th>Course No: <strong>09EC61 22</strong></th>
<th>Title: <strong>WIRELESS COMMUNICATION</strong></th>
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<tr>
<th>Module</th>
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<th>% marks Internal exam</th>
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<tbody>
<tr>
<td><strong>Module I</strong></td>
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<tr>
<td><strong>Module II</strong></td>
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</tr>
<tr>
<td>Fading Channel Capacity: Capacity of Wireless Channels- Capacity of flat and frequency selective fading channels- Multiple Input Multiple output (MIMO) systems</td>
<td>5</td>
<td>12</td>
</tr>
</tbody>
</table>

**FIRST INTERNAL TEST**

Narrow band multiple antenna system model- Parallel Decomposition of MIMO Channels- Capacity of MIMO 5 | 13 |
<table>
<thead>
<tr>
<th>Channels.</th>
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</thead>
<tbody>
<tr>
<td><strong>Module III</strong></td>
</tr>
<tr>
<td>Cellular Communication: Cellular Networks- Multiple Access: FDM/TDM/FDMA/TDMA- Spatial reuse- Co-channel interference Analysis- Hand over Analysis- Erlang Capacity Analysis- Spectral efficiency and Grade of Service- Improving capacity - Cell splitting and sectoring</td>
</tr>
<tr>
<td><strong>SECOND INTERNAL TEST</strong></td>
</tr>
<tr>
<td><strong>Module IV</strong></td>
</tr>
</tbody>
</table>
Course No: 09EC6132  
Course Title: DIGITAL MOS CIRCUITS  
Credits: 3-0-0: 3  
Year: 2015  
Pre-requisites: Nil

Objective
- To introduce MOS transistor (MOST).  
- To familiarize with CMOS inverters and different MOS Logic circuits.  
- To introduce NORA logic and adiabatic logic.

Syllabus
Short and narrow channel effects in MOS transistor (MOST) - sub threshold current - channel length modulation - MOS inverters - CMOS ring oscillator - MOS logic circuits - BiCMOS logic circuits - Dynamic CMOS logic - NORA logic - true single phase clock dynamic logic - basic ideas of adiabatic logic.

Course Outcome
Students who successfully complete this course will have idea regarding MOS transistors, CMOS circuits used to design electronics circuits and different logic systems.

References:

Internal continuous assessment: 40 marks
i) Two internal tests : 2 x 15 = 30 Marks  
ii) Tutorials/Assignments = 10 Marks

End semester Examination: 60 marks
Answer any 6 questions by choosing at least one question from each module.
# Course Plan

Course No: **09EC61 32** Title: **DIGITAL MOS CIRCUITS**

(L-T-P): 3-0-0 Credits :3

<table>
<thead>
<tr>
<th>Module</th>
<th>Contact hours</th>
<th>% marks Internal exam</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Module I</strong>&lt;br&gt;Short and narrow channel effects in MOS transistor (MOST) – sub threshold current - channel length modulation - drain induced barrier lowering - hot electron effects - velocity saturation of charge carriers. Scaling of MOST - constant voltage and constant field scaling - digital MOSFET model - series connection of MOSFETs.</td>
<td>11</td>
<td>25</td>
</tr>
<tr>
<td><strong>Module II</strong>&lt;br&gt;MOS inverters - resistive load - NMOS load - pseudo NMOS and CMOS inverters - calculation of input high and low and output high and low levels</td>
<td>5</td>
<td>12</td>
</tr>
<tr>
<td><strong>FIRST INTERNAL TEST</strong>&lt;br&gt;Power dissipation - calculation of delay times for CMOS inverter - CMOS ring oscillator - design of super buffer - estimation of interconnect parasitics and calculation of interconnect delay.</td>
<td>5</td>
<td>13</td>
</tr>
<tr>
<td><strong>Module III</strong>&lt;br&gt;MOS logic circuits - CMOS NOR, NAND, AOI and OAI gates - full adder - SR and JK latches - CMOS latch - transmission gates - simple circuits using TG -basic principles of pass transistor logic - voltage boot strapping - BiCMOS logic circuits - BiCMOS inverter with resistive base pull down and active base pull down - BiCMOS switching transients - simple gates using BiCMOS.</td>
<td>10</td>
<td>25</td>
</tr>
<tr>
<td><strong>SECOND INTERNAL TEST</strong>&lt;br&gt;Dynamic CMOS logic - precharge/evaluate logic - cascading problem – domino logic- cascading domino logic gates - charge sharing in domino logic – solutions to charge sharing problem - realisation of simple functions using domino logic - NORA logic - true single phase clock dynamic logic - basic ideas of adiabatic logic.</td>
<td>11</td>
<td>25</td>
</tr>
</tbody>
</table>
ELECTIVE II

Course No: 09EC6116
Course Title: MULTIRATE SIGNAL PROCESSING
Credits: 3-0-0: 3    Year: 2015
Pre-requisites: Nil

Objective: The course focuses on multirate signal processing which is the basic to modern signal processing. Topics include multirate signal processing material such as decimation, interpolation, filter banks, polyphase filtering, advanced filtering structures and nonuniform sampling and the cosine modulated filter banks.

Syllabus

The sampling theorem: sampling at subnyquist rate - Basic Formulations and schemes - M-channel perfect reconstruction filter banks: Uniform band and non uniform filter bank - Paraunitary PR Filter Banks- Filter Bank Properties induced by paraunitarity- Cosine Modulated filter banks: Cosine Modulated pseudo QMF Bank.

Course outcome

Students got an idea regarding decimation interpolation different filtering methods.

Text Books


Reference Books


Internal continuous assessment: 40 marks

i) Two internal tests : 2 x 15 = 30 Marks
ii) Tutorials/Assignments = 10 Marks

End semester Examination: 60 marks

Answer any 6 questions by choosing at least one question from each module.

COURSE PLAN
## Module I

<table>
<thead>
<tr>
<th>Module</th>
<th>Contact hours</th>
<th>% marks Internal exam</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>11</td>
<td>25</td>
</tr>
</tbody>
</table>

### Module II
M-channel perfect reconstruction filter banks: Uniform band and non uniform filter bank - tree structured filter bank

**FIRST INTERNAL TEST**
Errors created by filter bank system-Polyphase representation- perfect reconstruction systems

<table>
<thead>
<tr>
<th>Module</th>
<th>Contact hours</th>
<th>% marks Internal exam</th>
</tr>
</thead>
<tbody>
<tr>
<td>II</td>
<td>5</td>
<td>12</td>
</tr>
</tbody>
</table>

### Module III
Paraunitary PR Filter Banks- Filter Bank Properties induced by paraunitarity- Two channel FIR paraunitary QMF Bank- Linear phase PR Filter banks- Necessary conditions for Linear phase property- Quantization Effects: -Types of quantization effects in filter banks. - coefficient sensitivity effects, dynamic range and scaling.

