B. E. COMMON TO ALL PROGRAMMES  
Choice Based Credit System (CBCS) and Outcome Based Education (OBE)  
SEMESTER - III  
TRANSFORM CALCULUS, FOURIER SERIES AND NUMERICAL TECHNIQUES

<table>
<thead>
<tr>
<th>Course Code</th>
<th>18MAT31</th>
<th>CIE Marks</th>
<th>40</th>
</tr>
</thead>
<tbody>
<tr>
<td>Teaching Hours/Week (L:T:P)</td>
<td>(2:2:0)</td>
<td>SEE Marks</td>
<td>60</td>
</tr>
<tr>
<td>Credits</td>
<td>03</td>
<td>Exam Hours</td>
<td>03</td>
</tr>
</tbody>
</table>

Course Learning Objectives:

- To have an insight into Fourier series, Fourier transforms, Laplace transforms, Difference equations and Z-transforms.
- To develop the proficiency in variational calculus and solving ODE’s arising in engineering applications, using numerical methods.

Module-1

Laplace Transforms: Definition and Laplace transform of elementary functions. Laplace transforms of Periodic functions and unit-step function – problems.

Inverse Laplace Transforms: Inverse Laplace transform - problems, Convolution theorem to find the inverse Laplace transform (without proof) and problems, solution of linear differential equations using Laplace transform.

Module-2


Module-3


Difference Equations and Z-Transforms: Difference equations, basic definition, z-transform-definition, Standard z-transforms, Damping and shifting rules, initial value and final value theorems (without proof) and problems. Inverse z-transform. Simple problems.

Module-4


Module-5


Calculus of Variations: Variation of function and functional, variational problems, Euler’s equation, Geodesics, hanging chain, problems.

Course Outcomes: At the end of the course the student will be able to:

- CO1: Use Laplace transform and inverse Laplace transform in solving differential/ integral equation arising in network analysis, control systems and other fields of engineering.
- CO2: Demonstrate Fourier series to study the behaviour of periodic functions and their applications in system communications, digital signal processing and field theory.
- CO3: Make use of Fourier transform and Z-transform to illustrate discrete/continuous function arising in wave and heat propagation, signals and systems.
- CO4: Solve first and second order ordinary differential equations arising in engineering problems using single step and multistep numerical methods.
- CO5: Determine the extremals of functionals using calculus of variations and solve problems arising in dynamics of rigid bodies and vibrational analysis.

Question paper pattern:

1. The question paper will have ten full questions carrying equal marks.
2. Each full question will be for 20 marks.
3. There will be two full questions (with a maximum of four sub-questions) from each module.

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Title of the Book</th>
<th>Name of the Author/s</th>
<th>Name of the Publisher</th>
<th>Edition and Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Textbooks</td>
<td></td>
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</tr>
<tr>
<td></td>
<td>Reference Books</td>
<td>Authors/Editors</td>
<td>Publisher</td>
<td>Edition Date</td>
</tr>
<tr>
<td>---</td>
<td>---------------------------------------------------------------------------------</td>
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</tr>
<tr>
<td>5</td>
<td>Advanced Engineering Mathematics</td>
<td>Chandrika Prasad and Reena Garg</td>
<td>Khanna Publishing</td>
<td>2018</td>
</tr>
</tbody>
</table>

**Web links and Video Lectures:**
2. http://www.class-central.com/subject/math(MOOCs)
4. VTU EDUSAT PROGRAMME - 20
### Course Learning Objectives:

- Describe basic network concepts emphasizing source transformation, source shifting, mesh and nodal techniques to solve for resistance/impedance, voltage, current and power.
- Explain network Thevenin’s, Millman’s, Superposition, Maximum Power transfer and Norton’s Theorems and apply them in solving the problems related to Electrical Circuits.
- Explain the behavior of networks subjected to transient conditions.
- Use applications of Laplace transforms to network problems.
- Study two port network parameters like Z, Y, T and h and their inter-relationships and applications.
- Study of RLC Series and parallel tuned circuit.

### Modules

<table>
<thead>
<tr>
<th>Modules</th>
<th>RBT Level</th>
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</thead>
<tbody>
<tr>
<td><strong>Module – 1</strong></td>
<td>L1, L2, L3, L4</td>
</tr>
<tr>
<td><strong>Basic Concepts:</strong> Practical sources, Source transformations, Network reduction using Star – Delta transformation, Loop and node analysis with linearly dependent and independent sources for DC and AC networks.</td>
<td></td>
</tr>
<tr>
<td><strong>Module – 2</strong></td>
<td>L1, L2, L3, L4</td>
</tr>
<tr>
<td><strong>Network Theorems:</strong> Superposition, Millman’s theorems, Thevinin’s and Norton’s theorems, Maximum Power transfer theorem.</td>
<td></td>
</tr>
<tr>
<td><strong>Module – 3</strong></td>
<td>L1, L2, L3, L4</td>
</tr>
<tr>
<td><strong>Transient behavior and initial conditions:</strong> Behavior of circuit elements under switching condition and their Representation, evaluation of initial and final conditions in RL, RC and RLC circuits for AC and DC excitations.</td>
<td>L1, L2, L3</td>
</tr>
<tr>
<td><strong>Module – 4</strong></td>
<td>L1, L2, L3, L4</td>
</tr>
<tr>
<td><strong>Laplace Transformation &amp; Applications:</strong> Solution of networks, step, ramp and impulse responses, waveform Synthesis.</td>
<td></td>
</tr>
<tr>
<td><strong>Module – 5</strong></td>
<td>L1, L2, L3, L4</td>
</tr>
<tr>
<td><strong>Two port network parameters:</strong> Definition of Z, Y, h and Transmission parameters, modelling with these parameters, relationship between parameters sets.</td>
<td></td>
</tr>
<tr>
<td><strong>Resonance:</strong></td>
<td>L1, L2, L3, L4</td>
</tr>
<tr>
<td><strong>Series Resonance:</strong> Variation of Current and Voltage with Frequency, Selectivity and Bandwidth, Q-Factor, Circuit Magnification Factor, Selectivity with Variable Capacitance, Selectivity with Variable Inductance.</td>
<td></td>
</tr>
<tr>
<td><strong>Parallel Resonance:</strong> Selectivity and Bandwidth, Maximum Impedance Conditions with C, L and f Variable, current in Anti-Resonant Circuit, The General Case-Resistance Present in both Branches.</td>
<td></td>
</tr>
</tbody>
</table>

### Course Outcomes:

- Determine currents and voltages using source transformation/ source shifting/ mesh/ nodal analysis and reduce given network using star-delta transformation/source transformation/ source shifting.
- Solve network problems by applying Superposition/ Reciprocity/ Thevenin’s/ Norton’s/ Maximum Power Transfer/ Millman’s Network Theorems and electrical laws to reduce circuit complexities and to arrive at feasible solutions.
- Calculate current and voltages for the given circuit under transient conditions.
Apply Laplace transform to solve the given network.

Solve the given network using specified two port network parameter like Z or Y or T or h.

Understand the concept of resonance

**Question paper pattern:**
- Examination will be conducted for 100 marks with question paper containing 10 full questions, each of 20 marks.
- Each full question can have a maximum of 4 sub questions.
- There will be 2 full questions from each module covering all the topics of the module.
- Students will have to answer 5 full questions, selecting one full question from each module.
- The total marks will be proportionally reduced to 60 marks as SEE marks is 60.

**Text Books:**

**Reference Books:**
# Course Code: 18EC33

**Course Learning Objectives:** This course will enable students to:
- Understand the basics of semiconductor physics and electronic devices.
- Describe the mathematical models BJTs and FETs along with the constructional details.
- Understand the construction and working principles of optoelectronic devices.
- Understand the fabrication process of semiconductor devices and CMOS process integration.

<table>
<thead>
<tr>
<th>Module</th>
<th>RBT Level</th>
</tr>
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<tbody>
<tr>
<td><strong>Module-1</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Semiconductors</strong></td>
<td>L1,L2</td>
</tr>
<tr>
<td>Bonding forces in solids, Energy bands, Metals, Semiconductors and Insulators, Direct and Indirect semiconductors, Electrons and Holes, Intrinsic and Extrinsic materials, Conductivity and Mobility, Drift and Resistance, Effects of temperature and doping on mobility, Hall Effect. (Text 1: 3.1.1, 3.1.2, 3.1.3, 3.1.4, 3.2.1, 3.2.3, 3.2.4, 3.4.1, 3.4.2, 3.4.3, 3.4.5).</td>
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<tr>
<td><strong>Module-2</strong></td>
<td></td>
</tr>
<tr>
<td><strong>P-N Junctions</strong></td>
<td>L1,L2</td>
</tr>
<tr>
<td>Forward and Reverse biased junctions- Qualitative description of Current flow at a junction, reverse bias, Reverse bias breakdown- Zener breakdown, avalanche breakdown, Rectifiers. (Text 1: 5.3.1, 5.3.3, 5.4, 5.4.1, 5.4.2, 5.4.3)</td>
<td></td>
</tr>
<tr>
<td>Optoelectronic Devices Photodiodes: Current and Voltage in an Illuminated Junction, Solar Cells, Photodetectors. Light Emitting Diode: Light Emitting materials. (Text 1: 8.1.1, 8.1.2, 8.1.3, 8.2, 8.2.1)</td>
<td></td>
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<tr>
<td><strong>Module – 3</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Bipolar Junction Transistor</strong></td>
<td>L1,L2</td>
</tr>
<tr>
<td>Fundamentals of BJT operation, Amplification with BJTs, BJT Fabrication, The coupled Diode model (Ebers-Moll Model), Switching operation of a transistor, Cutoff, saturation, switching cycle, specifications, Drift in the base region, Base narrowing, Avalanche breakdown. (Text 1: 7.1, 7.2, 7.3, 7.5.1, 7.6, 7.7.1, 7.7.2, 7.7.3).</td>
<td></td>
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<tr>
<td><strong>Module-4</strong></td>
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<tr>
<td><strong>Field Effect Transistors</strong></td>
<td>L1,L2</td>
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<tr>
<td><strong>Module-5</strong></td>
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<tr>
<td><strong>Fabrication of p-n junctions</strong></td>
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</tr>
<tr>
<td>Thermal Oxidation, Diffusion, Rapid Thermal Processing, Ion implantation, chemical vapour deposition, photolithography, Etching, metallization. (Text 1: 5.1)</td>
<td>L1,L2</td>
</tr>
<tr>
<td><strong>Integrated Circuits</strong></td>
<td></td>
</tr>
<tr>
<td>Background, Evolution of ICs, CMOS Process Integration, Integration of Other Circuit Elements. (Text 1: 9.1, 9.2, 9.3.1, 9.3.3).</td>
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</tr>
</tbody>
</table>

**Course outcomes:** After studying this course, students will be able to:
- Understand the principles of semiconductor Physics.
- Understand the principles and characteristics of different types of semiconductor devices.
- Understand the fabrication process of semiconductor devices.
- Utilize the mathematical models of semiconductor junctions and MOS transistors for circuits and systems.
Question paper pattern:
☐ Examination will be conducted for 100 marks with question paper containing 10 full questions, each of 20 marks.
☐ Each full question can have a maximum of 4 sub questions.
☐ There will be 2 full questions from each module covering all the topics of the module.
☐ Students will have to answer 5 full questions, selecting one full question from each module.
☐ The total marks will be proportionally reduced to 60 marks as SEE marks is 60.

Text Books:

Reference Book:
# B. E. (EC / TC)

**Choice Based Credit System (CBCS) and Outcome Based Education (OBE)**

**SEMESTER – III**

**DIGITAL SYSTEM DESIGN**

<table>
<thead>
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<th>Course Code</th>
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<td>Number of Lecture Hours/Week</td>
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<td>40 (08 Hours per Module)</td>
<td>Exam Hour</td>
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**CREDITS – 03**

**Course Learning Objectives:** This course will enable students to:

- Illustrate simplification of Algebraic equations using Karnaugh Maps and Quine-Mcclusky Techniques.
- Design Decoders, Encoders, Digital Multiplexer, Adders, Subtractors and Binary Comparators.
- Describe Latches and Flip-flops, Registers and Counters.
- Analyze Mealy and Moore Models.
- Develop state diagrams Synchronous Sequential Circuits.
- Appreciate the applications of digital circuits.

**Module – 1**

**Principles of combinational logic:** Definition of combinational logic, canonical forms, Generation of switching equations from truth tables, Karnaugh maps-3,4,5 variables, Incompletely specified functions (Don’t care terms) Simplifying Max term equations, Quine-McClusky techniques – 3 & 4 variables. *(Text 1 - Chapter 3)*

**L1, L2, L3**

**Module – 2**

**Analysis and design of combinational logic:** Decoders, Encoders, Digital multiplexers, Adders and subtractors, Look ahead carry, Binary comparators.*(Text 1 - Chapter 4).* Programmable Logic Devices, Complex PLD, FPGA. *(Text 3 - Chapter 9, 9.6 to 9.8)*

**L1, L2, L3**

**Module -3**

**Flip-Flops and its Applications:** Basic Bistable elements, Latches, The master-slave flip-flops (pulse-triggered flip-flops): SR flip-flops, JK flip-flops, Characteristic equations, Registers, binary ripple counters, and synchronous binary counters. *(Text 2 - Chapter 6)*

**L1, L2, L3**

**Module -4**

**Sequential Circuit Design:** Design of a synchronous counter,Design of a synchronous mod-n counter using clockedJK, D, T and SR flip-flops. *(Text 2 - Chapter 6)* Mealy and Moore models, State machine notation, Construction of state diagrams. *(Text 1 - Chapter 6)*

**L1, L2, L3**

**Module -5**

**Applications of Digital Circuits:** Design of a Sequence Detector, Guidelines for construction of state graphs, Design Example – Code Converter, Design of Iterative Circuits (Comparator), Design of Sequential Circuits using ROMs and PLAs,CPLDs and FPGAs, Serial Adder with Accumulator, Design of Binary Multiplier, Design of Binary Divider. *(Text 3 – 14.1, 14.3, 16.2, 16.3, 16.4, 18.1, 18.2, 18.3)*

**L1, L2, L3**

**Course Outcomes:** After studying this course, students will be able to:

- Explain the concept of combinational and sequential logic circuits.
- Design the combinational logic circuits.
- Design the sequential circuits using SR, JK, D, T flip-flops and Mealy & Moore machines
- Design applications of Combinational & Sequential Circuits.

**Question paper pattern:**

- Examination will be conducted for 100 marks with question paper containing 10 full questions, each of 20 marks.
- Each full question can have a maximum of 4 sub questions.
- There will be 2 full questions from each module covering all the topics of the module.
- Students will have to answer 5 full questions, selecting one full question from each module.
- The total marks will be proportionally reduced to 60 marks as SEE marks is 60.

### COMPUTER ORGANIZATION AND ARCHITECTURE

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<td>Total Number of Lecture Hours</td>
<td>40 (08 Hours per Module)</td>
<td>Exam Hours</td>
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**CREDITS—03**

**Course Learning Objectives:** This course will enable students to:
- Explain the basic sub systems of a computer, their organization, structure and operation.
- Illustrate the concept of programs as sequences of machine instructions.
- Demonstrate different ways of communicating with I/O devices.
- Describe memory hierarchy and concept of virtual memory.
- Illustrate organization of simple pipelined processor and other computing systems.

<table>
<thead>
<tr>
<th>Module 1</th>
<th>RBT Level</th>
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<tbody>
<tr>
<td><strong>Basic Structure of Computers:</strong> Computer Types, Functional Units, Basic Operational Concepts, Bus Structures, Software, Performance – Processor Clock, Basic Performance Equation (upto 1.6.2 of Chap 1 of Text).</td>
<td>L1, L2, L3</td>
</tr>
<tr>
<td><strong>Machine Instructions and Programs:</strong> Numbers, Arithmetic Operations and Characters, IEEE standard for Floating point Numbers, Memory Location and Addresses, Memory Operations, Instructions and Instruction Sequencing (upto 2.4.6 of Chap 2 and 6.7.1 of Chap 6 of Text).</td>
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<table>
<thead>
<tr>
<th>Module 2</th>
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<tbody>
<tr>
<td>Addressing Modes, Assembly Language, Basic Input and Output Operations, Stacks and Queues, Subroutines, Additional Instructions (from 2.4.7 of Chap 2, except 2.9.3, 2.11 &amp; 2.12 of Text).</td>
<td>L1, L2, L3</td>
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<table>
<thead>
<tr>
<th>Module 3</th>
<th></th>
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<tbody>
<tr>
<td><strong>Input/Output Organization:</strong> Accessing I/O Devices, Interrupts – Interrupt Hardware, Enabling and Disabling Interrupts, Handling Multiple Devices, Controlling Device Requests, Direct Memory Access (upto 4.2.4 and 4.4 except 4.4.1 of Chap 4 of Text).</td>
<td>L1, L2, L3</td>
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<table>
<thead>
<tr>
<th>Module 4</th>
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</thead>
<tbody>
<tr>
<td><strong>Memory System:</strong> Basic Concepts, Semiconductor RAM Memories-Internal organization of memory chips, Static memories, Asynchronous DRAMS, Read Only Memories, Cash Memories, Virtual Memories, Secondary Storage-Magnetic Hard Disks (5.1, 5.2, 5.2.1, 5.2.2, 5.2.3, 5.3, 5.5 (except 5.5.1 to 5.5.4), 5.7 (except 5.7.1), 5.9, 5.9.1 of Chap 5 of Text).</td>
<td>L1, L2, L3</td>
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<thead>
<tr>
<th>Module 5</th>
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<tbody>
<tr>
<td><strong>Basic Processing Unit:</strong> Some Fundamental Concepts, Execution of a Complete Instruction, Multiple Bus Organization, Hardwired Control, Microprogrammed Control (upto 7.5 except 7.5.1 to 7.5.6 of Chap 7 of Text).</td>
<td>L1, L2, L3</td>
</tr>
</tbody>
</table>

**Course Outcomes:** After studying this course, students will be able to:
- Explain the basic organization of a computer system.
- Explain different ways of accessing an input / output device including interrupts.
- Illustrate the organization of different types of semiconductor and other secondary storage memories.
- Illustrate simple processor organization based on hardwired control and micro programed control.
<table>
<thead>
<tr>
<th><strong>Question paper pattern:</strong></th>
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<tbody>
<tr>
<td>- Examination will be conducted for 100 marks with question paper containing 10 full questions, each of 20 marks.</td>
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<td>- Students will have to answer 5 full questions, selecting one full question from each module</td>
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<td>- The total marks will be proportionally reduced to 60 marks as SEE marks is 60.</td>
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<table>
<thead>
<tr>
<th><strong>Text Book:</strong></th>
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<table>
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<tr>
<th><strong>Reference Books:</strong></th>
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</table>
# Course Code: 18EC36
## Course Learning Objectives:
This course will enable students to:
- Study and analysis of thyristor circuits with different triggering conditions.
- Learn the applications of power devices in controlled rectifiers, converters and inverters.
- Understand types of instrument errors.
- Develop circuits for multirange Ammeters and Voltmeters.
- Describe principle of operation of digital measuring instruments and Bridges.
- Understand the operation of Transducers, Instrumentation amplifiers and PLCs.

## Module-1
### Introduction:
History, Power Electronic Systems, Power Electronic Converters and Applications (1.2, 1.3, 1.5 & 1.6 of Text 1).

### Thyristors:
- Static Anode-Cathode characteristics and Gate characteristics of SCR, Turn-ON methods, Turn-OFF mechanisms (2.3, 2.6 without 2.6.1), 2.7, 2.9 of text 1).
- Turn-OFF Methods: Natural and Forced Commutation – Class A and Class B types (refer 2.10 without design considerations).
- Gate Trigger Circuit: Resistance Firing Circuit, Resistance capacitance firing circuit (refer 3.5 upto 3.5.2 of Text 1).
- Unijunction Transistor: Basic operation and UJT Firing Circuit (refer 3.6, upto 3.6.4, except 3.6.2).

## Module-2
### Phase Controlled Converter:
Control techniques, Single phase half wave and full wave controlled rectifier with resistive and inductive loads, effect of freewheeling diode (refer Chapter 6 of Text 1 upto 6.4.1 without derivations).

### Choppers:
Chopper Classification, Basic Chopper operation: step-down, step-up and step-up/down choppers. (refer Chapter 8 of Text 1 upto 8.3.3)

## Module-3
### Inverters:
Classification, Single phase Half bridge and full bridge inverters with R and RL load (refer Chapter 9 of Text 1 upto 9.4.2 without Circuit Analysis).

### Switched Mode Power Supplies:
Isolated Flyback Converter, Isolated Forward Converter (only refer to the circuit operations in section 16.3 of Text 1upto 16.3.2 except 16.3.1.3 and derivations).

### Principles of Measurement:
Static Characteristics, Error in Measurement, Types of Static Error. (Text 2: 1.2-1.6) Multirange Ammeters, Multirange Voltmeter. (Text 2: 3.2, 4.4)

## Module-4
### Digital Voltmeter
- Ramp Technique, Dual slope integrating Type DVM, Direct Compensation type and Successive Approximations type DVM (Text 2: 5.1-5.3, 5.5, 5.6)
- **Digital Multimeter**: Digital Frequency Meter and Digital Measurement of Time, Function Generator.
- **Bridges**: Measurement of resistance: Wheatstone’s Bridge, AC Bridges-Capacitance and Inductance Comparison bridge, Wien’s bridge.
  (Text 2: refer 6.2, 6.3 upto 6.3.2, 6.4 upto 6.4.2, 8.8, 11.2, 11.8-11.10, 11.14).

#### Module-5

**Transducers**: Introduction, Electrical Transducer, Resistive Transducer, Resistive position Transducer, Resistance Wire Strain Gauges, Resistance Thermometer, Thermistor, LVDT.
- Instrumentation Amplifier using Transducer Bridge, Temperature indicators using Thermometer, Analog Weight Scale (Text 2: 14.3.3, 14.4.1, 14.4.3).