**SECOND INTERNAL TEST**

<table>
<thead>
<tr>
<th>Module</th>
<th>Contact hours</th>
<th>% marks Internal exam</th>
</tr>
</thead>
<tbody>
<tr>
<td>III</td>
<td>10</td>
<td>25</td>
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</table>

### Module IV

<table>
<thead>
<tr>
<th>Module</th>
<th>Contact hours</th>
<th>% marks Internal exam</th>
</tr>
</thead>
<tbody>
<tr>
<td>IV</td>
<td>11</td>
<td>25</td>
</tr>
</tbody>
</table>

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**SPREAD SPECTRUM AND CDMA SYSTEMS**

<table>
<thead>
<tr>
<th>09EC61 26</th>
<th>Credits – 3</th>
</tr>
</thead>
</table>

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40 /116
Course No: 09EC6126
Course Title: SPREAD SPECTRUM AND CDMA SYSTEMS
Credits: 3-0-0: 3 Year : 2015
Pre-requisites: Nil

Objectives: Upon completion of this course, students will have deep insight on spread spectrum communication systems. The course imparts knowledge about principle of spread spectrum and use of orthogonal codes, performance of CDMA systems under AWGN and fading channels, use of CDMA systems in cellular communication and important CDMA standards.

Syllabus

Introduction to spread spectrum communication- direct sequence spread spectrum, frequency-hopping and time-hopping spread spectrum systems- Performance of spread spectrum system under AWGN- RAKE receiver - Basics of spread spectrum multiple access in cellular environments - General aspects of CDMA cellular systems

Course outcome.

Got a brief idea about CDMA communication systems, interference cancellation methods used in modern communication systems, basics of mobile communication techniques.

References:

Internal continuous assessment: 40 marks

i) Two internal tests : 2 x 15 = 30 Marks
ii) Tutorials/Assignments = 10 Marks

End semester Examination: 60 marks
Answer any 6 questions by choosing at least one question from each module.

**COURSE PLAN**

**Course No:** 09EC61 26  **Title:** SPREAD SPECTRUM AND CDMA SYSTEMS  
**(L-T-P):** 3-0-0  **Credits:** 3

<table>
<thead>
<tr>
<th>Module</th>
<th>Contact hours</th>
<th>% marks Internal exam</th>
</tr>
</thead>
</table>

42 /116
<table>
<thead>
<tr>
<th>Module I</th>
<th>Introduction to spread spectrum communication, pulse noise jamming, low probability of detection, direct sequence spread spectrum, frequency-hopping and time-hopping spread spectrum systems, correlation functions, spreading sequences- maximal-length sequences, gold codes, Walsh orthogonal codes- properties and generation of sequences Synchronization and Tracking: delay lock and tau-dither loops, coarse synchronization- principles of serial search and match filter techniques.</th>
<th>11</th>
<th>25</th>
</tr>
</thead>
<tbody>
<tr>
<td>Module II</td>
<td>Performance of spread spectrum system under AWGN, multi-user Interference, jamming and narrow band interferences Low probability of intercept methods, <strong>FIRST INTERNAL TEST</strong> optimum intercept receiver for direct sequence spread spectrum, Error probability of DS-CDMA system under AWGN and fading channels, RAKE receiver.</td>
<td>5</td>
<td>12</td>
</tr>
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<td>---</td>
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<tr>
<td>Module III</td>
<td>Basics of spread spectrum multiple access in cellular environments, reverse Link power control, multiple cell pilot tracking, soft and hard handoffs, cell coverage issues with hard and soft handoff, spread spectrum multiple access outage, outage with imperfect power control, Erlang capacity of forward and reverse links. Multi-user Detection -MF detector, decorrelating detector, MMSE detector. Interference Cancellation: successive, Parallel Interference Cancellation, performance analysis of multiuser detectors and interference cancellers. <strong>SECOND INTERNAL TEST</strong></td>
<td>10</td>
<td>25</td>
</tr>
<tr>
<td>Module IV (9 Hours)</td>
<td>General aspects of CDMA cellular systems, IS-95 standard, Downlink and uplink, Evolution to Third Generation systems, WCDMA and CDMA-2000 standards, Principles of Multicarrier communication, MCCDMA and MC-DS-CDMA.</td>
<td>11</td>
<td>25</td>
</tr>
</tbody>
</table>
Course No: 09EC6136  
Course Title: SPEECH & AUDIO PROCESSING  
Credits: 3-0-0: 3  
Year: 2015  
Pre-requisites: Nil  

Objectives: To study the mechanisms of speech production and various models used for speech processing. To provide a knowledge of different coding methods used in speech and audio processing.

Syllabus


Course outcome.
Got a brief idea about speech coding techniques, different vocoders, speech transformation and real time applications of speech coding

Reference books:


Internal continuous assessment: 40 marks

i) Two internal tests : 2 x 15 = 30 Marks

ii) Tutorials/Assignments = 10 Marks

End semester Examination: 60 marks

Answer any 6 questions by choosing at least one question from each module.
## COURSE PLAN

**Course No:** 09EC61 36 **Title:** SPEECH & AUDIO PROCESSING  
(L-T-P): 3-0-0 Credits :3

<table>
<thead>
<tr>
<th>Module</th>
<th>Contact hours</th>
<th>% marks Internal exam</th>
</tr>
</thead>
</table>
| **Module I**  
| **Module II**  
Speech coding -subband coding of speech - transform coding - channel vocoder - formant vocoder – cepstral vocoder - vector quantizer coder- Linear predictive Coder. Speech synthesis - pitch extraction algorithms - gold rabiner pitch trackers - autocorrelation pitch trackers | 5 | 12 |
| **FIRST INTERNAL TEST**  
- voice/unvoiced detection - homomorphic speech processing - homomorphic systems for convolution | 5 | 13 |
complex cepstrums - pitch extraction using homomorphic speech processing. Sound Mixtures and Separation - CASA, ICA & Model based separation.

<table>
<thead>
<tr>
<th>Module III</th>
<th></th>
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</thead>
</table>

<table>
<thead>
<tr>
<th>Module IV</th>
<th></th>
<th></th>
</tr>
</thead>
</table>
Course No: 09EC6146  
Course Title: AD-HOC & SENSOR NETWORKS  
Credits: 3-0-0: 3 Year : 2015  
Pre-requisites: Nil  

Objectives: To study the mechanisms of ad hoc networks and various network models used. To study about various Networking platforms for detecting the network related issues  

Syllabus  
Mobile ad hoc networking; imperatives, challenges and characteristics- Energy efficient communication in ad hoc networks- The Sensor Network Concept. Introduction, Applications- Collaborative Signal Processing and Distributed Computation-Detection, estimation, classification problems  

Course outcome  
Students will be aware about network securities and different protocols used  

Text Books:  
1. S.Basagni & M.Conti, Mobile Ad Hoc Networking, Wiley, 2004  

Reference Books:  