### Course Outcomes
- At the end of the course students should be able to:
  - Build and test circuits using power electronic devices.
  - Analyze and design controlled rectifier, DC to DC converters, DC to AC inverters and SMPS.
  - Define instrument errors.
  - Develop circuits for multirange Ammeters, Voltmeters and Bridges to measure passive component values and frequency.
  - Describe the principle of operation of Digital instruments and PLCs.
  - Use Instrumentation amplifier for measuring physical parameters.

### Question paper pattern:
- Examination will be conducted for 100 marks with question paper containing 10 full questions, each of 20 marks.
- Each full question can have a maximum of 4 sub questions.
- There will be 2 full questions from each module covering all the topics of the module.
- Students will have to answer 5 full questions, selecting one full question from each module.
- The total marks will be proportionally reduced to 60 marks as SEE marks is 60.

### Text Books

### Reference Books
Choice Based Credit System (CBCS) and Outcome Based Education (OBE)

SEMESTER – III

ELECTRONIC DEVICES AND INSTRUMENTATION LABORATORY

<table>
<thead>
<tr>
<th>Laboratory Code</th>
<th>18ECL37</th>
<th>CIE Marks</th>
<th>40</th>
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</thead>
<tbody>
<tr>
<td>Number of Lecture Hours/Week</td>
<td>02 Hr Tutorial (Instructions) + 02 Hours Laboratory</td>
<td>SEE Marks</td>
<td>60</td>
</tr>
<tr>
<td>RBT Level</td>
<td>L1, L2, L3</td>
<td>Exam Hours</td>
<td>03</td>
</tr>
</tbody>
</table>

CREDITS – 02

Course Learning Objectives: This laboratory course enables students to

- Understand the circuit schematic and its working.
- Study the characteristics of different electronic devices.
- Design and test simple electronic circuits as per the specifications using discrete electronic components.
- Familiarize with EDA software which can be used for electronic circuit simulation.

Laboratory Experiments

**PART A : Experiments using Discrete components**

1. Conduct experiment to test diode clipping (single/double ended) and clamping circuits (positive/negative).
2. Conduct experiment to study the working of half wave rectifier and full wave rectifier with and without filter and measure the ripple factor.
3. Conduct experiment to understand the characteristics of Zener diode and design a simple Zener voltage regulator to determine line and load regulation.
4. Conduct experiment to study the characteristics of LDR and photodiode and turn on an LED using LDR.
5. Conduct experiment to study the static characteristics of SCR.
6. Conduct experiment to study the SCR controlled half wave rectifier and full wave rectifier using RC triggering circuit.
7. Conduct experiment to study the characteristics of a temperature sensor bridge.
8. Conduct experiment to measure temperature in terms of current/voltage using a temperature sensor bridge.

**PART-B : Simulation using EDA software**

(EDWinXP, PSpice, MultiSim, Proteus, Circuit Lab or any equivalent tool)

1. Consider the input and output characteristics of BJT Common emitter configuration and evaluation of parameters.
2. Consider the input and output characteristics of a JFET and MOSFET.
3. Conduct experiment to study the UJT triggering circuit for controlled full wave Rectifier.
4. Design and simulation of a regulated power supply using EDA software.

Course Outcomes: On the completion of this laboratory course, the students will be able to:

- Understand the characteristics of various electronic devices and measurement of parameters.
- Design and test simple electronic circuits.
- Use of circuit simulation software for the implementation and characterization of electronic circuits and devices.

Conduct of Practical Examination:

- All laboratory experiments are to be considered for practical examination.
- For examination one question from **PART-A** and one question from **PART-B** or only one question from **PART-A** experiments based on the complexity, to be set.
- Students are allowed to pick one experiment from the lot.
- Strictly follow the instructions as printed on the cover page of answer script for breakup of marks.
- Change of experiment is allowed only once and Marks allotted to the procedure part to be made zero.

References:

B. E. (EC / TC)  
Choice Based Credit System (CBCS) and Outcome Based Education (OBE)  
SEMESTER – III  

DIGITAL SYSTEM DESIGN LABORATORY  

<table>
<thead>
<tr>
<th>Laboratory Code</th>
<th>IA Marks</th>
<th>Exam Mark</th>
<th>Exam Hour</th>
</tr>
</thead>
<tbody>
<tr>
<td>18ECL38</td>
<td></td>
<td>60</td>
<td>03</td>
</tr>
</tbody>
</table>

Number of Lecture Hours/Week  
02Hr Tutorial (Instructions)  
+ 02 Hours Laboratory  

CREDITS – 02  

Course objectives: This laboratory course enables students to get practical experience in design, realization and verification of  
- Demorgan’s Theorem, SOP, POS forms  
- Full/Parallel Adders, Subtractors and Magnitude Comparator  
- Multiplexer using logic gates  
- Demultiplexers and Decoders  
- Flip-Flops, Shift registers and Counters.  

NOTE:  
1. Use discrete components to test and verify the logic gates. The IC numbers given are suggestive; any equivalent ICs can be used.  
2. For experiment No. 11 and 12 any open source or licensed simulation tool may be used.  

Laboratory Experiments:  

1. Verify  
   (i) Demorgan's Theorem for 2 variables.  

2. Design and implement  
   (i) Half Adder & Full Adder using i) basic gates. ii) NAND gates  
   (ii) Half subtractor & Full subtractor using i) basic gates ii) NAND gates  

3. Design and implement  
   (i) 4-bit Parallel Adder/Subtractor using IC 7483.  
   (ii) BCD to Excess-3 code conversion and vice-versa.  

4. Design and Implementation of  
   (i) 1-bit Comparator  
   (ii) 5-bit Magnitude Comparator using IC 7485.  

5. Realize  
   (i) Adder & Subtractors using IC 74153.  
   (ii) 4-variable function using IC 74151(8:1MUX).  

6. Realize (i) Adder & Subtractors using IC 74139.  
   (ii) Binary to Gray code conversion & vice-versa (74139)  

7. Realize the following flip-flops using NAND Gates.  
   Master-Slave JK, D & T Flip-Flop.  

8. Realize the following shift registers using IC 7474/7495  
   (i) SISO (ii) SIPO (iii) PISO (iv) PIPO (v) Ring (vi) Johnson counter  

Revised Bloom’s Taxonomy (RBT) Level:

- L1, L2, L3
- L3, L4
- L3, L4
- L3, L4
- L3, L3
| 9. | Realize (i) Design Mod – N Synchronous Up Counter & Down Counter using 7476 JK Flip-flop  
|    | (ii) Mod-N Counter using IC7490 / 7476  
|    | (iii) Synchronous counter using IC74192 | L2, L3 |
| 10. | Design Pseudo Random Sequence generator using 7495. | L2, L3 |
| 11. | Design Serial Adder with Accumulator and Simulate using Simulation tool. | L2, L3, L4 |
| 12. | Design Binary Multiplier and Simulate using Simulation tool. | L2, L3, L4 |

**Course Outcomes:** On the completion of this laboratory course, the students will be able to:
- Demonstrate the truth table of various expressions and combinational circuits using logic gates.
- Design various combinational circuits such as adders, subtractors, comparators, multiplexers and demultiplexers.
- Construct flip-flops, counters and shift registers.
- Simulate Serial adder and Binary Multiplier.

**Conduct of Practical Examination:**
- All laboratory experiments are to be included for practical examination.
- Students are allowed to pick one experiment from the lot.
- Strictly follow the instructions as printed on the cover page of answer script for breakup of marks.
- Change of experiment is allowed only once and 15% Marks allotted to the procedure part to be made zero.
# B.E. (Common to all Programmes)
Choice Based Credit System (CBCS) and Outcome Based Education (OBE)

## SEMESTER –II / III / IV

### Aadalitha Kannada

<table>
<thead>
<tr>
<th>Course Code</th>
<th>18KAK28/39/49</th>
</tr>
</thead>
<tbody>
<tr>
<td>CIE Marks</td>
<td>100</td>
</tr>
</tbody>
</table>

| Teaching Hours/Week (L:T:P) | (0:2:0) |

| Credits | 01 |

### Course Details:

- **Course Code**: 18KAK28/39/49
- **CIE Marks**: 100
- **Teaching Hours/Week (L:T:P)**: (0:2:0)
- **Credits**: 01

### Learning Outcomes:

- Develop critical thinking skills and problem-solving abilities.
- Enhance understanding of the subject matter.
- Foster effective communication and interpersonal skills.
- Improve research and analytical skills.
- Develop lifelong learning habits.

### Course Objectives:

- **Objective 1**: Gain proficiency in the subject matter.
- **Objective 2**: Develop leadership skills.
- **Objective 3**: Foster ethical and professional behavior.
- **Objective 4**: Enhance team collaboration and project management.

### Course Content:

1. **Objectives and Methodologies**
   - Define objectives and methodologies for the course.
   - Implement course evaluation techniques.

2. **Course Evaluation Techniques**
   - Design and implement effective evaluation strategies.
   - Use CIE (Continuous Internal Evaluation)

3. **Course Assessment**
   - Develop assessment criteria.
   - Evaluate student performance.

### Conclusion:

- The course aims to equip students with the necessary skills and knowledge to succeed in their professional careers.
- Continuous assessment and evaluation techniques are crucial for student success.

---

**Note**: The information provided is a simplified representation of the course details and learning outcomes. Further details can be found in the course syllabus.

---

**Instructor**: Dr. [Name]

**Department Head**: [Name]

**Program Coordinator**: [Name]
<table>
<thead>
<tr>
<th><strong>Course Code</strong></th>
<th>18KVK28/39/49</th>
<th><strong>CIE Marks</strong></th>
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</thead>
<tbody>
<tr>
<td><strong>Credits</strong></td>
<td>01</td>
<td><strong>Teaching Hours/Week (L:T:P)</strong></td>
<td>(0:2:0)</td>
</tr>
</tbody>
</table>

**Course Learning Objectives:**
The course will enable the students to understand Kannada and communicate in Kannada language.

**Table of Contents:**
Chapter - 1: Vyavaharika kannada – Parichaya (Introduction to Vyavaharika Kannada).
Chapter - 2: Kannada Aksharamale haagu uchcharane (Kannada Alpabets and Pronunciation).
Chapter - 3: Sambhashanegaagi Kannada Padagalu (Kannada Vocabulary for Communication).
Chapter - 4: Kannada Grammar in Conversations (Sambhashaneyalli Kannada Vyakarana).
Chapter - 5: Activities in Kannada.

**Course Outcomes:**
At the end of the course, the student will be able to understand Kannada and communicate in Kannada language.
# CONSTITUTION OF INDIA, PROFESSIONAL ETHICS AND CYBER LAW (CPC)

<table>
<thead>
<tr>
<th>Course Code</th>
<th>18CPC39/49</th>
<th>CIE Marks</th>
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</tr>
</thead>
<tbody>
<tr>
<td>Teaching Hours/Week (L:T:P)</td>
<td>(1:0:0)</td>
<td>SEE Marks</td>
<td>60</td>
</tr>
<tr>
<td>Credits</td>
<td>01</td>
<td>Exam Hours</td>
<td>02</td>
</tr>
</tbody>
</table>

**Course Learning Objectives:** To
- know the fundamental political codes, structure, procedures, powers, and duties of Indian government institutions, fundamental rights, directive principles, and the duties of citizens
- Understand engineering ethics and their responsibilities; identify their individual roles and ethical responsibilities towards society.
- Know about the cybercrimes and cyber laws for cyber safety measures.

## Module-1
### Introduction to Indian Constitution:

## Module-2
### Union Executive and State Executive:

## Module-3
### Elections, Amendments and Emergency Provisions:

### Constitutional special provisions:
Special Provisions for SC and ST, OBC, Women, Children and Backward Classes.

## Module-4
### Professional / Engineering Ethics:
Scope & Aims of Engineering & Professional Ethics - Business Ethics, Corporate Ethics, Personal Ethics, Engineering and Professionalism, Positive and Negative Faces of Engineering Ethics, Code of Ethics as defined in the website of Institution of Engineers (India): Profession, Professionalism, and Professional Responsibility. Clash of Ethics, Conflicts of Interest. Responsibilities in Engineering Responsibilities in Engineering and Engineering Standards, the impediments to Responsibility. Trust and Reliability in Engineering, IPRs (Intellectual Property Rights), Risks, Safety and liability in Engineering

## Module-5
### Internet Laws, Cyber Crimes and Cyber Laws:
Internet and Need for Cyber Laws, Modes of Regulation of Internet. Types of cyber terror capability, Net neutrality, Types of Cyber Crimes, India and cyber law, Cyber Crimes and the information Technology Act 2000. Internet Censorship. Cybercrimes and enforcement agencies.

**Course Outcomes:** On completion of this course, students will be able to,
- CO 1: Have constitutional knowledge and legal literacy.
- CO 2: Understand Engineering and Professional ethics and responsibilities of Engineers.
- CO 3: Understand the the cybercrimes and cyber laws for cyber safety measures.

### Question paper pattern for SEE and CIE:
- The SEE question paper will be set for 100 marks and the marks scored by the students will proportionately be reduced to 60. The pattern of the question paper will be objective type (MCQ).
- For the award of 40 CIE marks, refer the University regulations 2018.
<table>
<thead>
<tr>
<th>No.</th>
<th>Textbook/s</th>
<th>Author/s</th>
<th>Publisher</th>
<th>Year</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>Constitution of India, Professional Ethics and Human Rights</td>
<td>Shubham Singles, Charles E. Haries, and et al</td>
<td>Cengage Learning India</td>
<td>2018</td>
</tr>
<tr>
<td>2</td>
<td>Cyber Security and Cyber Laws</td>
<td>Alfred Basta and et al</td>
<td>Cengage Learning India</td>
<td>2018</td>
</tr>
<tr>
<td></td>
<td><strong>Reference Books</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Introduction to the Constitution of India</td>
<td>Durga Das Basu</td>
<td>Prentice –Hall,</td>
<td>2008</td>
</tr>
<tr>
<td>4</td>
<td>Engineering Ethics</td>
<td>M. Govindarajan, S. Natarajan, V. S. Senthilkumar</td>
<td>Prentice –Hall,</td>
<td>2004</td>
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</table>
**Course Code**: 18MATDIP31  
**CIE Marks**: 40  
**Teaching Hours/Week (L:T:P)**: (2:1:0)  
**SEE Marks**: 60  
**Credits**: 0  
**Exam Hours**: 03

**Course Learning Objectives:**
- To provide basic concepts of complex trigonometry, vector algebra, differential and integral calculus.
- To provide an insight into vector differentiation and first order ODE’s.

**Module-1**
- **Complex Trigonometry**: Complex Numbers: Definitions and properties. Modulus and amplitude of a complex number, Argand’s diagram, De-Moivre’s theorem (without proof).
- **Vector Algebra**: Scalar and vectors. Addition and subtraction and multiplication of vectors- Dot and Cross products, problems.

**Module-2**
- **Partial Differentiation**: Euler’s theorem for homogeneous functions of two variables. Total derivatives - differentiation of composite function. Application to Jacobians of order two.

**Module-3**
- **Vector Differentiation**: Differentiation of vector functions. Velocity and acceleration of a particle moving on a space curve. Scalar and vector point functions. Gradient, Divergence, Curl and Laplacian (Definitions only). Solenoidal and irrotational vector fields-Problems.

**Module-4**
- **Integral Calculus**: Review of elementary integral calculus. Statement of reduction formulae for \( \sin^n x, \cos^n x, and \sin^m x \times \cos^n x \) and evaluation of these with standard limits-Examples. Double and triple integrals, problems.

**Module-5**

**Course Outcomes**: At the end of the course the student will be able to:
- CO1: Apply concepts of complex numbers and vector algebra to analyze the problems arising in related area.
- CO2: Use derivatives and partial derivatives to calculate rate of change of multivariate functions.
- CO3: Analyze position, velocity and acceleration in two and three dimensions of vector valued functions. CO4: Learn techniques of integration including the evaluation of double and triple integrals.
- CO5: Identify and solve first order ordinary differential equations.

**Question paper pattern:**
3. The question paper will have ten full questions carrying equal marks.
4. Each full question will be for 20 marks.
- There will be two full questions (with a maximum of four sub-questions) from each module.

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Title of the Book</th>
<th>Name of the Author/s</th>
<th>Name of the Publisher</th>
<th>Edition and Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Learning</td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>
# Complex Analysis, Probability and Statistical Methods

**Course Code:** 18MAT41  
**CIE Marks:** 40  
**Teaching Hours/Week (L:T:P):** (2:2:0)  
**SEE Marks:** 60  
**Credits:** 03  
**Exam Hours:** 03

## Course Learning Objectives:
- To provide an insight into applications of complex variables, conformal mapping and special functions arising in potential theory, quantum mechanics, heat conduction and field theory.
- To develop probability distribution of discrete, continuous random variables and joint probability distribution occurring in digital signal processing, design engineering and microwave engineering.

### Module-1
**Calculus of complex functions:** Review of function of a complex variable, limits, continuity, and differentiability. Analytic functions: Cauchy-Riemann equations in Cartesian and polar forms and consequences.  
**Construction of analytic functions:** Milne-Thomson method- Problems.

### Module-2
**Conformal transformations:** Introduction. Discussion of transformations: \( w = z^2, w = e^z, w = z + \frac{1}{z}, (z \neq 0). \)  
**Bilinear transformations: Problems.**  
**Complex integration:** Line integral of a complex function-Cauchy’s theorem and Cauchy’s integral formula and problems.

### Module-3
**Probability Distributions:** Review of basic probability theory. Random variables (discrete and continuous), probability mass/density functions. Binomial, Poisson, exponential and normal distributions- problems (No derivation for mean and standard deviation)-Illustrative examples.

### Module-4
**Statistical Methods:** Correlation and regression-Karl Pearson’s coefficient of correlation and rank correlation -problems. Regression analysis- lines of regression –problems.  
**Curve Fitting:** Curve fitting by the method of least squares- fitting the curves of the form- 
\[ y = ax + b, \quad y = ax^b, \quad y = ax^2 + bx + c. \]

### Module-5
**Joint probability distribution:** Joint Probability distribution for two discrete random variables, expectation and covariance.  
**Sampling Theory:** Introduction to sampling distributions, standard error, Type-I and Type-II errors. Test of hypothesis for means, student’s t-distribution, Chi-square distribution as a test of goodness of fit.

## Course Outcomes:
At the end of the course the student will be able to:
- Use the concepts of analytic function and complex potentials to solve the problems arising in electromagnetic field theory.
- Utilize conformal transformation and complex integral arising in aerofoil theory, fluid flow visualization and image processing.
- Apply discrete and continuous probability distributions in analyzing the probability models arising in engineering field.
- Make use of the correlation and regression analysis to fit a suitable mathematical model for the statistical data.
- Construct joint probability distributions and demonstrate the validity of testing the hypothesis.

### Question paper pattern:
5. The question paper will have ten full questions carrying equal marks.  
6. Each full question will be for 20 marks.  
   - There will be two full questions (with a maximum of four sub-questions) from each module.
<table>
<thead>
<tr>
<th>Textbooks</th>
<th>Author/s</th>
<th>Publisher</th>
<th>Edition</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Reference Books</th>
<th>Author/s</th>
<th>Publisher</th>
<th>Edition</th>
</tr>
</thead>
</table>

**Web links and Video Lectures:**
1. [http://nptel.ac.in/courses.php?disciplineID=111](http://nptel.ac.in/courses.php?disciplineID=111)
2. [http://www.class-central.com/subject/math(MOOCs)](http://www.class-central.com/subject/math(MOOCs))
4. [VTU EDUSAT PROGRAMME - 20](http://nptel.ac.in/courses.php?disciplineID=111)
Choice Based Credit System (CBCS) and Outcome Based Education (OBE)
SEMESTER – IV

ANALOG CIRCUITS

Subject Code  18EC42  CIE Marks  40
Number of Lecture Hours/Week  3+2 (Tutorial)  SEE Marks  60

Exam Hours  03  CREDITS – 04

Course Learning Objectives: This course will enable students to:

• Explain various BJT parameters, connections and configurations.
• Design and demonstrate the diode circuits and transistor amplifiers.
• Explain various types of FET biasing, and demonstrate the use of FET amplifiers.
• Construct frequency response of FET amplifiers at various frequencies.
• Analyze Power amplifier circuits in different modes of operation.
• Construct Feedback and Oscillator circuits using FET.

Modules

<table>
<thead>
<tr>
<th>Modules</th>
<th>RBT Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Module -1</td>
<td>L1, L2, L3</td>
</tr>
<tr>
<td><strong>BJT Biasing: Biasing in BJT amplifier circuits</strong>: The Classical Discrete circuit bias (Voltage-divider bias), Biasing using a collector to base feedback resistor.</td>
<td></td>
</tr>
<tr>
<td><strong>Small signal operation and Models</strong>: Collector current and transconductance, Base current and input resistance, Emitter current and input resistance, voltage gain, Separating the signal and the DC quantities, The hybrid Π model.</td>
<td></td>
</tr>
<tr>
<td><strong>MOSFETs: Biasing in MOS amplifier circuits</strong>: Fixing $V_{GS}$, Fixing $V_G$, Drain to Gate feedback resistor.</td>
<td></td>
</tr>
<tr>
<td><strong>Small signal operation and modeling</strong>: The DC bias point, signal current in drain, voltage gain, small signal equivalent circuit models, transconductance.</td>
<td>[Text 1: 3.5(3.5.1, 3.5.3), 3.6(3.6.1 to 3.6.6), 4.5(4.5.1, 4.5.2, 4.5.3), 4.6(4.6.1 to 4.6.6)]</td>
</tr>
<tr>
<td>Module -2</td>
<td>L1, L2, L3</td>
</tr>
<tr>
<td><strong>MOSFET Amplifier configuration</strong>: Basic configurations, characterizing amplifiers, CS amplifier with and without source resistance $R_S$, Source follower.</td>
<td></td>
</tr>
<tr>
<td><strong>MOSFET internal capacitances and High frequency model</strong>: The gate capacitive effect, Junction capacitances, High frequency model.</td>
<td></td>
</tr>
<tr>
<td><strong>Frequency response of the CS amplifier</strong>: The three frequency bands, high frequency response, Low frequency response.</td>
<td></td>
</tr>
<tr>
<td><strong>Oscillators</strong>: FET based Phase shift oscillator, LC and Crystal Oscillators (no derivation)</td>
<td>[Text 1: 4.7(4.7.1 to 4.7.4, 4.7.6) 4.8(4.8.1, 4.8.2, 4.8.3), 4.9, 12.2.2, 12.3.1, 12,3,2]</td>
</tr>
<tr>
<td>Module -3</td>
<td>L1, L2, L3</td>
</tr>
<tr>
<td><strong>Output Stages and Power Amplifiers</strong>: Introduction, Classification of output stages,, Class A output stage, Class B output stage: Transfer Characteristics, Power Dissipation, Power Conversion efficiency, Class AB output stage, Class C tuned Amplifier.</td>
<td>[Text 1: 7.1, 7.2, 7.3, 7.4.1, 7.5.1, 7.6 (7.6.1 to 7.6.3), 13.1, 13.2, 13.3(13.3.1, 13.3.2, 13.3.3, 13.4, 13.7)]</td>
</tr>
<tr>
<td>Module -4</td>
<td>L1, L2, L3</td>
</tr>
<tr>
<td><strong>Op-Amp with Negative Feedback and general applications</strong></td>
<td>[Text 2: 3.3(3.3.1 to 3.3.6), 3.4(3.4.1 to 3.4.5) 6.2, 6.5, 6.6 (6.6.1), 8.2, 8.3, 8.4]</td>
</tr>
<tr>
<td>Module -5</td>
<td>L1, L2, L3</td>
</tr>
</tbody>
</table>
### Op-Amp Circuits:
DAC - Weighted resistor and R-2R ladder, ADC- Successive approximation type, Small Signal half wave rectifier, Active Filters, First and second order low-pass and high-pass Butterworth filters, Band-pass filters, Band reject filters.

### 555 Timer and its applications:
Monostable and a stable Multivibrators.

[Text 2: 8.11(8.11.1a, 8.11.1b), 8.11.2a, 8.12.2, 7.2, 7.3, 7.4, 7.5, 7.6, 7.8, 7.9, 9.4.1, 9.4.1(a), 9.4.3, 9.4.3(a)]

### Course Outcomes:
At the end of this course students will demonstrate the ability to
- Understand the characteristics of BJTs and FETs.
- Design and analyze BJT and FET amplifier circuits.
- Design sinusoidal and non-sinusoidal oscillators.
- Understand the functioning of linear ICs.
- Design of Linear IC based circuits.

### Question paper pattern:
- Examination will be conducted for 100 marks with question paper containing 10 full questions, each of 20 marks.
- Each full question can have a maximum of 4 sub questions.
- There will be 2 full questions from each module covering all the topics of the module.
- Students will have to answer 5 full questions, selecting one full question from each module.
- The total marks will be proportionally reduced to 60 marks as SEE marks is 60.

### Text Books:

### Reference Books:
B. E. (EC / TC)
Choice Based Credit System (CBCS) and Outcome Based Education (OBE)
SEMESTER – III

**CONTROL SYSTEMS**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>18EC43</th>
</tr>
</thead>
<tbody>
<tr>
<td>CIE Marks</td>
<td>40</td>
</tr>
<tr>
<td>SEE Marks</td>
<td>60</td>
</tr>
<tr>
<td>Total Number of Lecture Hours</td>
<td>40 (08 Hours per Module)</td>
</tr>
<tr>
<td>Exam Hours</td>
<td>03</td>
</tr>
</tbody>
</table>

**CREDITS – 03**

Course Learning Objectives: This course will enable students to:
- Understand the basic features, configurations and application of control systems.
- Understand various terminologies and definitions for the control systems.
- Learn how to find a mathematical model of electrical, mechanical and electro-mechanical systems.
- Know how to find time response from the transfer function.
- Find the transfer function via Mason’s rule.
- Analyze the stability of a system from the transfer function.

<table>
<thead>
<tr>
<th>Modules</th>
<th>RBT Level</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Module – 1</strong></td>
<td></td>
</tr>
</tbody>
</table>

| **Module – 2**                               |           |
| **Block diagrams and signal flow graphs:** Transfer functions, Block diagram algebra and Signal Flow graphs. | L1, L2, L3 |

| **Module – 3**                               |           |
| **Time Response of feedback control systems:** Standard test signals, Unit step response of First and Second order Systems. Time response specifications, Time response specifications of second order systems, steady state errors and error constants. Introduction to PI, PD and PID Controllers (excluding design). | L1, L2, L3 |

| **Module – 4**                               |           |

| **Module – 5**                               |           |
| **Frequency domain analysis and stability:** Correlation between time and frequency response, Bode Plots, Experimental determination of transfer function. | L1, L2, L3 |

| **Module – 6**                               |           |
| **Introduction to Polar Plots:** (Inverse Polar Plots excluded) Mathematical preliminaries, Nyquist Stability criterion, (System s with transportation lag excluded). Introduction to lead, lag and lead- lag compensating networks (excluding design). **Introduction to State variable analysis:** Concepts of state, state variable and state models for electrical systems, Solution of state equations. | L1, L2, L3 |
**Course Outcomes:** At the end of the course, the students will be able to
- Develop the mathematical model of mechanical and electrical systems.
- Develop transfer function for a given control system using block diagram reduction techniques and signal flow graph method.
- Determine the time domain specifications for first and second order systems.
- Determine the stability of a system in the time domain using Routh-Hurwitz criterion and Root-locus technique.
- Determine the stability of a system in the frequency domain using Nyquist and Bode plots.

**Question paper pattern:**
- Examination will be conducted for 100 marks with question paper containing 10 full questions, each of 20 marks.
- Each full question can have a maximum of 4 sub questions.
- There will be 2 full questions from each module covering all the topics of the module.
- Students will have to answer 5 full questions, selecting one full question from each module.
- The total marks will be proportionally reduced to 60 marks as SEE marks is 60.

**Text Book:**

**Reference Books:**
<table>
<thead>
<tr>
<th>Course Code</th>
<th>18EC44</th>
<th>CIE Marks</th>
<th>40</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of Lecture Hours/Week</td>
<td>03</td>
<td>SEE Marks</td>
<td>60</td>
</tr>
<tr>
<td>Total Number of Lecture Hours</td>
<td>40 (8 Hours per Module)</td>
<td>Exam Hours</td>
<td>03</td>
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</tbody>
</table>

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**Course Learning Objectives:** This course will enable students to:

- Understand and Analyze Single and Multiple Random Variables, and their extension to Random Processes.
- Familiarization with the concept of Vector spaces and orthogonality with a qualitative insight into applications in communications.
- Compute the quantitative parameters for functions of single and Multiple Random Variables and Processes.
- Compute the quantitative parameters for Matrices and Linear Transformations.

---

**Module-1**

**Single Random Variables:** Definition of random variables, cumulative distribution function continuous and discrete random variables; probability mass function, probability density functions and properties; Expectations, Characteristic functions, Functions of single Random Variables, Conditioned Random variables. Application exercises to Some special distributions: Uniform, Exponential, Laplace, Gaussian; Binomial, and Poisson distribution. (Chapter 4 Text 1)

**RBT Level:** L1, L2, L3

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**Module -2**

**Multiple Random variables:** Concept, Two variable CDF and PDF, Two Variable expectations (Correlation, orthogonality, Independent), Two variable transformation, Two Gaussian Random variables, Sum of two independent Random Variables, Sum of IID Random Variables – Central limit Theorem and law of large numbers, Conditional joint Probabilities, Application exercises to Chi-square RV, Student-T RV, Cauchy and Rayleigh RVs. (Chapter 5 Text 1)

**RBT Level:** L1, L2, L3

---

**Module-3**

**Random Processes:** Ensemble, PDF, Independence, Expectations, Stationarity, Correlation Functions (ACF, CCF, Addition, and Multiplication), Ergodic Random Processes, Power Spectral Densities (Wiener Khinchin, Addition and Multiplication of RPs, Cross spectral densities), Linear Systems (output Mean, Cross correlation and Auto correlation of Input and output), Exercises with Noise. (Chapter 6 Text 1)

**RBT Level:** L1, L2, L3

---

**Module -4**

**Vector Spaces:** Vector spaces and Null subspaces, Rank and Row reduced form, Independence, Basis and dimension, Dimensions of the four subspaces, Rank-Nullity Theorem, Linear Transformations

**Orthogonality:** Orthogonal Vectors and Subspaces, Projections and Least squares, Orthogonal Bases and Gram- Schmidt Orthogonalization procedure. (Refer Chapters 2 and 3 Text 2)

**RBT Level:** L1, L2, L3

---

**Module -5**

**Determinants:** Properties of Determinants, Permutations and Cofactors. (Refer Chapter 4, Text 2)

**Eigenvalues and Eigen vectors:** Review of Eigenvalues and Diagonalization of a Matrix, Special Matrices (Positive Definite, Symmetric) and their properties, Singular Value Decomposition. (Refer Chapter 5, Text 2)

**RBT Level:** L1, L2, L3
**Course Outcomes:** After studying this course, students will be able to:

- Identify and associate Random Variables and Random Processes in Communication events.
- Analyze and model the Random events in typical communication events to extract quantitative statistical parameters.
- Analyze and model typical signal sets in terms of a basis function set of Amplitude, phase and frequency.
- Demonstrate by way of simulation or emulation the ease of analysis employing basis functions, statistical representation and Eigen values.

**Question paper pattern:**

- Examination will be conducted for 100 marks with question paper containing 10 full questions, each of 20 marks.
- Each full question can have a maximum of 4 sub questions.
- There will be 2 full questions from each module covering all the topics of the module.
- Students will have to answer 5 full questions, selecting one full question from each module.
- The total marks will be proportionally reduced to 60 marks as SEE marks is 60.

**Text Books:**


**Reference Books:**

## Course Learning Objectives:
This course will enable students to:
- Understand the mathematical description of continuous and discrete time signals and systems.
- Analyze the signals in time domain using convolution sum and Integral.
- Classify signals into different categories based on their properties.
- Analyze Linear Time Invariant (LTI) systems in time and transform domains.

### Module-1

**Introduction and Classification of signals:** Definition of signal and systems, communication and control system as examples Classification of signals.

**Basic Operations on signals:** Amplitude scaling, addition, multiplication, differentiation, integration, time scaling, time shift and time reversal.

**Elementary signals/Functions:** Exponential, sinusoidal, step, impulse and ramp functions.

### Module-2

**System Classification and properties:** Linear-nonlinear, Time variant-invariant, causal-noncausal, static-dynamic, stable-unstable, invertible.

**Time domain representation of LTI System:** Impulse response, convolution sum, convolution integral. Computation of convolution sum and convolution integral using graphical method for unit step and unit step, unit step and exponential, exponential and exponential, unit step and rectangular, and rectangular and rectangular.

### Module-3

**LTI system Properties in terms of impulse response:** System interconnection, Memory less, Causal, Stable, Invertible and Deconvolution, and step response.

**Fourier Representation of Periodic Signals:** CTF S properties and basic problems.

### Module-4

**Fourier Representation of aperiodic Signals:** Introduction to Fourier Transform & DTFT, Definition and basic problems.

**Properties of Fourier Transform:** Linearity, Time shift, Frequency shift, Scaling, Differentiation and Integration, Convolution and Modulation, Parseval’s theorem and problems on properties of Fourier Transform.

### Module-5

**The Z-Transforms:** Z transform, properties of the region of convergence, properties of the Z-transform, Inverse Z-transform, Causality and stability, Transform analysis of LTI systems.

### Course Outcomes:
At the end of the course, students will be able to:
- Analyze the different types of signals and systems.
- Determine the linearity, causality, time-invariance and stability properties of continuous and discrete time systems.
- Represent continuous and discrete systems in time and frequency domain using different transforms.
- Test whether the system is stable.
Question paper pattern:
- Examination will be conducted for 100 marks with question paper containing 10 full questions, each of 20 marks.
- Each full question can have a maximum of 4 sub questions.
- There will be 2 full questions from each module covering all the topics of the module.
- Students will have to answer 5 full questions, selecting one full question from each module.
- The total marks will be proportionally reduced to 60 marks as SEE marks is 60.

Text Book:

Reference Books:
## Course Learning Objectives:
This course will enable students to:

- Understand the difference between a Microprocessor and a Microcontroller and embedded microcontrollers.
- Familiarize the basic architecture of 8051 microcontroller.
- Program 8051 microprocessor using Assembly Level Language and C.
- Understand the interrupt system of 8051 and the use of interrupts.
- Understand the operation and use of inbuilt Timers/Counters and Serial port of 8051.
- Interface 8051 to external memory and I/O devices using its I/O ports.

### Module 1: 8051 Microcontroller

**Microprocessor Vs Microcontroller, Embedded Systems, Embedded Microcontrollers, 8051 Architecture- Registers, Pin diagram, I/O ports functions, Internal Memory organization. External Memory (ROM & RAM) interfacing.**

### Module 2: 8051 Instruction Set

**Addressing Modes, Data Transfer instructions, Arithmetic instructions, Logical instructions, Branch instructions, Bit manipulation instructions. Simple Assembly language program examples (without loops) to use these instructions.**

### Module 3: 8051 Stack, I/O Port Interfacing and Programming

**8051 Stack, Stack and Subroutine instructions. Assembly language program examples on subroutine and involving loops. Interfacing simple switch and LED to I/O ports to switch on/off LED with respect to switch status.**

### Module 4: 8051 Timers and Serial Port

**8051 Timers and Counters – Operation and Assembly language programming to generate a pulse using Mode-1 and a square wave using Mode-2 on a port pin. 8051 Serial Communication- Basics of Serial Data Communication, RS-232 standard, 9 pin RS232 signals, Simple Serial Port programming in Assembly and C to transmit a message and to receive data serially.**

### Module 5: 8051 Interrupts and Interfacing Applications

**8051 Interrupts. 8051 Assembly language programming to generate an external interrupt using a switch, 8051 C programming to generate a square waveform on a port pin using a Timer interrupt. Interfacing 8051 to ADC-0804, DAC, LCD and Stepper motor and their 8051 Assembly language interfacing programming.**

### Course Outcomes:
At the end of the course, students will be able to:

- Explain the difference between Microprocessors & Microcontrollers, Architecture of 8051 Microcontroller, Interfacing of 8051 to external memory and Instruction set of 8051.
- Write 8051 Assembly level programs using 8051 instruction set.
- Explain the Interrupt system, operation of Timers/Counters and Serial port of 8051.
- Write 8051 Assembly language program to generate timings and waveforms using 8051 timers, to send & receive serial data using 8051 serial port and to generate an external interrupt using a switch.
- Write 8051 Assembly language programs to generate square wave on 8051 I/O port pin using interrupt and C Programme to send & receive serial data using 8051 serial port.
- Interface simple switches, simple LEDs, ADC 0804, LCD and Stepper Motor to 8051 using 8051 I/O ports.

**Question paper pattern:**
- Examination will be conducted for 100 marks with question paper containing 10 full questions, each of 20 marks.
- Each full question can have a maximum of 4 sub questions.
- There will be 2 full questions from each module covering all the topics of the module.
- Students will have to answer 5 full questions, selecting one full question from each module.
- The total marks will be proportionally reduced to 60 marks as SEE marks is 60.

**Text Books:**

**Reference Books:**
**B. E. (EC / TC)**
Choice Based Credit System (CBCS) and Outcome Based Education (OBE)
SEMESTER – IV

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<td>Number of Lecture Hours/Week</td>
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<tr>
<td>RBT Levels</td>
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<tr>
<td>Exam Hours</td>
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**CREDITS – 02**

**Course Learning Objectives:** This laboratory course enables students to
- Understand the basics of microcontroller and its applications.
- Have in-depth knowledge of 8051 assembly language programming.
- Understand controlling the devices using C programming.
- The concepts of I/O interfacing for developing real time embedded systems.

## Laboratory Experiments

### I. PROGRAMMING
3. Counters.
4. Boolean & Logical Instructions (Bit manipulations).
5. Conditional CALL & RETURN.
6. Code conversion: BCD – ASCII; ASCII – Decimal; Decimal - ASCII; HEX - Decimal and Decimal - HEX.
7. Programs to generate delay. Programs using serial port and on-Chip timer/counter.

### II. INTERFACING
1. Interface a simple toggle switch to 8051 and write an ALP to generate an interrupt which switches on an LED (i) continuously as long as switch is on and (ii) only once for a small time when the switch is turned on.
2. Write a C program to (i) transmit and (ii) to receive a set of characters serially by interfacing 8051 to a terminal.
3. Write ALPs to generate waveforms using ADC interface.
4. Write ALP to interface an LCD display and to display a message on it.
5. Write ALP to interface a Stepper Motor to 8051 to rotate the motor.
6. Write ALP to interface ADC-0804 and convert an analog input connected to it.

**Course Outcomes:** On the completion of this laboratory course, the students will be able to:
- Write Assembly language programs in 8051 for solving simple problems that manipulate input data using different instructions of 8051.
- Interface different input and output devices to 8051 and control them using Assembly language programs.
- Interface the serial devices to 8051 and do the serial transfer using C programming.

**Conduct of Practical Examination:**
- All laboratory experiments are to be included for practical examination.
- Students are allowed to pick one experiment from the lot.
- Strictly follow the instructions as printed on the cover page of answer script for breakup of marks.
- Change of experiment is allowed only once and 15% Marks allotted to the procedure part to be made zero.
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<td>RBT Level</td>
<td>L1, L2, L3</td>
<td>Exam Hours</td>
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</table>

**CREDITS – 02**

**Course Learning Objectives:** This laboratory course enables students to
- Understand the circuit configurations and connectivity of BJT and FET Amplifiers and Study of frequency response
- Design and test of analog circuits using OPAMPs
- Understand the feedback configurations of transistor and OPAMP circuits
- Use of circuit simulation for the analysis of electronic circuits.

**Laboratory Experiments**

**PART A : Hardware Experiments**

1. Design and setup the Common Source JFET/MOSFET amplifier and plot the frequency response.
2. Design and set up the BJT common emitter voltage amplifier with and without feedback and determine the gain-bandwidth product, input and output impedances.
3. Design and set-up BJT/FET i) Colpitts Oscillator, and ii) Crystal Oscillator
4. Design active second order Butterworth low pass and high pass filters.
5. Design Adder, Integrator and Differentiator circuits using Op-Amp
6. Test a comparator circuit and design a Schmitt trigger for the given UTP and LTP values and obtain the hysteresis.
7. Design 4 bit R – 2R Op-Amp Digital to Analog Converter (i) using 4 bit binary input from toggle switches and (ii) by generating digital inputs using mod-16 counter.
8. Design Monostable and a stable Multivibrator using 555 Timer.

**PART-B : Simulation using EDA software** (EDWinXP, PSpice, MultiSim, Proteus, CircuitLab or any other equivalent tool can be used)

1. RC Phase shift oscillator and Hartley oscillator
2. Narrow Band-pass Filter and Narrow band-reject filter
3. Precision Half and full wave rectifier

**Course Outcomes:** On the completion of this laboratory course, the students will be able to:
- Design analog circuits using BJT/FETs and evaluate their performance characteristics.
- Design analog circuits using OPAMPs for different applications
- Simulate and analyze analog circuits that usesICs for different electronic applications.

**Conduct of Practical Examination:**
- All laboratory experiments are to be included for practical examination.
- Students are allowed to pick one experiment from the lot.
- Strictly follow the instructions as printed on the cover page of answer script for breakup of marks.
- Change of experiment is allowed only once and Marks allotted to the procedure part to be made zero.
Reference Books:
B. E. Common to all Programmes  
Choice Based Credit System (CBCS) and Outcome Based Education (OBE)  
SEMESTER - IV 

ADDITIONAL MATHEMATICS – II  
(A Mandatory Learning Course: Common to All Programmes)  
(A Bridge course for Lateral Entry students under Diploma quota to BE/B. Tech. programmes) 

Course Code  18MATDIP41  
CIE Marks  40  
Teaching Hours/Week (L:T:P)  (2:1:0)  
SEE Marks  60  
Credits  0  
Exam Hours  03  

Course Learning Objectives:  
- To provide essential concepts of linear algebra, second & higher order differential equations along with methods to solve them. 
- To provide an insight into elementary probability theory and numerical methods. 

Module-1  

Module-2  

Module-3  
Higher order ODE’s: Linear differential equations of second and higher order equations with constant coefficients. Homogeneous /non-homogeneous equations. Inverse differential operators. \[ \text{Particular Integral restricted to } R(x) = e^{ax}, \sin ax, \cos ax \text{ for } f(p)y = R(x) \]  

Module-4  
Partial Differential Equations (PDE’s):- Formation of PDE’s by elimination of arbitrary constants and functions. Solution of non-homogeneous PDE by direct integration. Homogeneous PDEs involving derivative with respect to one independent variable only. 

Module-5  

Course Outcomes: At the end of the course the student will be able to: 
CO1: Solve systems of linear equations using matrix algebra. 
CO2: Apply the knowledge of numerical methods in modelling and solving engineering problems. 
CO3: Make use of analytical methods to solve higher order differential equations. 
CO4: Classify partial differential equations and solve them by exact methods. 
CO5: Apply elementary probability theory and solve related problems. 