Internal continuous assessment: 40 marks  

i) Two internal tests : 2 x 15 = 30 Marks  
ii) Tutorials/Assignments = 10 Marks  

End semester Examination: 60 marks  
Answer any 6 questions by choosing at least one question from each module.
<table>
<thead>
<tr>
<th>Module</th>
<th>Contact hours</th>
<th>% marks Internal exam</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Module II</strong>&lt;br&gt;Energy efficient communication in ad hoc networks. Measuring energy consumption. Power save protocols. Maximum life time routing</td>
<td>5</td>
<td>12</td>
</tr>
<tr>
<td><strong>FIRST INTERNAL TEST</strong>&lt;br&gt;Secure routing protocols. Intrusion detection. Security considerations in ad hoc sensor networks. Key management.</td>
<td>5</td>
<td>13</td>
</tr>
<tr>
<td><strong>Module III</strong>&lt;br&gt;The Sensor Network Concept. Introduction, Applications. Deployment and Configuration, Localization and calibration, Coverage and connectivity. Data Gathering-Tree construction algorithms and an Asymptotic capacity, Lifetime optimization formulations, Routing and Querying--Publish/Subscribe mechanisms -Geographic routing-Robustness -Storage and retrieval.</td>
<td>10</td>
<td>25</td>
</tr>
<tr>
<td><strong>SECOND INTERNAL TEST</strong>&lt;br&gt;Collaborative Signal Processing and Distributed Computation-Detection, estimation, classification problems-Energy-efficient distributed algorithms, Security-Privacy issues-Attacks and countermeasures.</td>
<td>11</td>
<td>25</td>
</tr>
</tbody>
</table>

Course No: **09EC6156**<br>Course Title: **GLOBAL POSITIONING SYSTEMS**<br>Credits: 3-0-0: 3 Year : 2015<br>Pre-requisites: Nil

**Objectives**- To study the principle of global positioning systems and satellite communication used in various aspects of engineering field
**Syllabus**

History of GPS – BC-4 System – HIRAN – NNSS – NAVSTAR GLONASS and GNSS Systems - Static and Kinematic Positioning - Coordinate Systems – Geo Centric Coordinate System- C/A code; P-code; Y-code; L1, L2 Carrier frequencies – Code Pseudo Ranges – Carries Phases- Propagation Media – Multipath – Antenna Phase Centre

**Course outcome**

Got an idea regarding global positioning systems and tracking networks satellite signal signature and navigation systems

**References:**


**Internal continuous assessment: 40 marks**

i) Two internal tests : 2 x 15 = 30 Marks
ii) Tutorials/Assignments = 10 Marks

**End semester Examination: 60 marks**

Answer any 6 questions by choosing at least one question from each module.

**COURSE PLAN**

<table>
<thead>
<tr>
<th>Course No: 09EC61 56</th>
<th>Title: GLOBAL POSITIONING SYSTEMS</th>
</tr>
</thead>
<tbody>
<tr>
<td>(L-T-P): 3-0-0 Credits :3</td>
<td></td>
</tr>
<tr>
<td>Module</td>
<td>Contact hours</td>
</tr>
</tbody>
</table>

50 /116
ELECTIVE III

Course No: 09EC6166
Course Title: POWER ELECTRONICS
Credits: 3-0-0: 3       Year: 2015
Pre-requisites: Nil

Objectives - To study various power electronics devices and its principles

Syllabus
Review of line commutated converters, inverters, voltage control & Power factor improvement - Switched - mode rectifier: various Power circuit configurations & wave shaping techniques - Current source inverters: single phase and three phase power circuit configuration and analysis - DC- DC, Converters - principle of operation of buck, boost, buck-boost

Course objective
Students will get a detail idea regarding power electronic devices and its principles.

References:
1. N.Mohan, T.M. Undeland & W.P. Robbins, Power Electronics: Converter,
Applications & Design, John Wiley & Sons.
2. M.H. Rashid, Power Electronics, Prentice Hall of India.

**Internal continuous assessment: 40 marks**

i) Two internal tests : 2 x 15 = 30 Marks  

ii) Tutorials/Assignments = 10 Marks

**End semester Examination: 60 marks**

Answer any 6 questions by choosing at least one question from each module.

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**COURSE PLAN**

<table>
<thead>
<tr>
<th>Course No: <strong>09EC61 66</strong></th>
<th>Title: <strong>POWER ELECTRONICS</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>(L-T-P): 3-0-0 Credits :3</td>
<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Module</th>
<th>Contact hours</th>
<th>% marks Internal exam</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Module I</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Review of line commutated converters, inverters, voltage control &amp; Power factor improvement. Power Devices: BJT, MOSFET, IGBT &amp; GTOs - operating characteristics and gate drive requirements and circuits.</td>
<td>11</td>
<td>25</td>
</tr>
<tr>
<td><strong>Module II</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Switched - mode rectifier: various Power circuit configurations &amp; wave shaping techniques. Synchronous link rectifiers: Power circuit configurations, control techniques</td>
<td>5</td>
<td>12</td>
</tr>
<tr>
<td><strong>FIRST INTERNAL TEST</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>applications. Inverters: voltage source inverters: single phase &amp; Six step inverters, voltage control &amp; PWM strategies, and implementation aspects. Modification of power circuit for Four quadrant operation.</td>
<td>5</td>
<td>13</td>
</tr>
<tr>
<td><strong>Module III (9 Hours)</strong></td>
<td>10</td>
<td>25</td>
</tr>
</tbody>
</table>
Current source inverters: single phase and three phase power circuit configuration and analysis. Load commutated inverters: principle of operation, modification of power circuit configuration for low frequency operation. Phase Controllers.

**SECOND INTERNAL TEST**

<table>
<thead>
<tr>
<th>Module IV (10 Hours)</th>
<th>11</th>
<th>25</th>
</tr>
</thead>
<tbody>
<tr>
<td>DC- DC, Converters - principle of operation of buck, boost, buck-boost, Cuk, flyback, forward, push-pull, half bridge, full bridge &amp; isolated Cuk Converters, Input &amp; output filter design, multi-output operation of isolated converters, MMF equations. Design of transformers and inductors.</td>
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<td></td>
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</tbody>
</table>

**Course No: 09EC6176**

**Course Title:** ELECTRONICS SYSTEM DESIGN  
**Credits:** 3-0-0: 3  
**Year:** 2015  
**Pre-requisites:** Nil

**Objectives** - To study different electronic systems and its design

**Syllabus**


**Course outcome**

Students will get an idea regarding analog and mixed circuit design issues, practical logic circuit design issues, electromagnetic compatibility issues

**TEXT BOOKS:**

5. Intuitive Analog circuit design by: Mark.T Thompson; Published by Elsevier
REFERENCES:

2. A Designer’s Guide to Instrumentation Amplifiers; by: Charles Kitchin and Lew Counts; Seminar Materials @ http://www.analog.com
3. Errors and Error Budget Analysis in Instrumentation Amplifier Applications; by: Eamon Nash; Application note AN-539@ http://www.analog.com
4. Practical Analog Design Techniques; by: Adolfo Garcia and Wes Freeman; Seminar Materials@ http://www.analog.com
5. Selecting An A/D Converter; by:Larry Gaddy; Application bulletin @ http://www.Ti.com
6. Benefits and issues on migration of 5-volt and 3.3 volt logic to lower voltage supplies; Application note SDAA011A@ http://www.Ti.com
7. JTAG/IEEE 1149.1 designs considerations; Application note SCTA029@ http://www.Ti.com
8. Live Insertion; Application note SDYA012@ http://www.Ti.com
9. PCB Design Guidelines For Reduced EMI; Application note SZZA009@ http://www.Ti.com

In addition, National & International journals in the related topics, manufacturer’s device data sheets and application notes are to be referred to get practical application oriented information.