Question paper pattern: 
7. The question paper will have ten full questions carrying equal marks. 
8. Each full question will be for 20 marks.  
- There will be two full questions (with a maximum of four sub-questions) from each module. 
- Each full question will have sub-question covering all the topics under a module. 
- The students will have to answer five full questions, selecting one full question from each 

<table>
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<th>SI No</th>
<th>Title of the Book</th>
<th>Name of the Author/s</th>
<th>Name of the Publisher</th>
<th>Edition and Year</th>
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Reference Books
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<th>Edition, Year</th>
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### TECHNOCRITICAL INNOVATION MANAGEMENT AND ENTREPRENEURSHIP

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<td>18ES51</td>
<td>40</td>
<td>60</td>
<td>40 (08 Hours / Module)</td>
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**CREDITS – 03**

**Module-1**

| Management: Nature and Functions of Management – Importance, Definition, Management Functions, Levels of Management, Roles of Manager, Managerial Skills, Management & Administration, Management as a Science, Art & Profession (Selected topics of Chapter 1, Text 1). |
| Planning: Planning- Nature, Importance, Types, Steps and Limitations of Planning; Decision Making – Meaning, Types and Steps in Decision Making(Selected topics from Chapters 4 & 5, Text 1). |

**Module-2**

| Organizing and Staffing: Organization-Meaning, Characteristics, Process of Organizing, Principles of Organizing, Span of Management (meaning and importance only), Departmentalisation, Committees–Meaning, Types of Committees; Centralization Vs Decentralization of Authority and Responsibility; Staffing- Need and Importance, Recruitment and Selection Process (Selected topics from Chapters 7, 8 & 11, Text 1). |
| Directing and Controlling: Meaning and Requirements of Effective Direction, Giving Orders; Motivation-Nature of Motivation, Motivation Theories (Maslow’s Need-Hierarchy Theory and Herzberg’s Two Factor Theory); Communication – Meaning, Importance and Purposes of Communication; Leadership-Meaning, Characteristics, Behavioural Approach of Leadership; Coordination-Meaning, Types, Techniques of Coordination; Controlling – Meaning, Need for Control System, Benefits of Control, Essentials of Effective Control System, Steps in Control Process (Selected topics from Chapters 15 to 18 and 9, Text 1). |

**Module-3**

| Social Responsibilities of Business: Meaning of Social Responsibility, Social Responsibilities of Business towards Different Groups, Social Audit, Business Ethics and Corporate Governance (Selected topics from Chapter 3, Text 1). |
| Entrepreneurship: Definition of Entrepreneur, Importance of Entrepreneurship, concepts of Entrepreneurship, Characteristics of successful Entrepreneur, Classification of Entrepreneurs, Myths of Entrepreneurship, Entrepreneurial Development models, Entrepreneurial development cycle, Problems faced by Entrepreneurs and capacity building for Entrepreneurship (Selected topics from Chapter 2, Text 2). |

**Module-4**

| Family Business: Role and Importance of Family Business, Contributions of Family Business in India, Stages of Development of a Family Business, Characteristics of a Family-owned Business in India, Various types of family businesses (Selected topics from Chapter 4,(Page 71-75) Text 2). |
| Idea Generation and Feasibility Analysis- Idea Generation; Creativity and Innovation; Identification of Business Opportunities; Market Entry Strategies; Marketing Feasibility; Financial Feasibilities; Political Feasibilities; Economic Feasibility; Social and Legal Feasibilities; Technical Feasibilities; Managerial Feasibility, Location and Other Utilities Feasibilities.(Selected topics from Chapter 6(Page No. 111-117) & Chapter 7(Page No. 140-142), Text 2) |

**Module-5**

| Course Learning Objectives: This course will enable students to: |
| Understand basic skills of Management |
| Understand the need for Entrepreneurs and their skills |
| Identify the Management functions and Social responsibilities |
| Understand the Ideation Process, creation of Business Model, Feasibility Study and sources of funding |

**RBT Level:** L1, L2
**Business model** – Meaning, designing, analyzing and improvising; Business Plan – Meaning, Scope and Need; Financial, Marketing, Human Resource and Production/Service Plan; Business plan Formats; Project report preparation and presentation; Why some Business Plan fails? *(Selected topics from Chapter 8 (Page No 159-164, Text 2)*

**Financing and How to start a Business?** Financial opportunity identification; Banking sources; Nonbanking Institutions and Agencies; Venture Capital – Meaning and Role in Entrepreneurship; Government Schemes for funding business; Pre launch, Launch and Post launch requirements; Procedure for getting License and Registration; Challenges and Difficulties in Starting an Enterprise *(Selected topics from Chapter 7(Page No 147-149), Chapter 5(Page No 93-99) & Chapter 8(Page No. 166-172) Text 2)*

**Project Design and Network Analysis:** Introduction, Importance of Network Analysis, Origin of PERT and CPM, Network, Network Techniques, Need for Network Techniques, Steps in PERT, CPM, Advantages, Limitations and Differences. *(Selected topics from Chapters 20, Text 3)*

**Course Outcomes:** After studying this course, students will be able to:
- Understand the fundamental concepts of Management and Entrepreneurship and opportunities in order to setup a business
- Describe the functions of Managers, Entrepreneurs and their social responsibilities
- Understand the components in developing a business plan
- Awareness about various sources of funding and institutions supporting entrepreneurs

**Text Books:**

**Reference Book:**
**B. E. (EC / TC)**  
Choice Based Credit System (CBCS) and Outcome Based Education (OBE)  
SEMESTER – V  

**DIGITAL SIGNAL PROCESSING**

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<th>CIE Marks</th>
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<td>SEE Marks</td>
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<td>Exam Hours</td>
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</table>

**CREDITS – 04**

**Course Learning Objectives:** This course will enable students to
- Understand the frequency domain sampling and reconstruction of discrete time signals.
- Study the properties and the development of efficient algorithms for the computation of DFT.
- Realization of FIR and IIR filters in different structural forms.
- Learn the procedures to design of IIR filters from the analog filters using impulse invariance and bilinear transformation.
- Study the different windows used in the design of FIR filters and design appropriate filters based on the specifications.
- Understand the architecture and working of DSP processor

**Module-1**

**Discrete Fourier Transforms (DFT):** Frequency domain sampling and Reconstruction of Discrete Time Signals, The Discrete Fourier Transform, DFT as a linear transformation, Properties of the DFT: Periodicity, Linearity and Symmetry properties, Multiplication of two DFTs and Circular Convolution, Additional DFT properties. [Text 1]

**Module-2**

**Linear filtering methods based on the DFT:** Use of DFT in Linear Filtering, Filtering of Long data Sequences.  
**Fast-Fourier-Transform (FFT) algorithms:** Efficient Computation of the DFT: Radix-2 FFT algorithms for the computation of DFT and IDFT–decimation-in-time and decimation-in-frequency algorithms. [Text 1]

**Module-3**

**Design of FIR Filters:** Characteristics of practical frequency –selective filters, Symmetric and Antisymmetric FIR filters, Design of Linear-phase FIR filters using windows - Rectangular, Hamming, Hanning, Bartlett windows. Design of FIR filters using frequency sampling method. Structure for FIR Systems: Direct form, Cascade form and Lattice structures.[Text1]

**Module-4**


**Module-5**

**Digital Signal Processors:** DSP Architecture, DSP Hardware Units, Fixed point format, Floating point Format, IEEE Floating point formats, Fixed point digital signal processors, Floating point processors, FIR and IIR filter implementations in Fixed point systems,[Text 2]

**Course Outcomes:** After studying this course, students will be able to:
- Determine response of LTI systems using time domain and DFT techniques.
- Compute DFT of real and complex discrete time signals.
- Computation of DFT using FFT algorithms and linear filtering approach.
- Design and realize FIR and IIR digital filters
- Understand the DSP processor architecture.
Question paper pattern:
- Examination will be conducted for 100 marks with question paper containing 10 full questions, each of 20 marks.
- Each full question can have a maximum of 4 sub questions.
- There will be 2 full questions from each module covering all the topics of the module.
- Students will have to answer 5 full questions, selecting one full question from each module.
- The total marks will be proportionally reduced to 60 marks as SEE marks is 60

Text Book:

Reference Books:
Choice Based Credit System (CBCS) and Outcome Based Education (OBE)

SEMESTER – V

PRINCIPLES OF COMMUNICATION SYSTEMS

Subject Code: 18EC53
CIE Marks: 40
Number of Lecture Hours/Week: 3+2 (Tutorial)
SEE Marks: 60
Exam Hours: 03
CREDITS – 04

Course Learning Objectives:

- Understand and analyze concepts of Analog Modulation schemes viz; AM, FM, Low pass sampling and Quantization as a random process.
- Understand and analyze concepts digitization of signals viz; sampling, quantizing and encoding.
- Evolve the concept of SNR in the presence of channel induced noise and study Demodulation of analog modulated signals.
- Evolve the concept of quantization noise for sampled and encoded signals and study the concepts of reconstruction from these samples at a receiver.

Module-1

AMPLITUDE MODULATION: Introduction, Amplitude Modulation: Time & Frequency Domain description, Switching modulator, Envelop detector. (3.1 – 3.2 in Text)
DOUBLE SIDE BAND-SUPPRESSED CARRIER MODULATION: Time and Frequency Domain description, Ring modulator, Coherent detection, Costas Receiver, Quadrature Carrier Multiplexing. (3.3 – 3.4 in Text)

Module-2


Module-3

[Review of Mean, Correlation and Covariance functions of Random Processes.
(No questions to be set on these topics)]
NOISE - Shot Noise, Thermal noise, White Noise, Noise Equivalent Bandwidth (5.10 in Text)
NOISE IN ANALOG MODULATION: Introduction, Receiver Model, Noise in DSB-SC receivers. Noise in AM receivers, Threshold effect, Noise in FM receivers, Capture effect, FM threshold effect, FM threshold reduction, Pre-emphasis and De-emphasis in FM (6.1 – 6.6 in Text)

Module-4


Module-5

SAMPLING AND QUANTIZATION (Contd):
The Quantization Random Process, Quantization Noise, Pulse–Code Modulation: Sampling, Quantization, Encoding, Decoding, Filtering, Multiplexing; Delta Modulation (7.8 – 7.10 in Text), Application examples - (a) Video + MPEG (7.11 in Text) and (b) Vocoders(refer Section 6.8 of Reference Book 1).

Course Outcomes:

After studying this course, students will be able to:
- Analyze and compute performance of AM and FM modulation in the presence of noise at the receiver.
- Analyze and compute performance of digital formatting processes with quantization noise.
- Multiplex digitally formatted signals at Transmitter and demultiplex the signals and reconstruct digitally formatted signals at the receiver.
- Design/Demonstrate the use of digital formatting in Multiplexers, Vocoders and Video transmission.
**Question paper pattern:**
- Examination will be conducted for 100 marks with question paper containing 10 full questions, each of 20 marks.
- Each full question can have a maximum of 4 sub questions.
- There will be 2 full questions from each module covering all the topics of the module.
- Students will have to answer 5 full questions, selecting one full question from each module.
- The total marks will be proportionally reduced to 60 marks as SEE marks is 60.

**Text Book:**

**Reference Books:**
## INFORMATION THEORY and CODING

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### Course Learning Objectives:

This course will enable students to
- Understand the concept of Entropy, Rate of information and order of the source with reference to dependent and independent source.
- Study various source encoding algorithms.
- Model discrete & continuous communication channels.
- Study various error control coding algorithms.

### Module-1

**Information Theory:** Introduction, Measure of information, Information content of message, Average Information content of symbols in Long Independent sequences, Average Information content of symbols in Long dependent sequences, Markov Statistical Model for Information Sources, Entropy and Information rate of Markov Sources

**L1, L2, L3**

### Module-2

**Source Coding:** Encoding of the Source Output, Shannon’s Encoding Algorithm

**L1, L2, L3**

### Module-3

**Information Channels:** Communication Channels, Discrete Communication channels Channel Matrix, Joint probability Matrix, Binary Symmetric Channel, System Entropies.

**L1, L2, L3**

### Module-4

**Error Control Coding:**
- Introduction, Examples of Error control coding, methods of Controlling Errors, Types of Errors, types of Codes, Linear Block Codes: matrix description of Linear Block Codes, Error detection & Correction capabilities of Linear Block Codes, Single error correction Hamming code, Table lookup Decoding using Standard Array.
- **Binary Cyclic Codes:** Algebraic Structure of Cyclic Codes, Encoding using an (n-k) Bit Shift register, Syndrome Calculation, Error Detection and Correction

**L1, L2, L3**

### Module-5

**Convolution Codes:** Convolution Encoder, Time domain approach, Transform domain approach, Code Tree, Trellis and State Diagram, The Viterbi Algorithm

**L1, L2, L3**

### Course Outcomes:

After studying this course, students will be able to:
- Explain concept of Dependent & Independent Source, measure of information, Entropy, Rate of Information and Order of a source
- Represent the information using Shannon Encoding, Shannon Fano, Prefix and Huffman Encoding Algorithms.
- Model the continuous and discrete communication channels using input, output and joint probabilities.
- Determine a codeword comprising of the check bits computed using Linear Block codes, cyclic codes & convolutional codes.
- Design the encoding and decoding circuits for Linear Block codes, cyclic codes, convolutional codes, BCH and Golay codes.

**Question paper pattern:**
- Examination will be conducted for 100 marks with question paper containing 10 full questions, each of 20 marks.
- Each full question can have a maximum of 4 sub questions.
- There will be 2 full questions from each module covering all the topics of the module.
- Students will have to answer 5 full questions, selecting one full question from each module.
- The total marks will be proportionally reduced to 60 marks as SEE marks is 60.

**Text Book:**

**Reference Books:**
# ELECTROMAGNETIC WAVES

<table>
<thead>
<tr>
<th>Course Code</th>
<th>CIE Marks</th>
<th>SEE Marks</th>
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<tr>
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<td>60</td>
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<table>
<thead>
<tr>
<th>Total Number of Lecture Hours</th>
<th>40 (8 Hours per Module)</th>
<th>Exam Hours</th>
</tr>
</thead>
</table>

## CREDITS – 03

### Course Learning Objectives:

- Study the different coordinate systems, Physical significance of Divergence, Curl and Gradient.
- Understand the applications of Coulomb’s law and Gauss law to different charge distributions and the applications of Laplace’s and Poisson’s Equations to solve real time problems on capacitance of different charge distributions.
- Understand the physical significance of Biot-Savart’s, Amperes’s Law and Stokes'theorem for different current distributions.
- Infer the effects of magnetic forces, materials and inductance.
- Know the physical interpretation of Maxwell’ equations and applications for Plane waves for their behavior in different media.
- Acquire knowledge of Poynting theorem and its application of power flow.

### Module-1

**Revison of Vector Calculus – (Text 1: Chapter 1)**

- **Coulomb’s Law, Electric Field Intensity and Flux density:** Experimental law of Coulomb, Electric field intensity, Field due to continuous volume charge distribution, Field of a line charge, Field due to Sheet of charge, Electric flux density, Numerical Problems. *(Text: Chapter 2.1 to 2.5, 3.1)*

### Module-2

- **Gauss’s law and Divergence:** Gauss ‘law, Application of Gauss’ law to point charge, line charge, Surface charge and volume charge, Point (differential) form of Gauss law, Divergence. Maxwell’s First equation (Electrostatics), Vector Operator ▼ and divergence theorem, Numerical Problems *(Text: Chapter 3.2 to 3.7).*
- **Energy, Potential and Conductors:** Energy expended or work done in moving a point charge in an electric field, The line integral, Definition of potential difference and potential, The potential field of point charge, Potential gradient, Numerical Problems *(Text: Chapter 4.1 to 4.4 and 4.6).*

### Module-3

- **Poisson’s and Laplace’s Equations:** Derivation of Poisson’s and Laplace’s Equations, Uniqueness theorem, Examples of the solution of Laplace’s equation, Numerical problems on Laplace equation *(Text: Chapter 7.1 to 7.3).*
- **Steady Magnetic Field:** Biot-Savart Law, Ampere’s circuital law, Curl, Stokes’ theorem, Magnetic flux and magnetic flux density, Basic concepts Scalar and Vector Magnetic Potentials, Numerical problems. *(Text: Chapter 8.1 to 8.6)*

### Module-4

- **Magnetic Forces:** Force on a moving charge, differential current elements, Force between differential current elements, Numerical problems *(Text: Chapter 9.1 to 9.3).*
- **Magnetic Materials:** Magnetization and permeability, Magnetic boundary conditions, The magnetic circuit, Potential energy and forces on magnetic materials, Inductance and mutual reactance, Numerical problems *(Text: Chapter 9.6 to 9.7).*
- **Faraday’ law of Electromagnetic Induction –**Integral form and Point form, Numerical problems *(Text: Chapter 10.1)*

### Module-5

- **Maxwell’s equations** Continuity equation, Inconsistency of Ampere’s law with continuity equation, displacement current, Conduction current, Derivation of Maxwell’s equations in point form, and integral form, Maxwell’s equations for different media, Numerical problems *(Text: Chapter 10.2 to 10.4).*
- **Uniform Plane Wave:** Plane wave, Uniform plane wave, Derivation of plane wave equations from
Maxwell’s equations, Solution of wave equation for perfect dielectric, Relation between E and H, Wave propagation in free space, Solution of wave equation for sinusoidal excitation, wave propagation in any conducting media \((\gamma, \alpha, \beta, \eta)\) and good conductors, Skin effect or Depth of penetration, Poynting’s theorem and wave power, Numerical problems. (Text: Chapter 12.1 to 12.4)

**Course Outcomes:** After studying this course, students will be able to:

- Evaluate problems on electrostatic force, electric field due to point, linear, volume charges by applying conventional methods and charge in a volume.
- Apply Gauss law to evaluate Electric fields due to different charge distributions and Volume Charge distribution by using Divergence Theorem.
- Determine potential and energy with respect to point charge and capacitance using Laplace equation and Apply Biot-Savart’s and Ampere’s laws for evaluating Magnetic field for different current configurations
- Calculate magnetic force, potential energy and Magnetization with respect to magnetic materials and voltage induced in electric circuits.
- Apply Maxwell’s equations for time varying fields, EM waves in free space and conductors and Evaluate power associated with EM waves using Poynting theorem

**Question paper pattern:**

- Examination will be conducted for 100 marks with question paper containing 10 full questions, each of 20 marks.
- Each full question can have a maximum of 4 sub questions.
- There will be 2 full questions from each module covering all the topics of the module.
- Students will have to answer 5 full questions, selecting one full question from each module.
- The total marks will be proportionally reduced to 60 marks as SEE marks is 60.

**Text Book:**


**Reference Books:**

| Course Learning Objectives:                                                                                                           |
| • Learn different Verilog HDL constructs.                                                                                             |
| • Familiarize the different levels of abstraction in Verilog.                                                                       |
| • Understand Verilog Tasks, Functions and Directives.                                                                               |
| • Understand timing and delay Simulation.                                                                                             |
| • Understand the concept of logic synthesis and its impact in verification                                                          |

<table>
<thead>
<tr>
<th>Module 1</th>
<th>RBT Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overview of Digital Design with Verilog HDL: Evolution of CAD, emergence of HDLs, typical HDL-flow, why Verilog HDL?, trends in HDLs.</td>
<td>L1, L2, L3</td>
</tr>
<tr>
<td>Hierarchical Modeling Concepts: Top-down and bottom-up design methodology, differences between modules and module instances, parts of a simulation, design block, stimulus block.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Module 2</th>
<th>RBT Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Basic Concepts: Lexical conventions, data types, system tasks, compiler directives.</td>
<td>L1, L2, L3</td>
</tr>
<tr>
<td>Modules and Ports: Module definition, port declaration, connecting ports, hierarchical name referencing.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Module 3</th>
<th>RBT Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gate-Level Modeling: Modeling using basic Verilog gate primitives, description of and/or and but/not type gates, rise, fall and turn-off delays, min, max, and typical delays.</td>
<td>L1, L2, L3</td>
</tr>
<tr>
<td>Dataflow Modeling: Continuous assignments, delay specification, expressions, operators, operands, operator types.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Module 4</th>
<th>RBT Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Behavioral Modeling: Structured procedures, initial and always, blocking and non-blocking statements, delay control, generate statement, event control, conditional statements, Multiway branching, loops, sequential and parallel blocks.</td>
<td>L1, L2, L3</td>
</tr>
<tr>
<td>Tasks and Functions: Differences between tasks and functions, declaration, invocation, automatic tasks and functions.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Module 5</th>
<th>RBT Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Useful Modeling Techniques: Procedural continuous assignments, overriding parameters, conditional compilation and execution, useful system tasks.</td>
<td>L1, L2, L3</td>
</tr>
</tbody>
</table>

| Course Outcomes: At the end of this course, students should be able to                                                                 |
| • Write Verilog programs in gate, dataflow (RTL), behavioral and switch modeling levels of Abstraction.                           |
| • Design and verify the functionality of digital circuit/system using test benches.                                             |
| • Identify the suitable Abstraction level for a particular digital design.                                                      |
| • Write the programs more effectively using Verilog tasks, functions and directives.                                          |
| • Perform timing and delay Simulation                                                                                         |
| • Interpret the various constructs in logic synthesis.                                                                      |

| Question paper pattern:                                                                                                          |
| • Examination will be conducted for 100 marks with question paper containing 10 full questions, each of 20 marks.               |
| • Each full question can have a maximum of 4 sub questions.                                                                      |
| • There will be 2 full questions from each module covering all the topics of the module.                                        |
| • Students will have to answer 5 full questions, selecting one full question from each module.                                  |
- The total marks will be proportionally reduced to 60 marks as SEE marks is 60.

**Text Book:**

**Reference Books:**
B. E. (EC / TC)
Choice Based Credit System (CBCS) and Outcome Based Education (OBE)
SEMESTER – V

DIGITAL SIGNAL PROCESSING LABORATORY

Course Code | 18ECL57 | IA Marks | 40
Number of Lecture Hours/Week | 02Hr Tutorial (Instructions) + 02 Hours Laboratory | Exam marks | 60
RBT Level | L1, L2, L3 | Exam Hours | 03

CREDITS– 02

Course Learning Objectives: This course will enable students to
- Simulate discrete time signals and verification of sampling theorem.
- Compute the DFT for a discrete signal and verification of its properties using MATLAB.
- Find solution to the difference equations and computation of convolution and correlation along with the verification of properties.
  1. Compute and display the filtering operations and compare with the theoretical values.
  2. Implement the DSP computations on DSP hardware and verify the result.

Laboratory Experiments

Following Experiments to be done using MATLAB / SCILAB / OCTAVE or equivalent:
  1. Verification of sampling theorem (use interpolation function).
  2. Linear and circular convolution of two given sequences, Commutative, distributive and associative property of convolution.
  3. Auto and cross correlation of two sequences and verification of their properties
  4. Solving a given difference equation.
  5. Computation of N point DFT of a given sequence and to plot magnitude and phase spectrum (using DFT equation and verify it by built-in routine).
  6. (i) Verification of DFT properties (like Linearity and Parseval’s theorem, etc.)
     (ii) DFT computation of square pulse and Sinc function etc.
  7. Design and implementation of Low pass and High pass FIR filter to meet the desired specifications (using different window techniques) and test the filter with an audio file. Plot the spectrum of audio signal before and after filtering.
  8. Design and implementation of a digital IIR filter (Low pass and High pass) to meet given specifications and test with an audio file. Plot the spectrum of audio signal before and after filtering.

Following Experiments to be done using DSP kit
  9. Obtain the Linear convolution of two sequences.
  11. Compute the N-point DFT of a given sequence.
  12. Determine the Impulse response of first order and second order system.
  13. Generation of Sine wave and standard test signals

Course Outcomes: On the completion of this laboratory course, the students will be able to:
- Understand the concepts of analog to digital conversion of signals and frequency domain sampling of signals.
- Modeling of discrete time signals and systems and verification of its properties and results.
- Implementation of discrete computations using DSP processor and verify the results.
- Realize the digital filters using a simulation tool and analyze the response of the filter for an audio signal.

Conduct of Practical Examination:
  1. All laboratory experiments are to be included for practical examination.
  2. Strictly follow the instructions as printed on the cover page of answer script for breakup of marks.
  3. Change of experiment is allowed only once and Marks allotted to the procedure part to be made zero.
Reference Books:
Course Learning Objectives: This course will enable students to:

- Familiarize with the CAD tool to write HDL programs.
- Understand simulation and synthesis of digital design.
- Program FPGAs/CPLDs to synthesize the digital designs.
- Interface hardware to programmable ICs through I/O ports.
- Choose either Verilog or VHDL for a given Abstraction level.

Note: Programming can be done using any compiler. Download the programs on a FPGA/CPLD board and performance testing may be done using 32 channel pattern generator and logic analyzer apart from verification by simulation with tools such as Altera/Modelsim or equivalent.

Laboratory Experiments

PART A : Programming

1. Write Verilog program for the following combinational design along with test bench to verify the design:
   a. 2 to 4 decoder realization using NAND gates only (structural model)
   b. 8 to 3 encoder with priority and without priority (behavioural model)
   c. 8 to 1 multiplexer using case statement and if statements
   d. 4-bit binary to gray converter using 1-bit gray to binary converter 1-bit adder and subtractor

2. Model in Verilog for a full adder and addfunctionality to perform logical operations of XOR, XNOR, AND and OR gates. Write test bench with appropriate input patterns to verify the modeled behaviour.

3. Verilog 32-bit ALU shown in figure below and verify the functionality of ALU by selecting appropriate test patterns. The functionality of the ALU is presented in Table 1.
   a. Write test bench to verify the functionality of the ALU considering all possible input patterns
   b. The enable signal will set the output to required functions if enabled, if disabled all the outputs are set to tri-state
   c. The acknowledge signal is set high after every operation is completed
Figure 1 ALU top level block diagram

<table>
<thead>
<tr>
<th>Opcode(2:0)</th>
<th>ALU Operation</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>000</td>
<td>A + B</td>
<td>Addition of two numbers</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Both A and B are in two’s complement format</td>
</tr>
<tr>
<td>001</td>
<td>A – B</td>
<td>Subtraction of two numbers</td>
</tr>
<tr>
<td>010</td>
<td>A + 1</td>
<td>Increment Accumulator by 1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>A is in two’s complement format</td>
</tr>
<tr>
<td>011</td>
<td>A - 1</td>
<td>Decrement accumulator by 1</td>
</tr>
<tr>
<td>100</td>
<td>A</td>
<td>True</td>
</tr>
<tr>
<td>101</td>
<td>A Complement</td>
<td>Complement</td>
</tr>
<tr>
<td>110</td>
<td>A OR B</td>
<td>Logical OR</td>
</tr>
<tr>
<td>111</td>
<td>A AND B</td>
<td>Logical AND</td>
</tr>
</tbody>
</table>

Table 1 ALU Functions

4. Write Verilog code for SR, D and JK and verify the flip flop.

5. Write Verilog code for 4-bit BCD synchronous counter.

6. Write Verilog code for counter with given input clock and check whether it works as a clock divider performing division of clock by 2, 4, 8 and 16. Verify the functionality of the code.

PART-B : Interfacing and Debugging (EDWinXP, PSpice, MultiSim, Proteus, CircuitLab or any other equivalent tool can be used)

1. Write a Verilog code to design a clock divider circuit that generates 1/2, 1/3rd and 1/4th clock from a given input clock. Port the design to FPGA and validate the functionality through oscilloscope.

2. Interface a DC motor to FPGA and write Verilog code to change its speed and direction.

3. Interface a Stepper motor to FPGA and write Verilog code to control the Stepper motor rotation which in turn may control a Robotic Arm. External switches to be used for different control like rotate the Stepper motor (i) +N steps if Switch no.1 of a Dip switch is closed (ii) +N/2 steps if Switch no. 2 of a Dip switch is closed (iii) –N steps if Switch no. 3 of a Dip switch is closed etc.

4. Interface a DAC to FPGA and write Verilog code to generate Sine wave of frequency F KHz (eg. 200 KHz) frequency. Modify the code to down sample the frequency to F/2 KHz. Display the Original and Down sampled signals by connecting them to an oscilloscope.

5. Write Verilog code using FSM to simulate elevator operation.
6. Write Verilog code to convert an analog input of a sensor to digital form and to display the same on a suitable display like set of simple LEDs, 7-segment display digits or LCD display.

**Course Outcomes:** At the end of this course, students should be able to:
- Write the Verilog/VHDL programs to simulate Combinational circuits in Dataflow, Behavioral and Gate level Abstractions.
- Describe sequential circuits like flip flops and counters in Behavioral description and obtain simulation waveforms.
- Synthesize Combinational and Sequential circuits on programmable ICs and test the hardware.
- Interface the hardware to the programmable chips and obtain the required output

**Conduct of Practical Examination:**
- All laboratory experiments are to be included for practical examination.
- Students are allowed to pick one experiment from the lot.
- Strictly follow the instructions as printed on the cover page of answer script for breakup of marks.
- Change of experiment is allowed only once and Marks allotted to the procedure part to be made zero.
B. E. Common to all Branches
Choice Based Credit System (CBCS) and Outcome Based Education (OBE)

SEMESTER – V

ENVIRONMENTAL STUDIES

<table>
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<th>Course Code</th>
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<th>CIE Marks</th>
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<td>SEE Marks</td>
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</tr>
<tr>
<td>Credits</td>
<td>01</td>
<td>Exam Hours</td>
<td>02</td>
</tr>
</tbody>
</table>

**Module - 1**

**Ecosystems (Structure and Function):** Forest, Desert, Wetlands, Riverine, Oceanic and Lake.

**Biodiversity:** Types, Value; Hot-spots; Threats and Conservation of biodiversity, Forest Wealth, and Deforestation.

**Module - 2**


**Natural Resource Management** (Concept and case-studies): Disaster Management, Sustainable Mining, Cloud Seeding, and Carbon Trading.

**Module - 3**

**Environmental Pollution** (Sources, Impacts, Corrective and Preventive measures, Relevant Environmental Acts, Case-studies): Surface and Ground Water Pollution; Noise pollution; Soil Pollution and Air Pollution.

**Waste Management & Public Health Aspects:** Bio-medical Wastes; Solid waste; Hazardous wastes; E-wastes; Industrial and Municipal Sludge.

**Module - 4**

**Global Environmental Concerns** (Concept, policies and case-studies): Ground water depletion/recharging, Climate Change; Acid Rain; Ozone Depletion; Radon and Fluoride problem in drinking water; Resettlement and rehabilitation of people, Environmental Toxicology.

**Module - 5**


**Field work:** Visit to an Environmental Engineering Laboratory or Green Building or Water Treatment Plant or Waste water treatment Plant; ought to be Followed by understanding of process and its brief documentation.

**Course outcomes:** At the end of the course, students will be able to:
- Understand the principles of ecology and environmental issues that apply to air, land, and water issues on a global scale,
- Develop critical thinking and/or observation skills, and apply them to the analysis of a problem or question related to the environment.
- Demonstrate ecology knowledge of a complex relationship between biotic and a biotic components.
- Apply their ecological knowledge to illustrate and graph a problem and describe the realities that managers face when dealing with complex issues.

**Question paper pattern:**
- The Question paper will have 100 objective questions.
- Each question will be for 01 marks
- Student will have to answer all the questions in an OMR Sheet.
- The Duration of Exam will be 2 hours.

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Title of the Book</th>
<th>Name of the Author/s</th>
<th>Name of the Publisher</th>
<th>Edition and Year</th>
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<td><strong>Textbook/s</strong></td>
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<tr>
<td>2</td>
<td>Environmental Studies</td>
<td>S M Prakash</td>
<td>Pristine Publishing House, Mangalore</td>
<td>3rd Edition 2018</td>
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<tr>
<td>3</td>
<td>Environmental Studies – From Crisis to Cure</td>
<td>R Rajagopalan</td>
<td>Oxford Publisher</td>
<td>2005</td>
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<td><strong>Reference Books</strong></td>
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<td></td>
</tr>
<tr>
<td>1</td>
<td>Principals of</td>
<td>Raman Sivakumar</td>
<td>Cengage learning,</td>
<td>2nd Edition, 2005</td>
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<tr>
<td></td>
<td>Title</td>
<td>Author(s)</td>
<td>Publisher</td>
<td>Edition</td>
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</tr>
<tr>
<td>3</td>
<td>Text Book of Environmental and Ecology</td>
<td>Pratiba Sing, Anoop Singh &amp; Piyush Malaviya</td>
<td>Acme Learning Pvt. Ltd.</td>
<td>1st Edition</td>
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</table>
BE 2018 Scheme Sixth Semester EC Syllabus

B. E. (EC / TC)  
Choice Based Credit System (CBCS) and Outcome Based Education (OBE)  
SEMESTER – VI  
DIGITAL COMMUNICATION

<table>
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<th>CIE Marks</th>
<th>Number of Lecture Hours/Week</th>
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<th>Exam Hours</th>
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<td>40</td>
<td>03 + 02 (Tutorial)</td>
<td>60</td>
<td>03</td>
</tr>
</tbody>
</table>

**CREDITS – 04**

**Course Learning Objectives:** This course will enable students to:

- Understand the mathematical representation of signal, symbol, and noise.
- Understand the concept of signal processing of digital data and signal conversion to symbols at the transmitter and receiver.
- Compute performance metrics and parameters for symbol processing and recovery in ideal and corrupted channel conditions.
- Compute performance parameters and mitigate channel induced impediments in corrupted channel conditions.

**Module-1**

Bandpass Signal to Equivalent Low pass: Hilbert Transform, Pre-envelopes, Complex envelopes, Canonical representation of bandpass signals, Complex low pass representation of bandpass systems, Complex representation of band pass signals and systems (Text 1: 2.8, 2.9, 2.10, 2.11, 2.12, 2.13).

**Line codes:** Unipolar, Polar, Bipolar (AMI) and Manchester code and their power spectral densities (Text 1: Ch 6.10). Overview of HDB3, B3ZS, B6ZS (Ref. 1: 7.2)

**Module-2**

Signaling over AWGN Channels: Introduction, Geometric representation of signals, Gram-Schmidt Orthogonalization procedure, Conversion of the continuous AWGN channel into a vector channel, Optimum receivers using coherent detection: ML Decoding, Correlation receiver, matched filter receiver (Text 1: 7.1, 7.2, 7.3, 7.4).

**Module – 3**

Digital Modulation Techniques: Phase shift Keying techniques using coherent detection: generation, detection and error probabilities of BPSK and QPSK, M-ary PSK, M-ary QAM (Relevant topics in Text 1 of 7.6, 7.7).

Frequency shift keying techniques using Coherent detection: BFSK generation, detection and error probability (Relevant topics in Text 1 of 7.8).

Non coherent orthogonal modulation techniques: BFSK, DPSK Symbol representation, Block diagrams treatment of Transmitter and Receiver, Probability of error (without derivation of probability of error equation) (Text 1: 7.11, 7.12, 7.13).

**Module-4**


Channel Equalization: Linear Equalizers (ZFE, MMSE), (Text 2: 9.4.2).

**Module-5**


**Course Outcomes:** At the end of the course, the students will be able to:

- Associate and apply the concepts of Bandpass sampling to well specified signals and channels.
- Analyze and compute performance parameters and transfer rates for low pass and bandpass symbol under ideal and corrupted non band limited channels.
- Test and validate symbol processing and performance parameters at the receiver under ideal and corrupted bandlimited channels.
- Demonstrate that bandpass signals subjected to corruption and distortion in a bandlimited channel can be processed at the receiver to meet specified performance criteria.

**Question paper pattern:**
- Examination will be conducted for 100 marks with question paper containing 10 full questions, each of 20 marks.
- Each full question can have a maximum of 4 sub questions.
- There will be 2 full questions from each module covering all the topics of the module.
- Students will have to answer 5 full questions, selecting one full question from each module.
- The total marks will be proportionally reduced to 60 marks as SEE marks is 60.

**Text Books:**

**Reference Books:**
<table>
<thead>
<tr>
<th>Course Code</th>
<th>CIE Marks</th>
<th>SEMESTER – VI</th>
</tr>
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<tbody>
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<td>EMBEDDED SYSTEMS</td>
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<tr>
<td>Number of Lecture Hours/Week</td>
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<td>SEE Marks 60</td>
</tr>
<tr>
<td></td>
<td>Exam Hours</td>
<td>03</td>
</tr>
</tbody>
</table>

**Course Learning Objectives:** This course will enable students to:

- Explain the architectural features and instructions of 32 bit microcontroller -ARM Cortex M3.
- Develop Programs using the various instructions of ARM Cortex M3 and C language for different applications.
- Understand the basic hardware components and their selection method based on the characteristics and attributes of an embedded system.
- Develop the hardware software co-design and firmware design approaches.
- Explain the need of real time operating system for embedded system applications.

### Module 1
**ARM-32 bit Microcontroller:** Thumb-2 technology and applications of ARM, Architecture of ARM Cortex M3, Various Units in the architecture, Debugging support, General Purpose Registers, Special Registers, exceptions, interrupts, stack operation, reset sequence

(Text 1: Ch-1, 2, 3)

RBT Level: L1, L2

### Module 2
**ARM Cortex M3 Instruction Sets and Programming:** Assembly basics, Instruction list and description, Thumb and ARM instructions, Special instructions, Useful instructions, CMSIS, Assembly and C language Programming

(Text 1: Ch-4, Ch-10.1 to 10.6)

RBT Level: L1, L2, L3

### Module 3
**Embedded System Components:** Embedded Vs General computing system, Classification of Embedded systems, Major applications and purpose of ES. Elements of an Embedded System (Block diagram and explanation), Differences between RISC and CISC, Harvard and Princeton, Big and Little Endian formats, Memory (ROM and RAM types), Sensors, Actuators, Optocoupler, Communication Interfaces (I2C, SPI, IrDA, Bluetooth, Wi-Fi, Zigbee only)

(Text 2: All the Topics from Ch-1 and Ch-2 (Fig and explanation before 2.1) 2.1.1.6 to 2.1.1.8, 2.2 to 2.2.2.3, 2.3 to 2.3.2, 2.3.3.3, selected topics of 2.4.1 and 2.4.2 only)

RBT Level: L1, L2

### Module 4
**Embedded System Design Concepts:** Characteristics and Quality Attributes of Embedded Systems, Operational and non-operational quality attributes, Embedded Systems-Application and Domain specific, Hardware Software Co-Design and Program Modeling (excluding UML), Embedded firmware design and development (excluding C language).

(Text 2: Ch-3, Ch-4 (4.1, 4.2.1 and 4.2.2 only), Ch-7 (Sections 7.1, 7.2 only), Ch-9 (Sections 9.1, 9.2, 9.3.1, 9.3.2 only))

RBT Level: L1, L2, L3

### Module 5
**RTOS and IDE for Embedded System Design:** Operating System basics, Types of operating systems, Task, process and threads (Only POSIX Threads with an example program), Thread preemption, Preemptive Task scheduling techniques, Task Communication, Task synchronization issues – Racing and Deadlock, Concept of Binary and counting semaphores (Mutex example without any program), How to choose an RTOS, Integration and testing of Embedded hardware and firmware, Embedded system Development Environment – Block diagram (excluding Keil), Disassembler/decompiler, simulator, emulator and debugging techniques

(Text 2: Ch-10 (Sections 10.1, 10.2, 10.3, 10.5.2, 10.7, 10.8.1.1, 10.8.1.2, 10.8.2.2, 10.10 only), Ch-12, Ch-13 (a block diagram before 13.1, 13.3, 13.4, 13.5, 13.6 only))

RBT Level: L1, L2, L3
**Course Outcomes:** After studying this course, students will be able to:
- Describe the architectural features and instructions of 32 bit microcontroller ARM Cortex M3.
- Apply the knowledge gained for Programming ARM Cortex M3 for different applications.
- Understand the basic hardware components and their selection method based on the characteristics and attributes of an embedded system.
- Develop the hardware software co-design and firmware design approaches.
- Explain the need of real time operating system for embedded system applications.

**Question paper pattern:**
- Examination will be conducted for 100 marks with question paper containing 10 full questions, each of 20 marks.
- Each full question can have a maximum of 4 sub questions.
- There will be 2 full questions from each module covering all the topics of the module.
- Students will have to answer 5 full questions, selecting one full question from each module.
- The total marks will be proportionally reduced to 60 marks as SEE marks is 60.

**Text Books:**

**Reference Books:**
<table>
<thead>
<tr>
<th>Course Code</th>
<th>18EC63</th>
<th>CIE Marks</th>
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<tr>
<td>Number of Lecture Hours/Week</td>
<td>03+02(Tutorial)</td>
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<tr>
<td>Exam Hours</td>
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<td></td>
<td>03</td>
</tr>
<tr>
<td><strong>CREDITS – 04</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Course Learning Objectives:** This course will enable students to:
- Describe the microwave properties and its transmission media
- Describe microwave devices for several applications
- Understand the basics of antenna theory
- Select antennas for specific applications

<table>
<thead>
<tr>
<th>Module 1</th>
<th>RBT Level</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Microwave Tubes:</strong></td>
<td>L1, L2</td>
</tr>
<tr>
<td>Introduction, Reflex Klystron Oscillator, Mechanism of Oscillations, Modes of Oscillations, Mode Curve (Qualitative Analysis only).</td>
<td></td>
</tr>
<tr>
<td><strong>Microwave Transmission Lines:</strong></td>
<td></td>
</tr>
<tr>
<td>Microwave Frequencies, Microwave devices, Microwave Systems, Transmission Line equations and solutions, Reflection Coefficient and Transmission Coefficient, Standing Wave and Standing Wave Ratio, Smith Chart, Single Stub matching.</td>
<td></td>
</tr>
<tr>
<td>(Text 1: 9.1, 9.2.1)</td>
<td>L1, L2</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Module 2</th>
<th>RBT Level</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Microwave Network theory:</strong></td>
<td></td>
</tr>
<tr>
<td>Introduction, Symmetrical Z and Y-Parameters for reciprocal Networks, S matrix representation of Multi-Port Networks.</td>
<td></td>
</tr>
<tr>
<td><strong>Microwave Passive Devices:</strong></td>
<td></td>
</tr>
<tr>
<td>Coaxial Connectors and Adapters, Attenuators, Phase Shifters, Waveguide Tees, Magic tees.</td>
<td></td>
</tr>
<tr>
<td>(Text 1: 6.1, 6.2, 6.3)</td>
<td>L1, L2</td>
</tr>
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</table>

<table>
<thead>
<tr>
<th>Module 3</th>
<th>RBT Level</th>
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</thead>
<tbody>
<tr>
<td><strong>Strip Lines:</strong></td>
<td>L1, L2, L3</td>
</tr>
<tr>
<td>Introduction, Micro Strip lines, Parallel Strip lines, Coplanar Strip lines, Shielded Strip Lines.</td>
<td></td>
</tr>
<tr>
<td><strong>Antenna Basics:</strong></td>
<td>L1, L2, L3</td>
</tr>
<tr>
<td>Introduction, Basic Antenna Parameters, Patterns, Beam Area, Radiation Intensity, Beam Efficiency, Directivity and Gain, Antenna Apertures, Effective Height, Radio Communication Link, Antenna Field Zones.</td>
<td></td>
</tr>
<tr>
<td>(Text 3: 2.1 - 2.7, 2.9 – 2.11, 2.13)</td>
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</table>

<table>
<thead>
<tr>
<th>Module 4</th>
<th>RBT Level</th>
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</thead>
<tbody>
<tr>
<td><strong>Point Sources and Arrays:</strong></td>
<td></td>
</tr>
<tr>
<td>Introduction, Point Sources, Power Patterns, Power Theorem, Radiation Intensity, Arrays of two isotropic point sources, Linear Arrays of n Isotropic Point Sources of equal Amplitude and Spacing.</td>
<td></td>
</tr>
<tr>
<td><strong>Electric Dipoles:</strong></td>
<td>L1, L3, L4</td>
</tr>
<tr>
<td>Introduction, Short Electric Dipole, Fields of a Short Dipole, Radiation Resistance of a Short Electric Dipole, Thin Linear Antenna (Field Analyses)</td>
<td></td>
</tr>
<tr>
<td>(Text 3: 6.1 - 6.5)</td>
<td>L1, L3, L4</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Module 5</th>
<th>RBT Level</th>
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</thead>
<tbody>
<tr>
<td><strong>Loop and Horn Antenna:</strong></td>
<td></td>
</tr>
<tr>
<td>Introduction, Small loop, The Loop Antenna General Case, The Loop Antenna as a special case, Radiation resistance of loops, Directivity of Circular Loop Antennas with uniform current, Horn antennas Rectangular Horn Antennas.</td>
<td></td>
</tr>
<tr>
<td><strong>Antenna Types:</strong></td>
<td>L1, L2, L3</td>
</tr>
<tr>
<td>The Helix geometry, Helix modes, Practical Design considerations for the mono-filar axial mode Helical Antenna, Yagi-Uda array, Parabolic reflector</td>
<td></td>
</tr>
<tr>
<td>(Text 3: 8.3, 8.4, 8.5, 8.8, 9.5)</td>
<td>L1, L2, L3</td>
</tr>
</tbody>
</table>
**Course outcomes:** At the end of the course students will be able to:
- Describe the use and advantages of microwave transmission
- Analyze various parameters related to microwave transmission lines and waveguides
- Identify microwave devices for several applications
- Analyze various antenna parameters necessary for building a RF system
- Recommend various antenna configurations according to the applications.