Internal continuous assessment: 40 marks

i) Two internal tests : 2 x 15= 30 Marks
ii) Tutorials/Assignments = 10 Marks

End semester Examination: 60 marks

Answer any 6 questions by choosing at least one question from each module.
# Course Plan

**Course No:** 09EC61 **Title:** ELECTRONICS SYSTEM DESIGN

(L-T-P): 3-0-0 Credits :3

<table>
<thead>
<tr>
<th>Module</th>
<th>Contact hours</th>
<th>% marks Internal exam</th>
</tr>
</thead>
<tbody>
<tr>
<td>Module I</td>
<td>11</td>
<td>25</td>
</tr>
<tr>
<td>Module II</td>
<td>5</td>
<td>13</td>
</tr>
<tr>
<td>Practical Logic Circuit Design Issues and Techniques: Understanding and interpreting data sheets &amp; specifications of various CMOS &amp; BiCMOS family Logic devices. Electrical behavior (steady state &amp; dynamic) of CMOS &amp; BiCMOS family logic devices</td>
<td>10</td>
<td>25</td>
</tr>
<tr>
<td>FIRST INTERNAL TEST</td>
<td>56</td>
<td>116</td>
</tr>
<tr>
<td>Benefits and issues on migration of 5-volt and 3.3 volt logic to lower voltage supplies. CMOS/TTL Interfacing Basic design considerations for live insertion. JTAG/IEEE 1149.1 design considerations. Design for testability, Estimating digital system reliability. Digital circuit layout and grounding. PCB design guidelines for reduced EMI.</td>
<td>First Internal Test</td>
<td>56</td>
</tr>
<tr>
<td>Module III</td>
<td>5</td>
<td>13</td>
</tr>
</tbody>
</table>
coupling, effect of shield on inductive coupling, effect of shield on magnetic coupling, magnetic coupling between shield and inner conductor, shielding to prevent magnetic radiation, shielding a receptor against magnetic fields, coaxial cable versus shielded twisted pair, ribbon cables. Grounding of Electronic Systems: Safety grounds, signal grounds, single-point ground systems, multipoint-point ground systems, hybrid grounds, functional ground layout, practical low frequency grounding, hardware grounds, grounding of cable shields, ground loops, shield grounding at high frequencies.

<table>
<thead>
<tr>
<th>SECOND INTERNAL TEST</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Module IV</strong></td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>
Course No: 09EC6186
Course Title: ASIC DESIGN
Credits: 3-0-0: 3       Year : 2015
Pre-requisites: Nil

Objectives- To study different types of ASICS, ASIC Library Design

Syllabus
Types of Asics: Design Flow, Economics of Asics, ASIC Cell Libraries, CMOS Logic
Cell Data Path Logic Cells, I / O Cells, Cell Compilers.- ASIC Library Design: Transistors as Resistors- System on Chip Design Process: A Canonical SoC Design,
SoC Design Flow
Soc Verification: Verification Technology Options, Verification Methodology

Course outcome
Will get a clear idea regarding types of ASICS, ASIC library Design, chip design
process, Soc Verification

References:
Education India, 2008.
2. Farzad Nekoogar, Faranak Nekoogar & Jeffrey Ebert, “From ASICs to SOCs: A

Internal continuous assessment: 40 marks
i) Two internal tests : 2 x 15= 30 Marks
ii) Tutorials/Assignments = 10 Marks

End semester Examination: 60 marks
Answer any 6 questions by choosing at least one question from each module.

COURSE PLAN

Course No 09EC61 86       Title: ASIC DESIGN
<table>
<thead>
<tr>
<th>Module 1</th>
<th>Module 2 (9 hours)</th>
<th>Module 3 (11 hours)</th>
<th>Module 4 (9 hours)</th>
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<tbody>
<tr>
<td>11</td>
<td>5</td>
<td>10</td>
<td>11</td>
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<tr>
<td>25</td>
<td>12</td>
<td>25</td>
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</tr>
</tbody>
</table>
Introduction

Challenges going to sub-100 nm MOSFETs- MOS Based Devices Novel MOS-based devices- Quantum Structures Quantum structures – quantum wells- Nano Devices Carbon nanotubes based devices

Course outcome

Students will get an idea regarding MOS based devices, quantum structures and nano based devices

References:

Internal continuous assessment: 40 marks

i) Two internal tests : 2 x 15= 30 Marks
ii) Tutorials/Assignments = 10 Marks

End semester Examination: 60 marks

Answer any 6 questions by choosing at least one question from each module.

<table>
<thead>
<tr>
<th>Course No</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>09EC61 96</td>
<td>NANO ELECTRONICS</td>
</tr>
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</table>

(L-T-P): 3-0-0 Credits :3

<table>
<thead>
<tr>
<th>Module</th>
<th>Contact hours</th>
<th>% marks Internal exam</th>
</tr>
</thead>
</table>

Course Plan
| Module 1 |
| Introduction Challenges going to sub-100 nm MOSFETs – Oxide layer thickness, tunneling, power density, non uniform dopant concentration, threshold voltage scaling, lithography, hot electron effects, sub-threshold current, velocity saturation, interconnect issues, fundamental limits for MOS operation. |
| 11 | 25 |

| Module 2 |
| MOS Based Devices Novel MOS-based devices – Multiple gate MOSFETs |
| 5 | 12 |

**FIRST INTERNAL TEST**

| Silicon-on-insulator, Silicon-on-nothing, FinFETs, vertical MOSFETs, strained Si devices. |
| 5 | 13 |

| Module 3 |
| 10 | 25 |

**SECOND INTERNAL TEST**

| Module 4 |
| 11 | 25 |

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**Course No: 09EC6162**

**Course Title: MINI PROJECT**

**Credits: 0-0-4: 2**  
**Year : 2015**

**Pre-requisites: Nil**

**Objective:** To apply the concepts introduced in the courses to a moderately complex communication and to have a output
The students can select hardware, software or system level mini projects. The mini project can be implemented using **Microcontroller or DSP or FPGA or RTOS or Network Simulators (NS2 or NS3)** tools which they have studied. A complete product or project can be selected. The project can be done individually or as a group of two students.

**Internal Continuous Assessment: 100 marks**

Internal continuous assessment is in the form of evaluation, demonstration, presentation etc. The assessment details are to be announced to the students, right at the beginning of the semester by the teacher.

<table>
<thead>
<tr>
<th>Attendance &amp; Regularity</th>
<th>20 Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Evaluation I</td>
<td>30 Marks</td>
</tr>
<tr>
<td>Evaluation II</td>
<td>30 Marks</td>
</tr>
<tr>
<td>Assessment by Guide</td>
<td>20 Marks</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>100 Marks</strong></td>
</tr>
</tbody>
</table>

**Course No: 09EC6172**  
**Course Title: ADVANCED COMMUNICATION LAB**  
**Credits: 0-0-2: 1 Year : 2015**  
**Pre-requisites: Nil**  

**Objectives:** *Upon completion, the students will*  
1. Be able to design enlisted experiments and implement using hardware  
2. Acquire sufficient expertise in simulating these systems using MATLAB  
3. Be able to design and implement self standing systems of their choice with sufficient complexity.