**Question paper pattern:**
- Examination will be conducted for 100 marks with question paper containing 10 full questions, each of 20 marks.
- Each full question can have a maximum of 4 sub questions.
- There will be 2 full questions from each module covering all the topics of the module.

**Text Books:**
2. *Microwave Devices and circuits* - Samuel Y Liao, Pearson Education

**Reference Books:**
<table>
<thead>
<tr>
<th>Course Code</th>
<th>18EC641</th>
<th>CIE Marks</th>
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<tbody>
<tr>
<td>Number of Lecture Hours/Week</td>
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<tr>
<td>Total Number of Lecture Hours</td>
<td>40 (8 Hours /Module)</td>
<td>Exam Hours</td>
<td>03</td>
</tr>
</tbody>
</table>

CREDITS – 03

**Course Learning Objectives:** This course will enable students to:
- Understand the services provided by an operating system.
- Explain how processes are synchronized and scheduled.
- Understand different approaches of memory management and virtual memory management.
- Describe the structure and organization of the file system
- Understand interprocess communication and deadlock situations.

### Module-1

**Introduction to Operating Systems**
OS, Goals of an OS, Operation of an OS, Computational Structures, Resource allocation techniques, Efficiency, System Performance and User Convenience, Classes operating System, Batch processing, Multi programming, Time Sharing Systems, Real Time and distributed Operating Systems
*(Topics from Sections 1.2, 1.3, 2.2 to 2.8 of Text).*

**RBT Level:** L1, L2

### Module-2

**Process Management:** OS View of Processes, PCB, Fundamental State Transitions of a process, Threads, Kernel and User level Threads, Non-preemptive scheduling- FCFS and SRN, Preemptive Scheduling- RR and LCN, Scheduling in Unix and Scheduling in Linux
*(Topics from Sections 3.3, 3.3.1 to 3.3.4, 3.4, 3.4.1, 3.4.2, Selected scheduling topics from 4.2 and 4.3, 4.6, 4.7 of Text).*

**RBT Level:** L1, L2, L3

### Module-3

**Memory Management:** Contiguous Memory allocation, Non-Contiguos Memory Allocation, Paging, Segmentation, Segmentation with paging, Virtual Memory Management, Demand Paging, VM handler, FIFO, LRU page replacement policies, Virtual memory in Unix and Linux
*(Topics from Sections 5.5 to 5.9, 6.1 to 6.3 except Optimal policy and 6.3.1, 6.7, 6.8 of Text).*

**RBT Level:** L1, L2, L3

### Module-4

**File Systems:** File systems and IOCS, File Operations, File Organizations, Directory structures, File Protection, Interface between File system and IOCS, Allocation of disk space, Implementing file access
*(Topics from Sections 7.1 to 7.8 of Text).*

**RBT Level:** L1, L2

### Module-5

**Message Passing and Deadlocks:** Overview of Message Passing, Implementing message passing, Mailboxes, Deadlocks, Deadlocks in resource allocation, Handling deadlocks, Deadlock detection algorithm, Deadlock Prevention
*(Topics from Sections 10.1 to 10.3, 11.1 to 11.5 of Text).*

**RBT Level:** L1, L2

**Course Outcomes:** At the end of the course, the students will be able to:
- Explain the goals, structure, operation and types of operating systems.
- Apply scheduling techniques to find performance factors.
- Explain organization of file systems and IOCS.
- Apply suitable techniques for contiguous and non-contiguous memory allocation.
- Describe message passing, deadlock detection and prevention methods.
<table>
<thead>
<tr>
<th>Question paper pattern:</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Examination will be conducted for 100 marks with question paper containing 10 full</td>
</tr>
<tr>
<td>questions, each of 20 marks.</td>
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<td>• Each full question can have a maximum of 4 sub questions.</td>
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<tr>
<td>• There will be 2 full questions from each module covering all the topics of the</td>
</tr>
<tr>
<td>module.</td>
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<tr>
<td>• Students will have to answer 5 full questions, selecting one full question from each</td>
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<tr>
<td>module.</td>
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<tr>
<td>• The total marks will be proportionally reduced to 60 marks as SEE marks is 60.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Text Book:</th>
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<tbody>
<tr>
<td>Operating Systems – A concept based approach, by Dhamdhere, TMH, 2\textsuperscript{nd}</td>
</tr>
<tr>
<td>edition.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Reference Books:</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Operating systems concepts, Silberschatz and Galvin, John Wiley India Pvt. Ltd,</td>
</tr>
<tr>
<td>5\textsuperscript{th} edition, 2001.</td>
</tr>
<tr>
<td>2. Operating system–internals and design system, William Stallling, Pearson</td>
</tr>
<tr>
<td>Course Code</td>
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<tr>
<td>------------------</td>
</tr>
<tr>
<td>18EC642</td>
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</table>

**Course Learning Objectives:**

- Understand the basics of ANN and comparison with Human brain.
- Acquire knowledge on Generalization and function approximation of various ANN architectures.

### Module-1

**Introduction:** Biological Neuron – Artificial Neural Model - Types of activation functions –

**Architecture:** Feedforward and Feedback, Convex Sets, Convex Hull and Linear Separability, Non-Linear Seperable Problem, XOR Problem, Multilayer Networks.

**Learning:** Learning Algorithms, Error correction and Gradient Descent Rules, Learning objective of TLNs, Perceptron Learning Algorithm, Perceptron Convergence Theorem.

**Module-2**

**Supervised Learning:** Perceptron learning and Non Separable sets, $\alpha$-Least Mean Square Learning, MSE Error surface, Steepest Descent Search, $\mu$-LMS approximate to gradient descent, Application of LMS to Noise Cancelling, Multi-layered Network Architecture, Back propagation Learning Algorithm, Practical consideration of BP algorithm.

**Module-3**

**Support Vector Machines and Radial Basis Function:** Learning from Examples, Statistical Learning Theory, Support Vector Machines, SVM application to Image Classification, Radial Basis Function Regularization theory, Generalized RBF Networks, Learning in RBFNs, RBF application to face recognition.

**Module-4**

**Attractor Neural Networks:** Associative Learning Attractor Associative Memory, Linear Associative memory, Hopfield Network, application of Hopfield Network, Brain State in a Box neural Network, Simulated Annealing, Boltzmann Machine, Bidirectional Associative Memory.

**Module-5**

**Self-organization Feature Map:** Maximal Eigenvector Filtering, Extracting Principal Components, Generalized Learning Laws, Vector Quantization, Self-organization Feature Maps, Application of SOM, Growing Neural Gas.

**Course Outcomes:** At the end of the course, students should be able to:

- Understand the role of neural networks in engineering, artificial intelligence, and cognitive modelling.
- Understand the concepts and techniques of neural networks through the study of the most important neural network models.
- Evaluate whether neural networks are appropriate to a particular application.
- Apply neural networks to particular application, and to know what steps to take to improve performance.
**Question paper pattern:**
- Examination will be conducted for 100 marks with question paper containing 10 full questions, each of 20 marks.
- Each full question can have a maximum of 4 sub questions.
- There will be 2 full questions from each module covering all the topics of the module.
- Students will have to answer 5 full questions, selecting one full question from each module.
- The total marks will be proportionally reduced to 60 marks as SEE marks is 60.

**Text Book:**

**Reference Books:**
**DATA STRUCTURE USING C++**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>IA Marks</th>
<th>Number of Lecture Hours/Week</th>
<th>Exam Marks</th>
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<td>60</td>
<td>40 (08 Hrs per Module)</td>
<td>03</td>
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</tbody>
</table>

**CREDITS – 03**

**Course Learning Objectives:** This course will enable students to:
- Solve the problems using object oriented approach
- Explain fundamentals of data structures and their applications essential for programming/problem solving
- Analyze Linear Data Structures: Stack, Queues, Lists
- Analyze Non Linear Data Structures: Trees
- Assess appropriate data structure during program development/Problem Solving

**Module -1**

INTRODUCTION: C++ and its features, Data types, Variables, Operators, Expressions, Control structures, classes and Objects, Functions and parameters, function overloading, Recursion, Constructors, Destructors and Operator overloading, Inheritance, Polymorphism, Programming examples. L1, L2

**Module -2**

ARRAYS AND MATRICES: Arrays, Matrices, Special matrices, Sparse matrices.
POINTERs: Pointers, Dynamic memory allocation
LINEAR LISTS: Data objects and structures, Introduction to Linear and Non Linear data structures, Linear list data structures, Array Representation, Vector Representation, Singly Linked lists and chains. L1, L2

**Module -3**

STACKS: The abstract data types, Array Representation, Linked Representation, Applications – Parsing and Evaluation of arithmetic expressions, Parenthesis Matching & Towers of Hanoi. L1, L2, L3

**Module -4**

QUEUES: The abstract data types, Array Representation, Linked Representation, Applications-Railroad car arrangement, Priority Queues
HASHING: Dictionaries, Linear representation, Hash table representation. L1, L2, L3

**Module -5**

TREES: Binary trees, Properties and representation of binary trees, Common binary tree operations, Binary tree traversal the ADT binary tree, ADT binary tree and the class linked binary tree. Binary search trees operations and implementation. Heaps, Applications-Heap Sorting L1, L2, L3

**Course Outcomes:** After studying this course, students will be able to:
- Acquire knowledge of Dynamic memory allocation, Various types of data structures, operations and algorithms and Sparse matrices and Hashing
- Understand non Linear data structures trees and their applications
- Design appropriate data structures for solving computing problems
- Analyze the operations of Linear Data structures: Stack, Queue and Linked List and their applications

**Text Book:**

**Reference Books:**
<table>
<thead>
<tr>
<th>Course Learning Objectives: This course will enable students to</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Understand the concepts of Verilog Language.</td>
</tr>
<tr>
<td>• Design the digital systems as an activity in a larger systems design context.</td>
</tr>
<tr>
<td>• Study the design and operation of semiconductor memories frequently used in application specific digital system.</td>
</tr>
<tr>
<td>• Inspect how effectively IC’s are embedded in package and assembled in PCB’s for different application.</td>
</tr>
<tr>
<td>• Design and diagnosis of processors and I/O controllers used in embedded systems.</td>
</tr>
</tbody>
</table>

### Module -1

**Introduction and Methodology:**
Digital Systems and Embedded Systems, Real-World Circuits, Models, Design Methodology (1.1, 1.3 to 1.5 of Text).

**Combinational Basics:** Combinational Components and Circuits, Verification of Combinational Circuits (2.3 and 2.4 of Text).

**Number Basics:** Unsigned integers, Signed Integers, Fixed point Numbers, Floating point Numbers (3.1.1, 3.2.1, 3.3.1 and 3.4).

**Sequential Basics:** Sequential Datapaths and Control Clocked Synchronous Timing Methodology (4.3 up to 4.3.1, 4.4 up to 4.4.1 of Text).

### Module -2

**Memories:** Concepts, Memory Types, Error Detection and Correction (Chap 5 of Text).

### Module -3

**Implementation Fabrics:** Integrated Circuits, Programmable Logic Devices, Packaging and Circuit boards, Interconnection and Signal integrity (Chap 6 of Text).

### Module -4

**I/O interfacing:** I/O devices, I/O controllers, Parallel Buses, Serial Transmission, I/O software (Chap 8 of Text).

### Module -5

**Design Methodology:** Design flow, Design optimization, Design for test, Nontechnical Issues (Chap 10 of Text).

### Course outcomes: After studying this course, students will be able to:

- Construct the combinational circuits, using discrete gates and programmable logic devices.
- Describe how arithmetic operations can be performed for each kind of code, and also combinational circuits that implement arithmetic operations.
- Design a semiconductor memory for specific chip design.
- Design embedded systems using small microcontrollers, larger CPUs/DSPs, or hard or soft processor cores.
- Synthesize different types of I/O controllers that are used in embedded system.

### Question paper pattern:

- Examination will be conducted for 100 marks with question paper containing 10 full questions, each of 20 marks.
- Each full question can have a maximum of 4 sub questions.
- There will be 2 full questions from each module covering all the topics of the module.
Students will have to answer 5 full questions, selecting one full question from each module.  
The total marks will be proportionally reduced to 60 marks as SEE marks is 60.

**Text Book:**  

**Reference Books:**  
### B. E. (EC / TC)
Choice Based Credit System (CBCS) and Outcome Based Education (OBE)
SEMESTER – VI

#### NANOELECTRONICS

<table>
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<th>Course Code</th>
<th>18EC645</th>
<th>CIE Marks</th>
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<td>SEE Marks</td>
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<tr>
<td>Total Number of Lecture Hours</td>
<td>40 (8 Hours / Module)</td>
<td>Exam Hours</td>
<td>03</td>
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</tbody>
</table>

**CREDITS – 03**

**Course Learning Objectives:** This course will enable students to:
- Enhance basic engineering science and technical knowledge of Nanoelectronics.
- Explain basics of top-down and bottom-up fabrication process, devices and systems.
- Describe technologies involved in modern day electronic devices.
- Know various nanostructures of carbon and the nature of the carbon bond itself.
- Learn the photo physical properties of sensor used in generating a signal.

<table>
<thead>
<tr>
<th>Module-1</th>
<th>RBT Level</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Introduction:</strong> Overview of nanoscience and engineering. Development milestones in microfabrication and electronic industry. Moore’s law and continued miniaturization, Classification of Nanostructures, Electronic properties of atoms and solids: Isolated atom, Bonding between atoms, Giant molecular solids, Free electron models and energy bands, crystalline solids, Periodicity of crystal lattices, Electronic conduction, effects of nanometerlength scale, Fabrication methods: Top down processes, Bottom up processes methods for templating the growth of nanomaterials, ordering of nanosystems <em>(Text 1).</em></td>
<td>L1, L2</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Module-2</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Characterization:</strong> Classification, Microscopic techniques, Field ion microscopy, scanning probe techniques, diffraction techniques: bulk and surface diffraction techniques <em>(Text 1).</em></td>
<td>L1, L2</td>
</tr>
<tr>
<td><strong>Inorganic semiconductor nanostructures:</strong> overview of semiconductor physics. Quantum confinement in semiconductor nanostructures: quantum wells, quantum wires, quantum dots, superlattices, band offsets, electronic density of states <em>(Text 1).</em></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Module-3</th>
<th></th>
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</thead>
<tbody>
<tr>
<td><strong>Fabrication techniques:</strong> requirements of ideal semiconductor, epitaxial growth of quantum wells, lithography and etching, cleaved-edge over growth, growth of vicinal substrates, strain induced dots and wires, electrostatically induced dots and wires, Quantum well width fluctuations, thermally annealed quantum wells, semiconductor nanocrystals, collidal quantum dots, self-assembly techniques <em>(Text 1).</em></td>
<td>L1, L2</td>
</tr>
<tr>
<td><strong>Physical processes:</strong> modulation doping, quantum hall effect, resonant tunneling, charging effects, ballistic carrier transport, Inter band absorption, intraband absorption, Light emission processes, phonon bottleneck, quantum confined stark effect, nonlinear effects, coherence and dephasing, characterization of semiconductor nanostructures: optical electrical and structural <em>(Text 1).</em></td>
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<tr>
<th>Module-4</th>
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</thead>
<tbody>
<tr>
<td><strong>Carbon Nanostructures:</strong> Carbon molecules, Carbon Clusters, Carbon Nanotubes, application of Carbon Nanotubes <em>(Text 2)</em></td>
<td>L1, L2</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Module-5</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Nanosensors:</strong> Introduction, What is Sensor and Nanosensors?, What makes them Possible?, Order From Chaos, Characterization, Perception, NanosensorsBased On Quantum Size Effects, Electrochemical Sensors, Sensors Based On Physical Properties, Nanobiosensors, Smart dust Sensor for the future <em>(Text 3)</em></td>
<td>L1, L2</td>
</tr>
<tr>
<td><strong>Applications:</strong> Injection lasers, quantum cascade lasers, single-photon sources, biological tagging, optical memories, coulomb blockade devices, photonic structures, QWIP’s, NEMS, MEMS <em>(Text 1).</em></td>
<td></td>
</tr>
</tbody>
</table>

**Course Outcomes:** After studying this course, students will be able to:
- Understand the principles behind Nanoscience engineering and Nanoelectronics.
- Know the effect of particles size on mechanical, thermal, optical and electrical properties of nanomaterials.
- Know the properties of carbon and carbon nanotubes and its applications.
• Know the properties used for sensing and the use of smart dust sensors.
• Apply the knowledge to prepare and characterize nanomaterials.
• Analyse the process flow required to fabricate state-of-the-art transistor technology.

**Question paper pattern:**
• Examination will be conducted for 100 marks with question paper containing 10 full questions, each of 20 marks.
• Each full question can have a maximum of 4 sub questions.
• There will be 2 full questions from each module covering all the topics of the module.
• Students will have to answer 5 full questions, selecting one full question from each module.
• The total marks will be proportionally reduced to 60 marks as SEE marks is 60.

**Text Books:**
3. T Pradeep, “Nano: The essentials-Understanding Nanoscience and Nanotechnology”, TMH.

**Reference Book:**
B. E. ECE
Choice Based Credit System (CBCS) and Outcome Based Education (OBE)
SEMESTER – VI

PYTHON APPLICATION PROGRAMMING

Subject Code: 18EC 646
IA Marks 20
Number of Lecture Hours/Week 3
Exam Marks 80
Total Number of Lecture Hours 40
Exam Hours 03
CREDITS – 03

Course Learning Objectives: This course will enable students to

- Learn Syntax and Semantics and create Functions in Python.
- Handle Strings and Files in Python.
- Understand Lists, Dictionaries and Regular expressions in Python.
- Implement Object Oriented Programming concepts in Python
- Build Web Services, Network and Database Programs in Python.

Module – 1
Why should you learn to write programs, Variables, expressions and statements, Conditional execution, Functions
Teaching Hours
8 Hours

Module – 2
Iteration, Strings, Files
8 Hours

Module – 3
Lists, Dictionaries, Tuples, Regular Expressions
8 Hours

Module – 4
Classes and objects, Classes and functions, Classes and methods
8 Hours

Module – 5
Networked programs, Using Web Services, Using databases and SQL
8 Hours

Course outcomes: The students should be able to:

- Examine Python syntax and semantics and be fluent in the use of Python flow control and functions.
- Demonstrate proficiency in handling Strings and File Systems.
- Create, run and manipulate Python Programs using core data structures like Lists, Dictionaries and use Regular Expressions.
- Interpret the concepts of Object-Oriented Programming as used in Python.
- Implement exemplary applications related to Network Programming, Web Services and Databases in Python.

Question paper pattern:
- The question paper will have TEN questions.
- There will be TWO questions from each module.
- Each question will have questions covering all the topics under a module.
- The students will have to answer FIVE full questions, selecting ONE full question from each module.

Text Books:
References:


### SIGNAL PROCESSING

**Course Code**: 18EC651  
**CIE Marks**: 40  
**Number of Lecture Hours/Week**: 03  
**SEE Marks**: 60  
**Total Number of Lecture Hours**: 40 (8 Hours/Module)  
**Exam Hours**: 03  
**CREDITS**: 03

**Course objective**: This course will enable students to:
- Understand, represent and classify continuous time and discrete time signals and systems, together with the representation of LTI systems.
- Ability to represent continuous time signals (both periodic and non-periodic) in the time domain, s-domain and the frequency domain.
- Understand the properties of analog filters, and have the ability to design Butterworth filters.
- Understand and apply sampling theorem and convert a signal from continuous time to discrete time or from discrete time to continuous time (without loss of information).
- Able to represent the discrete time signal in the frequency domain.
- Able to design FIR and IIR filters to meet given specifications.

#### Module-1
**Signal Definition, Signal Classification, System definition, System classification, for both continuous time and discrete time. Definition of LTI systems (Chapter 1)**

**Level**: L1, L2

#### Module-2
**Introduction to Fourier Transform, Fourier Series, Relating the Laplace Transform to Fourier Transform, Frequency response of continuous time systems** (Chapter 3)

**Level**: L1, L2

#### Module-3
**Frequency response of ideal analog filters, Salient features of Butterworth filters Design and implementation of Analog Butterworth filters to meet given specifications** (Chapter 8)

**Level**: L1, L2, L3

#### Module-4
**Sampling Theorem- Statement and proof, converting the analog signal to a digital signal. Practical sampling. The Discrete Fourier Transform, Properties of DFT. Comparing the frequency response of analog and digital systems. (FFT not included)** (Chapter 3, 4)

**Level**: L1, L2, L3

#### Module-5
**Definition of FIR and IIR filters. Frequency response of ideal digital filters Transforming the Analog Butterworth filter to the Digital IIR Filter using suitable mapping techniques, to meet given specifications. Design of FIR Filters using the Window technique, and the frequency sampling technique to meet given specifications Comparing the designed filter with the desired filter frequency response** (Chapter 8)

**Level**: L1, L2, L3

**Course Outcomes**: After studying this course, students will be able to:
- Understand and explain continuous time and discrete time signals and systems, in time and frequency domain.
- Apply the concepts of signals and systems to obtain the desired parameter/ representation.
- Analyse the given system and classify the system/arrive at a suitable conclusion.
- Design analog/digital filters to meet given specifications.
- Design and implement the analog filter using components/ suitable simulation tools (**assignment component**).
- Design and implement the digital filter (FIR/IIR) using suitable simulation tools, and record the input and output of the filter for the given audio signal (**assignment component**).
**Question paper pattern:**
- Examination will be conducted for 100 marks with question paper containing 10 full questions, each of 20 marks.
- Each full question can have a maximum of 4 sub questions.
- There will be 2 full questions from each module covering all the topics of the module.
- Students will have to answer 5 full questions, selecting one full question from each module.
- The total marks will be proportionally reduced to 60 marks as SEE marks is 60.

**Text Book:**
‘Signals and Systems’, by Simon Haykin and Barry Van Veen, Wiley.

**References:**
2. ‘Signals and Systems’, Schaum’s Outline series
3. ‘Digital Signal Processing’, Schaum’s Outline series
<table>
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<tr>
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<td>Total Number of Lecture Hours</td>
<td>40 (08 Hrs/module)</td>
<td>Exam Hours</td>
<td>03</td>
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</tbody>
</table>

**Course Learning Objectives:** This course will enable students to:
- Understand various technologies associated in manufacturing of sensors
- Acquire knowledge about types of sensors used in modern digital systems
- Get acquainted about material properties required to make sensors

<table>
<thead>
<tr>
<th>Module 1</th>
<th>Introduction to sensor bases measurement systems:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>General concepts and terminology, sensor classification, primary sensors, material for sensors, microsensor technology, magnetoresistors, light dependent resistors, resistive hygrometers, resistive gas sensors, liquid conductivity sensors (Selected topics from ch.1 &amp; 2 of Text)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Module 2</th>
<th>Reactance Variation and Electromagnetic Sensors:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Signal Conditioning for Reactance Variation Sensors-Problems and Alternatives, ac Bridges Carrier Amplifiers, Coherent Detection, Specific Signal Conditioners for Capacitive Sensors, Resolver-to-Digital and Digital-to-Resolver Converters.</td>
</tr>
</tbody>
</table>

| Module 3 | Self-generating Sensors-Thermoelectric sensors, piezoelectric sensors, pyroelectric sensors, photovoltaic sensors, electrochemical sensors. |

| Module 4 | Digital and intelligent sensors-position encoders, resonant sensors, sensors based on quartz resonators, SAW sensors, Vibrating wire strain gages, vibrating cylinder sensors, Digital flow meters. |

| Module 5 | Sensors based on semiconductor junctions - Thermometers based on semiconductor junctions, magneto diodes and magneto transistors, photodiodes and phototransistors, sensors based on MOSFET transistors, charge-coupled sensors - types of CCD imaging sensors, ultrasonic-based sensors. |

**Course Outcomes:** After studying this course, students will be able to:
- Appreciate various types of sensors and their construction
- Use sensors specific to the end use application
- Design systems integrated with sensors

**Question paper pattern:**
- Examination will be conducted for 100 marks with question paper containing 10 full questions, each of 20 marks.
- Each full question can have a maximum of 4 sub questions.
- There will be 2 full questions from each module covering all the topics of the module.
- Students will have to answer 5 full questions, selecting one full question from each module.
- The total marks will be proportionally reduced to 60 marks as SEE marks is 60.

**Text Book:**
Choice Based Credit System (CBCS) and Outcome Based Education (OBE)

SEMESTER – VI

EMBEDDED SYSTEMS LAB

<table>
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<th>Course Code</th>
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<tr>
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<td>02 Hr Tutorial (Instructions) + 02 Hours Laboratory</td>
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<td>SEE Marks</td>
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<td>RBT Levels</td>
<td>L1, L2, L3</td>
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<tr>
<td>Exam Hours</td>
<td>03</td>
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</tbody>
</table>

CREDITS – 02

Course Learning Objectives: This course will enable students to:
- Understand the instruction set of ARM Cortex M3, a 32-bit microcontroller and the software tool required for programming in Assembly and C language.
- Program ARM Cortex M3 using the various instructions in assembly level language for different applications.
- Interface external devices and I/O with ARM Cortex M3.
- Develop C language programs and library functions for embedded system applications.

Laboratory Experiments

Conduct the following experiments on an ARM CORTEX M3 evaluation board to learn ALP and using evaluation version of Embedded 'C' & Keil uVision-4 tool/compiler.

PART A:
1. ALP to multiply two 16-bit binary numbers.
2. ALP to find the sum of first 10 integer numbers.
3. ALP to find the number of 0’s and 1’s in a 32-bit data.
4. ALP to find determine whether the given 16-bit is even or odd.
5. ALP to write data to RAM.

PART B:
6. Display “Hello world” message using internal UART.
7. Interface and Control the speed of a DC Motor.
8. Interface a Stepper motor and rotate it in clockwise and anti-clockwise direction.
9. Interface a DAC and generate Triangular and Square waveforms.
10. Interface a 4x4 keyboard and display the key code on an LCD.
11. Demonstrate the use of an external interrupt to toggle an LED On/Off.
12. Display the Hex digits 0 to F on a 7-segment LED interface, with an appropriate delay.
13. Measure Ambient temperature using a sensor and SPI ADC IC.

Course outcomes: After studying this course, students will be able to:
- Understand the instruction set of 32-bit microcontroller ARM Cortex M3, and the software tool required for programming in Assembly and C language.
- Develop assembly language programs using ARM Cortex M3 for different applications.
- Interface external devices and I/O with ARM Cortex M3.
- Develop C language programs and library functions for embedded system applications.

Conduction of Practical Examination:
- One Question from PART A and one Question from PART B to be asked in the examination.
- Strictly follow the instructions as printed on the cover page of answer script for breakup of marks.
- Change of experiment is allowed only once and Marks allotted to the procedure part to be made zero.
**Course Code** | **18ECL67**  
**Number of Lecture Hours/Week** | **02Hr Tutorial (Instructions)**  
| **+ 02 Hours Laboratory**  
**RBT Levels** | **L1, L2, L3**  
**CREDITS – 02**

**Course Learning Objectives:** This course will enable students to:
- Design and test the communication circuits for different analog modulation schemes.
- Design and demonstrate the digital modulation techniques.
- Demonstrate and measure the wave propagation in microstrip antennas.
- Characteristics of microstrip devices and measurement of its parameters.
- Understand the probability of error computations of coherent digital modulation schemes.

**Laboratory Experiments**

**PART-A:** Experiments No. 1 to 5 has to be performed using discrete components.

1. Amplitude Modulation and Demodulation:  
   i) Standard AM, ii) DSBSC (LM741 and LF398 ICs can be used)
2. Frequency modulation and demodulation (IC 8038/2206 can be used)
3. Pulse sampling, flat top sampling and reconstruction
4. Time Division Multiplexing and Demultiplexing of two bandlimited signals.
5. FSK and PSK generation and detection
6. Measurement of frequency, guide wavelength, power, VSWR and attenuation in microwave test bench.
7. Obtain the Radiation Pattern and Measurement of directivity and gain of microstrip dipole and Yagi antennas.
8. Determination of  
   a. Coupling and isolation characteristics of microstrip directional coupler.
   b. Resonance characteristics of microstrip ring resonator and computation of dielectric constant of the substrate.
   c. Power division and isolation of microstrip power divider.

**PART-B:** Simulation Experiments using SCILAB/MATLAB/Simulink or LabVIEW

1. Simulate NRZ, RZ, half-sinusoid and raised cosine pulses and generate eye diagram for binary polar signaling.
2. Pulse code modulation and demodulation system.
3. Computations of the Probability of bit error for coherent binary ASK, FSK and PSK for an AWGN Channel and Compare them with their Performance curves.
4. Digital Modulation Schemes i) DPSK Transmitter and receiver, ii) QPSK Transmitter and Receiver.

**Course Outcomes:** On the completion of this laboratory course, the students will be able to:
- Determine the characteristics and response of microwave waveguide.
- Determine the characteristics of microstrip antennas and devices and compute the parameters associated with it.
- Design and test the digital and analog modulation circuits and display the waveforms.
- Simulate the digital modulation systems and compare the error performance of basic digital modulation schemes.

**Conduct of Practical Examination:**
- All laboratory experiments are to be considered for practical examination.
- For examination one question from **PART-A** and one question from **PART-B** or only one question from **PART-B** experiments based on the complexity, to be set.
- Students are allowed to pick one experiment from the lot.
- Strictly follow the instructions as printed on the cover page of answer script for breakup of marks.
- Change of experiment is allowed only once and Marks allotted to the procedure part to be made zero.
### BE 2018 Scheme Seventh Semester EC Syllabus

**B. E. ECE**

**Choice Based Credit System (CBCS) and Outcome Based Education (OBE)**

#### SEMESTER – VII

**COMPUTER NETWORKS**

<table>
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<th>Course Code</th>
<th>CIE Marks</th>
<th>SEE Marks</th>
<th>Exam Hours</th>
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<tbody>
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<td>18EC71</td>
<td>40</td>
<td>60</td>
<td>03</td>
</tr>
</tbody>
</table>

**Number of Lecture Hours/Week**

| Total Number of Lecture Hours | 40 (08 Hours / Module) |

**CREDITS – 03**

**Course Learning Objectives:** This course will enable students to:
- Understand the layering architecture of OSI reference model and TCP/IP protocol suite.
- Understand the protocols associated with each layer.
- Learn the different networking architectures and their representations.
- Learn the functions and services associated with each layer.

### Module-1

**Introduction:** Data communication: Components, Data representation, Data flow, Networks: Network criteria, Physical Structures, Network types: LAN, WAN, Switching, The Internet. (1.1, 1.2, 1.3 (1.3.1 to 1.3.4 of Text).


### Module-2

**Data-Link Layer:** Introduction: Nodes and Links, Services, Two Categories’ of link, Sublayers, Link Layer addressing: Types of addresses, ARP. Data Link Control (DLC) services: Framing, Flow and Error Control, Data Link Layer Protocols: Simple Protocol, Stop and Wait protocol, Piggybacking. (9.1, 9.2 (9.2.1, 9.2.2), 11.1, 11.2 of Text).

**Media Access Control:** Random Access: ALOHA, CSMA, CSMA/CD, CSMA/CA. (12.1 of Text).

**Wired and Wireless LANs:** Ethernet Protocol, Standard Ethernet. Introduction to wireless LAN: Architectural Comparison, Characteristics, Access Control. (13.1, 13.2 (13.2.1 to 13.2.5), 15.1 of Text)

### Module-3

**Network Layer:** Introduction, Network Layer services: Packetizing, Routing and Forwarding, Other services, Packet Switching: Datagram Approach, Virtual Circuit Approach, IPv4 Addresses: Address Space, Classful Addressing, Classless Addressing, DHCP, Network Address Resolution, Forwarding of IP Packets: Based on destination Address and Label. (18.1, 18.2, 18.4, 18.5.1, 18.5.2 of Text)


**Unicast Routing:** Introduction, Routing Algorithms: Distance Vector Routing, Link State Routing, Path vector routing. (20.1, 20.2 of Text)

### Module-4

**Transport Layer:** Introduction: Transport Layer Services, Connectionless and Connection oriented Protocols, Transport Layer Protocols: Simple protocol, Stop and wait protocol, Go-Back-N Protocol, Selective repeat protocol. (23.1, 23.2.1, 23.2.2, 23.2.3, 23.2.4 of Text)

**Transport-Layer Protocols in the Internet:**
User Datagram Protocol: User Datagram, UDP Services, UDP Applications, Transmission Control
<table>
<thead>
<tr>
<th>Module-5</th>
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</thead>
</table>

**Course Outcomes:** At the end of the course, the students will be able to:
- Understand the concepts of networking thoroughly
- Identify the protocols and services of different layers.
- Distinguish the basic network configurations and standards associated with each network.
- Analyze a simple network and measurement of its parameters.

**Question paper pattern:**
- Examination will be conducted for 100 marks with question paper containing 10 full questions, each of 20 marks.
- Each full question can have a maximum of 4 sub questions.
- There will be 2 full questions from each module covering all the topics of the module.
- Students will have to answer 5 full questions, selecting one full question from each module.
- The total marks will be proportionally reduced to 60 marks as SEE marks is 60.

**TEXT BOOK:**

**REFERENCE BOOKS:**
2. Wayarles Tomasi, Introduction to Data Communication and Networking, Pearson Education.
4. William Stallings, “Data and computer communications”, Prentice Hall,
## VLSI Design

**Course Code**: 18EC72  
**CIE Marks**: 40  
**Number of Lecture Hours/Week**: 03  
**SEE Marks**: 60  
**Total Number of Lecture Hours**: 40 (08 Hours / Module)  
**Exam Hours**: 03  
**CREDITS**: 03

### Course Learning Objectives:
The objectives of the course is to enable students to:
- Impart knowledge of MOS transistor theory and CMOS technologies
- Learn the operation principles and analysis of inverter circuits.
- Design Combinational, sequential and dynamic logic circuits as per the requirements
- Infer the operation of Semiconductors Memory circuits.
- Demonstrate the concepts of CMOS testing

### Module-1
**Introduction**: A Brief History, MOS Transistors, CMOS Logic (1.1 to 1.4 of TEXT2)  
**MOS Transistor Theory**: Introduction, Long-channel I-V Characteristics, Non-ideal I-V Effects, DC Transfer Characteristics (2.1, 2.2, 2.4 and 2.5 of TEXT2).

### Module-2
**Fabrication**: CMOS Fabrication and Layout, VLSI Design Flow, Introduction, CMOS Technologies, Layout Design Rules, (1.5 and 3.1 to 3.3 of TEXT2). MOSFET Scaling and Small-Geometry Effects, MOSFET Capacitances (3.5 to 3.6 of TEXT1)

### Module-3
**Delay**: Introduction, Transient Response, RC Delay Model, Linear Delay Model, Logical Efforts of Paths (4.1 to 4.5 of TEXT2, except sub-sections 4.3.7, 4.4.5, 4.4.6, 4.5.5 and 4.5.6).  
**Combinational Circuit Design**: Introduction, Circuit families (9.1 to 9.2 of TEXT2, except subsection 9.2.4).

### Module-4
**Sequential Circuit Design**: Introduction, Circuit Design for Latches and Flip-Flops (10.1 and 10.3.1 to 10.3.4 of TEXT2)  
**Dynamic Logic Circuits**: Introduction, Basic Principles of Pass Transistor Circuits, Synchronous Dynamic Circuit Techniques, Dynamic CMOS Circuit Techniques (9.1, 9.2, 9.4 to 9.5 of TEXT1)

### Module-5
**Semiconductor Memories**: Introduction, Dynamic Random Access Memory (DRAM) and Static Random Access Memory (SRAM), (10.1 to 10.3 of TEXT1)  
**Testing and Verification**: Introduction, Logic Verification Principles, Manufacturing Test Principles, Design for testability (15.1, 15.3, 15.5 15.6.1 to 15.6.3 of TEXT 2).
Course outcomes: At the end of the course, the students will be able to:
- Demonstrate understanding of MOS transistor theory, CMOS fabrication flow and technology scaling.
- Draw the basic gates using the stick and layout diagrams with the knowledge of physical design aspects.
- Demonstrate ability to design Combinational, sequential and dynamic logic circuits as per the requirements
- Interpret Memory elements along with timing considerations
- Interpret testing and testability issues in VLSI Design

Question paper pattern:
- Examination will be conducted for 100 marks with question paper containing 10 full questions, each of 20 marks.
- Each full question can have a maximum of 4 sub questions.
- There will be 2 full questions from each module covering all the topics of the module.
- Students will have to answer 5 full questions, selecting one full question from each module.
- The total marks will be proportionally reduced to 60 marks as SEE marks is 60.

TEXT BOOKS:

REFERENCE BOOKS:
# Professional Elective – 2

## B. E. (EC/TC)

**Choice Based Credit System (CBCS) and Outcome Based Education (OBE)**

**SEMESTER – VII**

### REAL TIME SYSTEM

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<td>Exam Hours</td>
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</tr>
<tr>
<td>Credits – 03</td>
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</tbody>
</table>

### Course Learning Objectives:

This Course will enable students to:

- Understand the fundamentals of Real-time systems and its classifications.
- Describe the concepts of computer control and hardware components for Real-Time Application.
- Discuss the languages to develop software for Real-Time Applications.
- Explain the concepts of operating system and RTS development methodologies.

### Module-1

**Introduction to Real-Time Systems:** Historical background, Elements of a Computer Control System, RTS- Definition, Classification of Real-time Systems, Time Constraints, Classification of Programs.

**Concepts of Computer Control:** Introduction, Sequence Control, Loop Control, Supervisory Control, Centralized Computer Control, Hierarchical Systems. *(Text: 1.1 to 1.6 and 2.1 to 2.6)*

### Module-2

**Computer Hardware Requirements for Real-Time Applications:** Introduction, General Purpose Computer, Single Chip Microcomputers and Microcontrollers, Specialized Processors, Process-Related Interfaces, Data Transfer Techniques, Communications, Standard Interface. *(Text: 3.1 to 3.8).*

### Module-3

**Languages for Real-Time Applications:** Introduction, Syntax Layout and Readability, Declaration and Initialization of Variables and Constants, Cutillass, Modularity and Variables, Compilation of Modular Programs, Data types, Control Structures, Exception Handling, Low-level facilities, Coroutines, Interrupts and Device Handling, Concurrency, Real-Time Support, Overview of Real-Time Languages. *(Text: 5.1 to 5.14).*

### Module-4


### Module-5


**RTS Development Methodologies:** Introduction, Yourdon Methodology, Ward and Mellor Method, Hately and Pirbhai Method. *(Text: 7.1 to 7.5 and 8.1, 8.2, 8.4, 8.5).*

### Course Outcomes:

At the end of the course, students should be able to:

- Explain the fundamentals of Real time systems and its classifications.
- Understand the concepts of computer control and the suitable computer hardware requirements for real-time applications.
- Describe the operating system concepts and techniques required for real time systems.
- Develop the software algorithms using suitable languages to meet Real time applications.
- Apply suitable methodologies to design and develop Real-Time Systems.

### Text Book:

Reference Books:
## B. E. (EC/TC)
### Choice Based Credit System (CBCS) and Outcome Based Education (OBE)
#### SEMESTER – VII

**SATELLITE COMMUNICATION**

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<td>40 (8 Hours / Module)</td>
<td>Exam Hours</td>
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</table>

**CREDITS – 03**

**Course Learning Objectives:** This course will enable students to
- Understand the basic principle of satellite orbits and trajectories.
- Study of electronic systems associated with a satellite and the earth station.
- Understand the various technologies associated with the satellite communication.
- Focus on a communication satellite and the national satellite system.
- Study of satellite applications focusing various domains services such as remote sensing, weather forecasting and navigation.

<table>
<thead>
<tr>
<th>Module-1</th>
<th>Satellite Orbits and Trajectories: Definition, Basic Principles, Orbital parameters, Injection velocity and satellite trajectory, Types of Satellite orbits, Orbital perturbations, Satellite stabilization, Orbital effects on satellite’s performance, Eclipses, Look angles: Azimuth angle, Elevation angle.</th>
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<tbody>
<tr>
<td></td>
<td><strong>RBT Level</strong></td>
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<tr>
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<td><strong>RBT Level</strong></td>
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</tbody>
</table>

**Course Outcomes:** At the end of the course, the students will be able to:
- Describe the satellite orbits and its trajectories with the definitions of parameters associated with it.
- Describe the electronic hardware systems associated with the satellite subsystem and earth station.
- Describe the various applications of satellite with the focus on national satellite system.
- Compute the satellite link parameters under various propagation conditions with the illustration of multiple access techniques.
### Question paper pattern:
- Examination will be conducted for 100 marks with question paper containing 10 full questions, each of 20 marks.
- Each full question can have a maximum of 4 sub questions.
- There will be 2 full questions from each module covering all the topics of the module.
- Students will have to answer 5 full questions, selecting one full question from each module.
- The total marks will be proportionally reduced to 60 marks as SEE marks is 60.

### Text Book:

### Reference Books:
Course Code | 18EC733 | CIE Marks | 40
---|---|---|---
Number of Lecture Hours/Week | 03 | SEE Marks | 60
Total Number of Lecture Hours | 40 (08 Hours per Module) | Exam Hours | 03

**CREDITS– 03**

**Course Learning Objectives:** This course will enable students to

- Understand the fundamentals of digital image processing.
- Understand the image transforms used in digital image processing.
- Understand the image enhancement techniques used in digital image processing.
- Understand the image restoration techniques and methods used in digital image processing.
- Understand the Morphological Operations used in digital image processing.