**Tools:**  
Numerical Computing Environments – GNU Octave or MATLAB or any other equivalent tool

**Lab:**  
1. Implementation of digital modulation schemes – BASK, BFSK, BPSK. Plot BER vs $Eb / N0$ in AWGN channels.  
2. Performance comparison of QPSK, DPSK, MSK & GMSK.  
4. Comparison of diversity combining techniques – SC, EGC & MRC.
5. Simulation of CDMA systems.
8. Carrier recovery and bit synchronization.
9. Implementation of multicarrier communication.
11. Constellation diagram of various digital modulation schemes.

Course Outcome:

Students who successfully complete this course will have the ability to implement major concepts introduced in advanced digital communication.

Internal Continuous Assessment: 100 marks

<table>
<thead>
<tr>
<th></th>
<th>Marks</th>
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</thead>
<tbody>
<tr>
<td>Mid Term Internal Test</td>
<td>40</td>
</tr>
<tr>
<td>Laboratory Experiments &amp; Viva Voce</td>
<td>10</td>
</tr>
<tr>
<td>Final Internal Test</td>
<td>50</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>100</strong></td>
</tr>
</tbody>
</table>

SEMESTER III

ELECTIVE IV

Course No: 09EC7117
Course Title: SIGNAL COMPRESSION TECHNIQUES
Credits: 3-0-0: 3           Year: 2015
Pre-requisites: Nil

Objective:
• To familiarize with different coding techniques.
• To introduce the concept of rate distortion theory.
• To introduce different types of transforms
• To familiarize with different data compression standards

Syllabus

Review of Information Theory: The discrete memory less information source- Lossy Compression - Mathematical Preliminaries for Lossless Compression - Huffman Coding - Optimality of Huffman codes- Rate distortion theory: Rate distortion function R(D), Properties of R(D); Calculation of R(D) for the binary source and the Gaussian source- Mathematical Preliminaries for Transforms, Karhunen Loeve Transform- Data Compression standards: Zip and Gzip, Speech Compression Standards

Course outcome

Students will get an idea regarding the different coding scheme-different transformations
Text books


Reference books


Internal continuous assessment: 40 marks

i) Two internal tests : 2 x 15= 30 Marks

ii) Tutorials/Assignments = 10 Marks

End semester Examination: 60 marks

Answer any 6 questions by choosing at least one question from each module.
# Course Plan

Course No **09EC71 17** Title: **SIGNAL COMPRESSION TECHNIQUES**

(L-T-P): 3-0-0 Credits :3

<table>
<thead>
<tr>
<th>Module</th>
<th>Contact hours</th>
<th>% marks Internal exam</th>
</tr>
</thead>
</table>
| **Module I:**  

| Module II:  
Rate distortion theory: Rate distortion function R(D),Properties of R(D); Calculation of R(D) for the binary source and the Gaussian source, Rate distortion theorem, Converse of the Rate distortion theorem | 5 | 12 |

**FIRST INTERNAL TEST**

Quantization – Uniform & Non-uniform - optimal and adaptive quantization, vector quantization and structures for VQ, Optimality conditions for VQ, Predictive Coding - Differential Encoding Schemes | 5 | 12 |

| Module III: **(9 hours)**  
Mathematical Preliminaries for Transforms, Karhunen Loeve Transform, Discrete Cosine and Sine Transforms, Discrete Walsh Hadamard Transform, Lapped transforms - Transform coding - Subband coding - Wavelet Based Compression - Analysis/Synthesis Schemes. | 10 | 25 |

**SECOND INTERNAL TEST**

| Module IV: **(10 hours)**  
Course No: 09EC7127  
Course Title: BIOMEDICAL SIGNAL PROCESSING  
Credits: 3-0-0: 3  
Year: 2015  
Pre-requisites: Nil

Objectives: Upon completion of this course, students will have thorough understanding of the various biomedical signals, their processing using standard signal processing tools, cardio vascular and neurological applications of signal processing, modeling of EEG, EEG segmentation and Medical image formats.

Syllabus
Introduction to Biomedical Signals - Examples of Biomedical signals- Concurrent, coupled and correlated processes - illustration with case studies - Adaptive and optimal filtering- Cardio vascular applications: Basic ECG - Electrical Activity of the heart- ECG data acquisition - ECG parameters & their estimation- Neurological applications: The electroencephalogram (EEG) rhythms & waveform classification- EEG applications - Epilepsy, sleep disorders, brain computer interface.  
Model based spectral analysis

Course outcome
Students will get an idea regarding the biomedical signals, classification of biomedical signals, cardio vascular application

References:
4. Semmlow, Marcel Dekker “Biosignal and Biomedical Image Processing”, 2004  
5. Enderle, “Introduction to Biomedical Engineering,” 2/e, Elsevier, 2005  

Internal continuous assessment: 40 marks

i) Two internal tests : 2 x 15 = 30 Marks
ii) Tutorials/Assignments = 10 Marks

End semester Examination: 60 marks

Answer any 6 questions by choosing at least one question from each module.

COURSE PLAN
<table>
<thead>
<tr>
<th>Module</th>
<th>Contact hours</th>
<th>% marks Internal exam</th>
</tr>
</thead>
</table>
| **Module I**  
Introduction to Biomedical Signals - Examples of Biomedical signals - ECG, EEG, EMG - Tasks in Biomedical Signal Processing - Computer Aided Diagnosis. Origin of bio potentials - Review of linear systems - Fourier Transform and Time Frequency Analysis (Wavelet) of biomedical signals - Processing of Random & Stochastic signals - spectral estimation – Properties and effects of noise in biomedical instruments - Filtering in biomedical instruments | 11 | 25 |
| **Module II**  
Concurrent, coupled and correlated processes - illustration with case studies - Adaptive and optimal filtering - Modeling of Biomedical signals - Detection of biomedical signals in noise | 5 | 12 |
| **FIRST INTERNAL TEST**  
- removal of artifacts of one signal embedded in another  
-Maternal-Fetal ECG - Muscle-contraction interference. Event detection - case studies with ECG & EEG - Independent component Analysis - Cocktail party problem applied to EEG signals - Classification of biomedical signals | 5 | 12 |
| **Module III**  
| **SECOND INTERNAL TEST**  
Course No: 09EC7137
Course Title: MARKOV MODELING AND QUEUING THEORY
Credits: 3-0-0: 3 Year : 2015
Pre-requisites: Nil

Objectives: To give an idea of different models used in queuing theory

Syllabus

Course outcome
Will get an idea about different queuing models, time delays in queuing networks

References:

Internal continuous assessment: 40 marks

iii) Two internal tests : 2 x 15 = 30 Marks
iv) Tutorials/Assignments = 10 Marks

End semester Examination: 60 marks

Answer any 6 questions by choosing at least one question from each module.

**Course Plan**
<table>
<thead>
<tr>
<th>Module</th>
<th>Contact hours</th>
<th>% marks Internal exam</th>
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</thead>
<tbody>
<tr>
<td><strong>Module I</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stochastic Processes: Renewal Processes - Reward and Cost Models, Poisson Process; Point Processes; Regenerative Processes; Renewal Theorems.</td>
<td>11</td>
<td>25</td>
</tr>
<tr>
<td><strong>Module II</strong></td>
<td></td>
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</tr>
<tr>
<td>Markov Models: Discrete Time Markov Chain - Transition Probabilities, Communication Classes, Irreducible – Chains</td>
<td>5</td>
<td>12</td>
</tr>
<tr>
<td><strong>FIRST INTERNAL TEST</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Continuous Time Markov Chain - Pure-Jump Continuous-Time Chains, Regular Chains, Birth and Death Process, Semi-Markov Processes.</td>
<td>5</td>
<td>12</td>
</tr>
<tr>
<td><strong>Module III</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Single Class &amp; Multi-class Queuing Networks: Simple Markovian queues; M/G/1 queue; G/G/1 queue; Open queuing networks; Closed queuing networks; Mean value analysis; Multi-class traffic model; Service time distributions; BCMP networks; Priority systems.</td>
<td>10</td>
<td>25</td>
</tr>
<tr>
<td><strong>SECOND INTERNAL TEST</strong></td>
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<tr>
<td>Time Delays and Blocking in Queuing Networks: Time delays in single server queue; Time delays in networks of queues; Types of Blocking; Two finite queues in a closed network; Aggregating Markovian states.</td>
<td>11</td>
<td>25</td>
</tr>
</tbody>
</table>
Course No: 09EC7147
Course Title: DSP ALGORITHMS AND ARCHITECTURES
Credits: 3-0-0: 3 Year : 2015
Pre-requisites: Nil

Objectives: The evolving field of ASIC design enables the customized design of DSP algorithms on dedicated chips. This paper introduces systematic approaches for mapping algorithms to VLSI architectures. It deals with representation of DSP algorithms, various techniques to optimize these architectures for various parameters such as computation time, hardware, space and power consumption. It also introduces fast DSP algorithms for efficient hardware implementation.

Syllabus
DSP Algorithm Design: DSP representations (data-flow, control-flow, and signal-flow graphs, block diagrams)- Circuits and DSP Architecture Design: Fast filtering algorithms (Winograd's, FFT, short-length FIR), re-timing and pipelining - DSP Module Synthesis: Distributed arithmetic (DA) - Parallel algorithms and their dependence: - Data broadcast and pipelining Applications using common DSP algorithms.

Course outcome
Students will get a knowledge in DSP architectures and programming about DSP systems.

References:
3. Uwe Meyer-Baese, Digital Signal Processing with Field Programmable Gate Array, Springer- Verlag 2001

Internal continuous assessment: 40 marks

i) Two internal tests : 2 x 15 = 30 Marks
ii) Tutorials/Assignments = 10 Marks

End semester Examination: 60 marks

Answer any 6 questions by choosing at least one question from each module.


**Course Plan**

<table>
<thead>
<tr>
<th>Course No</th>
<th>Title: DSP ALGORITHMS AND ARCHITECTURES</th>
</tr>
</thead>
<tbody>
<tr>
<td>09EC7147</td>
<td>(L-T-P): 3-0-0 Credits: 3</td>
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</table>

<table>
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<tr>
<th>Module</th>
<th>Contact hours</th>
<th>% marks Internal exam</th>
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<tbody>
<tr>
<td>I</td>
<td>11</td>
<td>25</td>
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</table>


**FIRST INTERNAL TEST**

VLSI performance measures (area, power, and speed), structural modeling in VHDL. Analog signal processing for fast operation. Impact of non ideal characteristics of analog functional blocks on the system performance.

<table>
<thead>
<tr>
<th>Module</th>
<th>Contact hours</th>
<th>% marks Internal exam</th>
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<tbody>
<tr>
<td>II</td>
<td>5</td>
<td>12</td>
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</tbody>
</table>

**Module II** Circuits and DSP Architecture Design: Fast filtering algorithms (Winograd's, FFT, short-length FIR), retiming and pipelining, block processing, folding, distributed arithmetic architectures.


**SECOND INTERNAL TEST**

<table>
<thead>
<tr>
<th>Module</th>
<th>Contact hours</th>
<th>% marks Internal exam</th>
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<tbody>
<tr>
<td>IV</td>
<td>10</td>
<td>25</td>
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</tbody>
</table>

**Module IV** Parallel algorithms and their dependence: Applications to some common DSP algorithms. System timing using the scheduling vector. Projection of the dependence graph using a projection direction. The delay operator and z-transform techniques for mapping DSP algorithms onto processor arrays. Algebraic technique for mapping algorithms. The computation domain. The dependence matrix of a variable. The scheduling and projection functions. Data broadcast and pipelining Applications using common DSP algorithms.

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**Course No: 09EC7157**

**Course Title: HIGH PERFORMANCE NETWORKS**

**Credits: 3-0-0: 3** Year: 2015
Pre-requisites: Nil

Objective
- To study about different network topology
- To study about ATM TRAFFIC MANAGEMENT
- To study about different packet techniques.

Syllabus
High Speed LAN Fast Ethernet Technology - ISDN : Overview Of ISDN - asynchronous transfer mode networks- ATM traffic management - ATM signaling and data communication over ATM - LAN emulation over ATM, performance of data communication over ATM.

Course outcome
- Students will learn about different network topologies.
- Traffic managements and its solutions

References:
3. Craig Partridge, “Gigabit Networking”, Addison Wesley

Internal continuous assessment: 40 marks

i) Two internal tests : 2 x 15 = 30 Marks
ii) Tutorials/Assignments = 10 Marks

End semester Examination: 60 marks

Answer any 6 questions by choosing at least one question from each module.

Course Plan

<table>
<thead>
<tr>
<th>Course No</th>
<th>09EC71 57</th>
<th>Title: HIGH PERFORMANCE NETWORKS</th>
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<tbody>
<tr>
<td>(L-T-P)</td>
<td>3-0-0</td>
<td>Credits :3</td>
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<tr>
<th>Module</th>
<th>Contact hours</th>
<th>% marks Internal exam</th>
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</table>

### Module I
**HIGH SPEED LAN**: Fast Ethernet technology, FDDI, SONET and SDH standards, performance of high speed LAN – Throughput, delay and reliability, wavelength division multiplexed LAN – Routing and switching in WDM networks, Gigabit LAN.

<table>
<thead>
<tr>
<th>Module</th>
<th>Description</th>
<th>Credit</th>
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<tbody>
<tr>
<td>Module I</td>
<td><strong>HIGH SPEED LAN</strong>: Fast Ethernet technology, FDDI, SONET and SDH standards, performance of high speed LAN – Throughput, delay and reliability, wavelength division multiplexed LAN – Routing and switching in WDM networks, Gigabit LAN.</td>
<td>11 25</td>
</tr>
<tr>
<td>Module II</td>
<td><strong>ISDN</strong>: Overview of ISDN – user interface, architecture and standards, packet switched call over ISDN,B and D channels</td>
<td>5 12</td>
</tr>
<tr>
<td>Module III</td>
<td><strong>ASYNCHRONOUS TRANSFER MODE NETWORKS</strong>: TM protocol architecture, ATM adaption layer, fast packet switching techniques and VP/VC encapsulation, source characteristics.</td>
<td>10 25</td>
</tr>
<tr>
<td>Module IV (11 Hours)</td>
<td><strong>ATM TRAFFIC MANAGEMENT</strong>: Traffic management issues in ATM- resource management, connection management, policing and reactive control principles, discrete time queue analysis and application to CAC, leaky bucket and ECN/ICN. <strong>ATM SIGNALING AND DATA COMMUNICATION OVER ATM</strong>: ATM signaling fundamentals and Meta signaling, TCP/IP over ATM, challenges and proposals, LAN emulation over ATM, performance of data communication over ATM.</td>
<td>11 25</td>
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</tbody>
</table>

### ELECTIVE V
**Course No:** 09EC7167  
**Course Title:** LINEAR SYSTEMS THEORY  
**Credits:** 3-0-0: 3  
**Year:** 2015  
**Pre-requisites:** Nil  
**Objectives:** Upon completion of this course, the students will have deep knowledge and insight on vector space representation of signals, bases, orthonormal bases, analysis of linear systems, eigen values and eigen vectors, infinite dimensional vector spaces and Hilbert spaces.
Syllabus

Course outcome
students will be aware about vector space representation, Hilbert spaces and dimensional vector spaces.

References:
1. Sheldon Axler, Linear Algebra Done Right, Springer
3. Paul R. Halmos, Finite-Dimensional Vector Spaces, Springer
5. Arch W. Naylor and George R. Sell, Linear Operator Theory in Engineering and Science, Springer

Internal continuous assessment: 40 marks
i) Two internal tests : 2 x 15 = 30 Marks
ii) Tutorials/Assignments = 10 Marks

End semester Examination: 60 marks
Answer any 6 questions by choosing at least one question from each module.

COURSE PLAN

<table>
<thead>
<tr>
<th>Course No 09EC71 67</th>
<th>Title: LINEAR SYSTEMS THEORY</th>
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<tbody>
<tr>
<td></td>
<td>(L-T-P): 3-0-0 Credits :3</td>
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<tr>
<th>Module</th>
<th>Contact hours</th>
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<tbody>
<tr>
<td>Module I</td>
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<td>25</td>
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<tr>
<td>Module II</td>
<td>5</td>
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<tr>
<td>Linear Systems : Linear Maps :- Definitions and Examples,</td>
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</table>
Null Spaces and Ranges, The Matrix of a Linear Map, Invertibility

**FIRST INTERNAL TEST**

<table>
<thead>
<tr>
<th>Eigenvalues and Eigenvectors: Invariant Subspaces, Polynomials Applied to Operators, Upper-Triangular Matrices, Diagonal Matrices, Invariant Subspaces on Real Vector Spaces</th>
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<th>12</th>
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</table>

**Module III**


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**SECOND INTERNAL TEST**

**Module IV**


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</table>

**Course No:** 09EC7177

**Course Title:** OPTIMIZATION TECHNIQUES

**Credits:** 3-0-0: 3  **Year:** 2015

**Pre-requisites:** Nil

**Objectives:** The aim of this course is to expose students to various deterministic optimization tools and techniques. The course generally covers topics such as: an overview of mathematical modeling, linear and non linear programming and various constrained & unconstrained optimization techniques which will be useful for engineering applications.

**Syllabus**


**Course outcome**

Students will get an idea regarding different optimization techniques.

**References:**
1. David G Luenberger, Linear and Non Linear Programming, 2nd Ed, Addison-Wesley.

Internal continuous assessment: 40 marks

i) Two internal tests : 2 x 15 = 30 Marks
ii) Tutorials/Assignments = 10 Marks

End semester Examination: 60 marks
Answer any 6 questions by choosing at least one question from each module.

COURSE PLAN

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<table>
<thead>
<tr>
<th>Module II</th>
<th>Linear Programming: Introduction -Optimization model, formulation and applications -Classical optimization techniques: Single and multi variable problems-Types of constraints. Linear optimization algorithms: The simplex method -Basic solution and extreme point–Degeneracy</th>
<th>Contact hours</th>
<th>% marks</th>
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<td>5</td>
<td>12</td>
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FIRST INTERNAL TEST

The primal simplex method -Dual linear programs - Primal, dual, and duality theory - The dual simplex method -The primal-dual algorithm-Duality applications. Post optimization

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<tr>
<th>Contact hours</th>
<th>% marks</th>
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</table>
### Module III

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<td>25</td>
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### SECOND INTERNAL TEST

### Module IV
Constrained optimization: Lagrangian method - Sufficiency conditions - Kuhn-Tucker optimality conditions - Rate of convergence - Engineering applications Quadratic programming problems-Convex programming problems.

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<td>11</td>
<td>25</td>
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</tbody>
</table>
Course No: 09EC7187  
Course Title: SECURE COMMUNICATION  
Credits: 3-0-0: 3  
Year : 2015  
Pre-requisites: Nil  

Objective  
Objectives: The aim of this course is to expose students to various security techniques. The course generally covers topics such as: an overview of cryptographic algorithm.  

Syllabus  
Rings and fields - Homomorphism- Euclidean domains - Basic encryption techniques - Concept of cryptanalysis - Shannon’s theory - Private key and Public key cryptosystems - One way functions - Discrete log problem – Factorization problem - RSA encryption - Elliptic curves - Basic theory - Weistrass equation - Group law - Point at Infinity - Elliptic curves over finite fields  

Course outcome  
Students will be aware about the latest trends in secure communication and various cryptographic algorithms.  

References:  
5. Evangelos Kranakis, “ Primality and Cryptography”, John Wiley & Sons  

Internal continuous assessment: 40 marks  
i) Two internal tests : 2 x 15 = 30 Marks  
ii) Tutorials/Assignments = 10 Marks

End semester Examination: 60 marks  
Answer any 6 questions by choosing at least one question from each module.

Course Plan
Course No 09EC7187 Title: SECURE COMMUNICATION
(L-T-P): 3-0-0 Credits :3

<table>
<thead>
<tr>
<th>Module</th>
<th>Contact hours</th>
<th>% marks Internal exam</th>
</tr>
</thead>
<tbody>
<tr>
<td>Module 1</td>
<td>11</td>
<td>25</td>
</tr>
<tr>
<td>Module II</td>
<td>5</td>
<td>12</td>
</tr>
<tr>
<td>Watermarking in spatial domain - Additive methods, spread spectrum based methods- Steganography in spatial domain - Information theoretic approach for watermarking - Watermarking and steganography in frequency domain</td>
<td></td>
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</tbody>
</table>

FIRST INTERNAL TEST
Based on Discrete cosine transform, Discrete Wavelet transform and Contourlet transform - different methods - Comparison between frequency domain and spatial domain methods 5 12

Module III

SECOND INTERNAL TEST
Module 4: (10 Hours)
Elliptic curves - Basic theory - Weirstrass equation - Group law - Point at Infinity - Elliptic curves over finite fields - Discrete logarithm problem on EC - Elliptic curve cryptography - Diffie Hellmann key exchangever EC - Elgamal encryption over EC – ECDSA. 11 25

Course No: 09EC7197
Course Title: INFORMATION HIDING AND DATA ENCRYPTION
Credits: 3-0-0: 3 Year : 2015
Pre-requisites: Nil
Objectives: This course deals with the principles and implementation of secure communication. It extensively covers cryptography, steganography, their methods and
applications.

**Syllabus**


**Course outcome**

Studied various encryption schemes and obtain a clear idea about watermarking in both special and time domain.

**References:**

3. Fabien Petitcolas Stefan Katzenbeisser Information Hiding Techniques for Steganography and Digital Watermarking, Artech publishers

**Internal continuous assessment: 40 marks**

i) Two internal tests : 2 x 15 = 30 Marks
ii) Tutorials/Assignments = 10 Marks

**End semester Examination: 60 marks**

Answer any 6 questions by choosing at least one question from each module.
<table>
<thead>
<tr>
<th>Module</th>
<th>Contact hours</th>
<th>% marks Internal exam</th>
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</thead>
<tbody>
<tr>
<td>Module 1</td>
<td></td>
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<tr>
<td>Module 2</td>
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<tr>
<td>Basic encryption techniques - Concept of cryptanalysis - Shannon’s theory - Perfect secrecy - Block ciphers - Cryptographic algorithms</td>
<td>5</td>
<td>12</td>
</tr>
<tr>
<td>FIRST INTERNAL TEST</td>
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<tr>
<td>Features of DES - Stream ciphers - Pseudo random sequence generators – linear complexity - Non-linear combination of LFSRs - Boolean functions.</td>
<td>5</td>
<td>12</td>
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<tr>
<td>Module 3</td>
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<tr>
<td>Private key and Public key cryptosystems - One way functions - Discrete log problem – Factorization problem - RSA encryption - Diffie Hellmann key exchange - Message authentication and hash functions -Digital signatures - Secret sharing - features of visual cryptography - other applications of cryptography</td>
<td>10</td>
<td>25</td>
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<tr>
<td>SECOND INTERNAL TEST</td>
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<tr>
<td>Module 4</td>
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<tr>
<td>Difference between steganography and cryptography - Encryption and decryption for Watermarks - Embedding and Extraction Procedures – Image hashing - Watermarking with Visual Cryptography - Analysis of different methods.</td>
<td>11</td>
<td>25</td>
</tr>
</tbody>
</table>
**Course No:** 09EC7163  
**Course Title:** SEMINAR  
**Credits:** 0-0-2  
**Year:** 2015  
**Pre-requisites:** Nil

**Objective:** To assess the debating capability of the student to present a technical topic. Also to impart training to students to face audience and present their ideas and thus creating in them self esteem and courage that are essential for engineers.

Individual students are required to choose a topic of their interest from Embedded Systems related topics preferably from outside the M.Tech syllabus and give a seminar on that topic about 15 minutes. A committee consisting of at least three faculty members (preferably specialized in Embedded Systems) shall assess the presentation of the seminar and award marks to the students.

Each student shall submit two copies of a write up of his/her seminar topic. One copy shall be returned to the student after duly certifying it by the chairman of the assessing committee and the other will be kept in the departmental library. Internal continuous assessment marks are awarded based on the relevance of the topic, presentation skill, quality of the report and participation.

**Course outcome:**

The students who successfully complete this course will have the capability to

- Understand technical articles in peer reviewed journals and conferences;
- Analyze and present advanced topics in signal processing.

**Internal continuous assessment: 100 marks**

**Mark Distribution**

<table>
<thead>
<tr>
<th>Subject Relevance</th>
<th>10 marks</th>
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</thead>
<tbody>
<tr>
<td>Concept/ Knowledge in the topic</td>
<td>20 marks</td>
</tr>
<tr>
<td>Presentation</td>
<td>40 marks</td>
</tr>
<tr>
<td>Report</td>
<td>30 marks</td>
</tr>
<tr>
<td><strong>Total marks</strong></td>
<td>100 marks</td>
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</tbody>
</table>

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**Course No:** 09EC7183  
**Course Title:** MASTER RESEARCH PROJECT PHASE-I  
**Credits:** 0-0-12  
**Year:** 2015  
**Pre-requisites:** Nil
**Objective:** To improve the professional competency and research aptitude by touching the areas which otherwise not covered by theory or laboratory classes. The project work aims to develop the work practice in students to apply theoretical and practical tools/techniques to solve real life problems related to industry and current research.

The project work can be a design project/experimental project and/or computer simulation project on any of the topics in electronics design related topics. The project work is allotted individually on different topics. The students shall be encouraged to do their project work in the parent institute itself. If found essential, they may be permitted to continue their project outside the parent institute, subject to the conditions of M.Tech regulations. Department will constitute an Evaluation Committee to review the project work. The Evaluation committee shall be headed by the head of the department with two other faculty members in the area of the project, of which one shall be the project supervisor.

For this a committee

The student is required to undertake the master research project phase 1 during the third semester and the same is continued in the 4th semester (Phase 2). Phase 1 consist of preliminary thesis work, two reviews of the work and the submission of preliminary report. First review would highlight the topic, objectives, methodology and expected results. Second review evaluates the progress of the work, preliminary report and scope of the work which is to be completed in the 4th semester. The Evaluation committee consists of at least three faculty members of which internal guide and another expert in the specified area of the project shall be two essential members.

**Course outcome:**

The students who successfully complete this course will have the demonstrated capability to

- Formulate a research problem and perform literature review
- systematically carrying out a research and write technical reports

**Internal Continuous assessment:**

<table>
<thead>
<tr>
<th></th>
<th>Supervisor/ Guide</th>
<th>Evaluation Committee</th>
</tr>
</thead>
<tbody>
<tr>
<td>Project Review</td>
<td>20 Marks</td>
<td>30 Marks</td>
</tr>
</tbody>
</table>
Objective: To improve the professional competency and research aptitude by touching the areas which otherwise not covered by theory or laboratory classes. The project work aims to develop the work practice in students to apply theoretical and practical tools/techniques to solve real life problems related to industry and current research.

Master Research project phase II is a continuation of project phase I started in the third semester. There would be two reviews in the fourth semester, first in the middle of the semester and the second at the end of the semester. First review is to evaluate the progress of the work, presentation and discussion. Second review would be a pre-submission presentation before the evaluation committee to assess the quality and quantum of the work done. This would be a pre qualifying exercise for the students for getting approval by the departmental committee for the submission of the thesis. At least one technical paper is to be prepared for possible publication in journal or conferences. The technical paper is to be submitted along with the thesis.

The final evaluation of the project will be external evaluation. This shall be done by a committee constituted for the purpose by the principal of the college. The concerned head of the department shall be the chairman of this committee. It shall have two senior faculty members from the same department, project supervisor and the external supervisor, if any, of the student and an external expert either from an academic / R&D organization or from Industry as members.

Course outcome: The students who successfully complete this course will have the demonstrated capability to

- Formulate a research problem in signal processing area
- Systematically carrying out a research
- Write technical reports and research publications

Internal Continuous assessment:
<table>
<thead>
<tr>
<th>Project Review</th>
<th>Supervisor/ Guide</th>
<th>External Expert</th>
<th>Evaluation Committee</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>30 Marks</td>
<td>30 Marks</td>
<td>40 Marks</td>
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