<table>
<thead>
<tr>
<th>Module</th>
<th>RBT Level</th>
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</thead>
<tbody>
<tr>
<td>Module 1</td>
<td>L1, L2</td>
</tr>
<tr>
<td>Module 2</td>
<td>L1, L2</td>
</tr>
<tr>
<td><strong>Image Enhancement in the Spatial Domain:</strong> Image Sampling and Quantization, Some Basic Relationships Between Pixels, Linear and Nonlinear Operations. Some Basic Intensity Transformation Functions, Histogram Processing, Fundamentals of Spatial Filtering, Smoothing Spatial Filters, Sharpening Spatial Filters  (Text: Chapter 2: Sections 2.3 to 2.6.2, Chapter 3: Sections 3.2 to 3.6)</td>
<td></td>
</tr>
<tr>
<td>Module 3</td>
<td>L1, L2</td>
</tr>
<tr>
<td><strong>Frequency Domain:</strong> Preliminary Concepts, The Discrete Fourier Transform (DFT) of Two Variables, Properties of the 2-D DFT, Filtering in the Frequency Domain, Image Smoothing and Image Sharpening Using Frequency Domain Filters, Selective Filtering  (Text: Chapter 4: Sections 4.2, 4.5 to 4.10)</td>
<td></td>
</tr>
<tr>
<td>Module 4</td>
<td>L1, L2</td>
</tr>
<tr>
<td><strong>Restoration:</strong> Noise models, Restoration in the Presence of Noise Only using Spatial Filtering and Frequency Domain Filtering, Linear, Position-Invariant Degradations, Estimating the Degradation Function, Inverse Filtering, Minimum Mean Square Error (Wiener) Filtering, Constrained Least Squares Filtering  (Text: Chapter 5: Sections 5.2 to 5.9)</td>
<td></td>
</tr>
<tr>
<td>Module 5</td>
<td>L1, L2</td>
</tr>
</tbody>
</table>
| **Morphological Image Processing:** Preliminaries, Erosion and Dilation, Opening and Closing.  
**Color Image Processing:** Color Fundamentals, Color Models, Pseudo color Image Processing  (Text: Chapter 6: Sections 6.1 to 6.3 Chapter 9: Sections 9.1 to 9.3) | |
**Course Outcomes:** At the end of the course, students should be able to:

- Understand image formation and the role human visual system plays in perception of gray and color image data.
- Apply image processing techniques in both the spatial and frequency (Fourier) domains.
- Design and evaluate image analysis techniques.
- Conduct independent study and analysis of Image Enhancement and restoration techniques.

**Question paper pattern:**

- Examination will be conducted for 100 marks with question paper containing 10 full questions, each of 20 marks.
- Each full question can have a maximum of 4 sub questions.
- There will be 2 full questions from each module covering all the topics of the module.
- Students will have to answer 5 full questions, selecting one full question from each module.
- The total marks will be proportionally reduced to 60 marks as SEE marks is 60.

**Text Book:**


**Reference Books:**

Course Code: 18EC734
CIE Marks: 40
Number of Lecture Hours/Week: 03
Exam Marks: 60

Total Number of Lecture Hours: 40 (08 Hours per Module)
Exam Hours: 03
CREDITS – 03

Course Learning Objectives: This course will enable students to:
- Figure out the knowledge and concepts of digital signal processing techniques.
- Understand the computational building blocks of DSP processors and its speed issues.
- Understand the various addressing modes, peripherals, interrupts and pipelining structure of TMS320C54xx processor.
- Learn how to interface the external devices to TMS320C54xx processor in various modes.
- Understand basic DSP algorithms with their implementation.

Module -1
Introduction to Digital Signal Processing:

Computational Accuracy in DSP Implementations:
Number Formats for Signals and Coefficients in DSP Systems, Dynamic Range and Precision, Sources of Error in DSP Implementation.

Module -2
Architectures for Programmable Digital Signal – Processing Devices:
Introduction, Basic Architectural Features, DSP Computational Building Blocks, Bus Architecture and Memory, Data Addressing Capabilities, Address Generation Unit, Programmability and Program Execution, Speed Issues, Features for External Interfacing.

Module -3
Programmable Digital Signal Processors:
Introduction, Commercial Digital Signal-processing Devices, Data Addressing Modes of TMS320C54XX, Memory Space of TMS320C54xx Processors, Program Control. Detail Study of TMS320C54X & 54xx Instructions and Programming, On – Chip Peripherals, Interrupts of TMS320C54XX Processors, Pipeline Operation of TMS320C54xx Processor.

Module -4
Implementation of Basic DSP Algorithms:
Introduction, The Q – notation, FIR Filters, IIR Filters, Interpolation and Decimation Filters (one example in each case).

Implementation of FFT Algorithms:

Module -5
Interfacing Memory and Parallel I/O Peripherals to Programmable DSP Devices:

Interfacing and Applications of DSP Processors:
### Course Outcomes:
At the end of this course, students would be able to

- Comprehend the knowledge and concepts of digital signal processing techniques.
- Apply the knowledge of DSP computational building blocks to achieve speed in DSP architecture or processor.
- Apply knowledge of various types of addressing modes, interrupts, peripherals and pipelining structure of TMS320C54xx processor.
- Develop basic DSP algorithms using DSP processors.
- Discuss about synchronous serial interface and multichannel buffered serial port (McBSP) of DSP device.
- Demonstrate the programming of CODEC interfacing.

### Question paper pattern:

- Examination will be conducted for 100 marks with question paper containing 10 full questions, each of 20 marks.
- Each full question can have a maximum of 4 sub questions.
- There will be 2 full questions from each module covering all the topics of the module.
- Students will have to answer 5 full questions, selecting one full question from each module.
- The total marks will be proportionally reduced to 60 marks as SEE marks is 60.

### Text Book:

### Reference Books:
**Professional Electives – 3**

**B. E. (EC/TC)**  
Choice Based Credit System (CBCS) and Outcome Based Education (OBE)  
**SEMESTER – VII**

<table>
<thead>
<tr>
<th>IoT &amp; WIRELESS SENSOR NETWORKS</th>
<th></th>
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<tbody>
<tr>
<td><strong>Course Code</strong></td>
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<td><strong>SEE Marks</strong></td>
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<tr>
<td><strong>Exam Hours</strong></td>
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</tr>
</tbody>
</table>

**Credits – 03**

**Course Learning Objectives:**  
This course will enable students to:  
- Describe the OSI Model for IoT/M2M Systems.  
- Understand the architecture and design principles for device supporting IoT.  
- Develop competence in programming for IoT Applications.  
- Identify the uplink and downlink communication protocols which best suits the specific application of IOT / WSNs.

**Module-1**

**Overview of Internet of Things:**  
IoT Conceptual Framework, IoT Architectural View, Technology Behind IoT, Sources of IoT,M2M communication, Examples of IoT. Modified OSI Model for the IoT/M2M Systems, data enrichment, data consolidation and device management at IoT/M2M Gateway, web communication protocols used by connected IoT/M2M devices, Message communication protocols (CoAP-SMS, CoAP-MQ, MQTT,XMPP) for IoT/M2M devices. – Refer Chapter 1, 2 and 3 of Text 1.

**RBT Levels**  
L1, L2

**Module-2**

**Architecture and Design Principles for IoT:**  
Internet connectivity, Internet-based communication,IPv4, IPv6,6LoWPAN protocol, IP Addressing in the IoT, Application layer protocols: HTTP, HTTPS,FTP,TELNET and ports.

**Data Collection, Storage and Computing using a Cloud Platform:**  
Introduction, Cloud computing paradigm for data collection, storage and computing, Cloud service models, IoT Cloud- based data collection, storage and computing services using Nimbits. - Refer Chapter 4 and 6 of Text 1.

**Module-3**

**Prototyping and Designing Software for IoT Applications:**  
Introduction, Prototyping Embedded device software, Programming Embedded Device Arduino Platform using IDE, Reading data from sensors and devices, Devices, Gateways, Internet and Web/Cloud services software development. Programming MQTT clients and MQTT server. Introduction to IoT privacy and security, Vulnerabilities, security requirements and threat analysis, IoT Security Tomography and layered attacker model. - Refer Chapter 9 and 10 of Text 1.

**Module-4**

**Overview of Wireless Sensor Networks:**  

**Module-5**
**Communication Protocols:**

| L1, L2, L3 |
|---|---|

**Course Outcomes:** At the end of the course, students will be able to:
- Understand choice and application of IoT & M2M communication protocols.
- Describe Cloud computing and design principles of IoT.
- Awareness of MQTT clients, MQTT server and its programming.
- Develop an architecture and its communication protocols of WSNs.

**Question paper pattern:**
- Examination will be conducted for 100 marks with question paper containing 10 full questions, each of 20 marks.
- Each full question can have a maximum of 4sub questions.
- There will be 2 full questions from each module covering all the topics of the module.
- Students will have to answer 5 full questions, selecting one full question from each module.
- The total marks will be proportionally reduced to 60 marks as SEE marks is 60.

**Text Books:**

**Reference Books:**
### Choice Based Credit System (CBCS) and Outcome Based Education (OBE)

**SEMMESTER – VII**

**AUTOMOTIVE ELECTRONICS**

<table>
<thead>
<tr>
<th>Course Code</th>
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<th>SEE Marks</th>
<th>Exam Hours</th>
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</thead>
<tbody>
<tr>
<td>18EC742</td>
<td>40</td>
<td>60</td>
<td>03</td>
</tr>
</tbody>
</table>

**Course Code:** 18EC742  
**CIE Marks:** 40  
**SEE Marks:** 60  
**Exam Hours:** 03

**Course Learning Objectives:** This course will enable students to:
- Understand the basics of automobile dynamics and design electronics to complement those features.
- Design and implement the electronics that attribute the reliability, safety, and smartness to the automobiles, providing add-on comforts.

**Module -1**


**Module -2**


**Automotive Engine Control Actuators** – Solenoid, Fuel Injector, EGR Actuator, Ignition System (Text 1: Chapter 6)

**Module -3**

**Digital Engine Control Systems** – Digital Engine control features, Control modes for fuel Control (Seven Modes), EGR Control, Electronic Ignition Control - Closed loop Ignition timing, Spark Advance Correction Scheme, Integrated Engine Control System - Secondary Air Management, Evaporative Emissions Canister Purge, Automatic System Adjustment, System Diagnostics. (Text 1: Chapter 7)

**Control Units** – Operating conditions, Design, Data processing, Programming, Digital modules in the Control unit, Control unit software. (Text 2: Pg. 196-207)

**Module -4**

**Automotive Networking** – Bus Systems – Classification, Applications in the vehicle, Coupling of networks, Examples of networked vehicles (Text 2: Pg. 85-91), Buses - CAN Bus, LIN Bus, MOST Bus, Bluetooth, Flex Ray, Diagnostic Interfaces. (Text 2: Pg. 92-151)

**Vehicle Motion Control** – Typical Cruise Control System, Digital Cruise Control System, Digital Speed Sensor, Throttle Actuator, Digital Cruise Control configuration, Cruise Control Electronics (Digital only), Antilock Brake System (ABS) (Text 1: Chapter 8)

**Module -5**


**Future Automotive Electronic Systems** – Alternative Fuel Engines, Electric and Hybrid vehicles, Fuel cell powered cars, Collision Avoidance Radar warning Systems, Low tire pressure

**CREDITS – 03**

L1, L2, L3

Course Outcomes: At the end of the course, students will be able to:

- Acquire an overview of automotive components, subsystems, and basics of Electronic Engine Control in today’s automotive industry.
- Use available automotive sensors and actuators while interfacing with microcontrollers / microprocessors during automotive system design.
- Understand the networking of various modules in automotive systems, communication protocols and diagnostics of the sub systems.
- Design and implement the electronics that attribute the reliability, safety, and smartness to the automobiles, providing add-on comforts and get fair idea on future Automotive Electronic Systems.

Question paper pattern:

- Examination will be conducted for 100 marks with question paper containing 10 full questions, each of 20 marks.
- Each full question can have a maximum of 4 sub questions.
- There will be 2 full questions from each module covering all the topics of the module.
- Students will have to answer 5 full questions, selecting one full question from each module.
- The total marks will be proportionally reduced to 60 marks as SEE marks is 60.

Text Books:

### B. E. (EC/TC)
Choice Based Credit System (CBCS) and Outcome Based Education (OBE)
SEMESTER – VII

#### MULTIMEDIA COMMUNICATION

<table>
<thead>
<tr>
<th>Course Code</th>
<th>CIE Marks</th>
<th>Exam Marks</th>
<th>Exam Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>18EC743</td>
<td>40</td>
<td>60</td>
<td>03</td>
</tr>
</tbody>
</table>

**Number of Lecture Hours/Week:** 03

**Total Number of Lecture Hours:** 40 (08 Hours per Module)

**CREDITS – 03**

#### Course Learning Objectives:
This course will enable students to:

- Understand the importance of multimedia in today’s online and offline information sources and repositories.
- Understand the how Text, Audio, Image and Video information can be represented digitally in a computer so that it can be processed, transmitted and stored efficiently.
- Understand the Multimedia Transport in Wireless Networks
- Understand the Real-time multimedia network applications.
- Understand the Different network layer based application.

#### Module -1
**Multimedia Communications:** Introduction, Multimedia information representation, multimedia networks, multimedia applications, Application and networking terminology. *(Chapter 1 of Text 1)*

**RBT Level:** L1, L2

#### Module -2
**Information Representation:** Introduction, Digitization principles, Text, Images, Audio and Video. *(Chapter 2 of Text 1)*

**RBT Level:** L1, L2

#### Module -3
**Text and Image Compression:** Introduction, Compression principles, text compression, image compression. *(Chapter 3 of Text 1)*

**Distributed Multimedia Systems:** Introduction, main Features of a DMS, Resource management of DMS, Networking, Multimedia Operating Systems. *(Chapter 4 - Sections 4.1 to 4.5 of Text 2)*

**RBT Level:** L1, L2

#### Module -4
**Audio and video compression:** Introduction, Audio compression, video compression, video compression principles, video compression. *(Chapter 4 of Text 1)*

**RBT Level:** L1, L2

#### Module -5
**Multimedia Information Networks:** Introduction, LANs, Ethernet, Token ring, Bridges, FDDI High-speed LANs, LAN protocol *(Chap. 8 of Text 1).*

**The Internet:** Introduction, IP Datagrams, Fragmentation, IPAddress, ARP and RARP, QoS Support, IPv8. *(Chap. 9 of Text 1)*

**RBT Level:** L1, L2

#### Course Outcomes:
After studying this course, students will be able to:

- Understand basics of different multimedia networks and applications.
- Understand different compression techniques to compress audio and video.
- Describe multimedia Communication across Networks.
- Analyse different media types to represent them in digital form.
- Compress different types of text and images using different compression techniques.
**Question paper pattern:**
- Examination will be conducted for 100 marks with question paper containing 10 full questions, each of 20 marks.
- Each full question can have a maximum of 4 sub questions.
- There will be 2 full questions from each module covering all the topics of the module.
- Students will have to answer 5 full questions, selecting one full question from each module.
- The total marks will be proportionally reduced to 60 marks as SEE marks is 60.

**Text Book:**

**Reference Book:**
# B. E. (EC/TC)
Choice Based Credit System (CBCS) and Outcome Based Education (OBE)
SEMESTER – VII

## CRYPTOGRAPHY

<table>
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<th>18EC744</th>
<th>CIE Marks</th>
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<tr>
<td>Total Number of Lecture Hours</td>
<td>40 (08 Hours per Module)</td>
<td>Exam Hours</td>
<td>03</td>
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</tbody>
</table>

**Course Learning Objectives:** This course will enable students to:
- Understand the basics of symmetric key and public key cryptography.
- Explain classical cryptography algorithms.
- Acquire knowledge of mathematical concepts required for cryptography.
- Describe pseudo random sequence generation technique.
- Explain symmetric and asymmetric cryptography algorithms.

### Module -1
**Classical Encryption Techniques:** Symmetric cipher model, Substitution techniques, Transposition techniques (*Text 1: Chapter 1*)

**Basic Concepts of Number Theory and Finite Fields:** Euclidean algorithm, Modular arithmetic (*Text 1: Chapter 3*)

### Module -2
**SYMMETRIC CIPHERS:** Traditional Block Cipher structure, Data encryption standard (DES), The AES Cipher. (*Text 1: Chapter 2: Section1, 2, Chapter 4:Section 2, 3, 4*)

### Module -3
**Basic Concepts of Number Theory and Finite Fields:** Groups, Rings and Fields, Finite fields of the form GF(p), Prime Numbers, Fermat’s and Euler’s theorem, discrete logarithm. (*Text 1: Chapter 3 and Chapter 7: Section 1, 2, 5*)

### Module -4
**ASYMMETRIC CIPHERS:** Principles of Public-Key Cryptosystems, The RSA algorithm, Diffie - Hellman Key Exchange, Elliptic Curve Arithmetic, Elliptic Curve Cryptography (*Text 1: Chapter 8, Chapter 9: Section 1, 3, 4*)

### Module -5
**Pseudo-Random-Sequence Generators and Stream Ciphers:** Linear Congruential Generators, Linear Feedback Shift Registers, Design and analysis of stream ciphers, Stream ciphers using LFSRs, A5, Hughes XPD/KPD, Nanoteq, Rambutan, Additive generators, Gifford, Algorithm M, PKZIP (*Text 2: Chapter 16*)

**Course Outcomes:** After studying this course, students will be able to:
- Explain basic cryptographic algorithms to encrypt and decrypt the data.
- Use symmetric and asymmetric cryptography algorithms to encrypt and decrypt the information.
- Apply concepts of modern algebra in cryptography algorithms.
- Apply pseudo random sequence in stream cipher algorithms.
Question paper pattern:
- Examination will be conducted for 100 marks with question paper containing 10 full questions, each of 20 marks.
- Each full question can have a maximum of 4 sub questions.
- There will be 2 full questions from each module covering all the topics of the module.
- Students will have to answer 5 full questions, selecting one full question from each module.
- The total marks will be proportionally reduced to 60 marks as SEE marks is 60.

Text Books:

Reference Books:
## B. E. ECE
Choice Based Credit System (CBCS) and Outcome Based Education (OBE)
SEMESTER – VII

### MACHINE LEARNING WITH PYTHON

<table>
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<tbody>
<tr>
<td>18EC745</td>
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<table>
<thead>
<tr>
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<tbody>
<tr>
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<td>60</td>
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<table>
<thead>
<tr>
<th>Total Number of Lecture Hours</th>
<th>Exam Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>40</td>
<td>03</td>
</tr>
</tbody>
</table>

**CREDITS – 03**

### Course Learning Objectives:
This course will enable students to

- Define machine learning and problems relevant to machine learning.
- Differentiate supervised, unsupervised and reinforcement learning
- Perform statistical analysis of machine learning techniques.

### Module – 1

<table>
<thead>
<tr>
<th>Introduction</th>
<th>Teaching Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Well posed learning problems, Designing a Learning system, Perspective and Issues in Machine Learning.</td>
<td>10 Hours</td>
</tr>
</tbody>
</table>

**Concept Learning:** Concept learning task, Concept learning as search, Find-S algorithm, Version space, Candidate Elimination algorithm, Inductive Bias.

**Python libraries suitable for Machine Learning:** Numerical Analysis and Data Exploration with NumPy Arrays, and Data Visualization with Matplotlib.

**Text Book1, Sections:** 1.1 – 1.3, 2.1-2.5, 2.7

### Module – 2

**Decision Tree Learning:** Decision tree representation, Appropriate problems for decision tree learning, Basic decision tree learning algorithm, hypothesis space search in decision tree learning, Inductive bias in decision tree learning, Issues in decision tree learning. Example program in Python.

**Text Book1, Sections:** 3.1-3.7

### Module – 3

**Artificial Neural Networks:** Introduction, Neural Network representation, Appropriate problems, Perceptrons, Back propagation algorithm. Example program in Python.

**Text Book1, Sections:** 4.1 – 4.6

### Module – 4

**Bayesian Learning:** Introduction, Bayes theorem, Bayes theorem and concept learning, ML and LS error hypothesis, ML for predicting probabilities, MDL principle, Naive Bayes classifier, Bayesian belief networks, EM algorithm, Example program in Python.

**Text book 1, Sections:** 6.1 – 6.6, 6.9, 6.11, 6.12

### Module – 5

**Evaluating Hypothesis:** Motivation, Estimating hypothesis accuracy, Basics of sampling theorem, General approach for deriving confidence intervals, Difference in error of two hypothesis, Comparing learning algorithms.

**Instance Based Learning:** Introduction, k-nearest neighbor learning, locally weighted regression, radial basis function, cased-based reasoning.

**Reinforcement Learning:** Introduction, Learning Task, Q Learning Example program in Python.

**Text book 1, Sections:** 5.1-5.6, 8.1-8.5, 13.1-13.3

### Course Outcomes:
After studying this course, students will be able to

- Identify the problems in machine learning.
- Select supervised, unsupervised or reinforcement learning for problem solving.
- Apply theory of probability and statistics in machine learning.
- Apply concept learning, ANN, Bayes classifier, k nearest neighbor.
- Perform statistical analysis of machine learning techniques.
## Question paper pattern:

- The question paper will have ten questions.
- There will be 2 questions from each module.
- Each question will have questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module.

## Text Books:


## Reference Books:

2. Ethem Alpaydın, Introduction to machine learning, second edition, MIT press.
### Course Learning Objectives:

- Choose suitable tools to model a network and understand the protocols at various OSI reference levels.
- Design a suitable network and simulate using a Network simulator tool.
- Simulate the networking concepts and protocols using C/C++ programming.
- Model the networks for different configurations and analyze the results.

### Laboratory Experiments

#### PART-A: Simulation experiments using NS2/ NS3/ OPNET/ NCTUNS/ NetSim/QualNet or any other equivalent tool

1. Implement a point to point network with four nodes and duplex links between them. Analyze the network performance by setting the queue size and varying the bandwidth.
2. Implement a four node point to point network with links n0-n2, n1-n2 and n2-n3. Apply TCP agent between n0-n3 and UDP between n1-n3. Apply relevant applications over TCP and UDP agents changing the parameter and determine the number of packets sent by TCP/UDP.
3. Implement Ethernet LAN using n (6-10) nodes. Compare the throughput by changing the error rate and data rate.
4. Implement Ethernet LAN using n nodes and assign multiple traffic to the nodes and obtain congestion window for different sources/destinations.
5. Implement ESS with transmission nodes in Wireless LAN and obtain the performance parameters.

#### PART-B: Implement the following in C/C++

1. Write a program for a HLDC frame to perform the following.
   - i) Bit stuffing
   - ii) Character stuffing.
2. Write a program for distance vector algorithm to find suitable path for transmission.
3. Implement Dijkstra’s algorithm to compute the shortest routing path.
4. For the given data, use CRC-CCITT polynomial to obtain CRC code. Verify the program for the cases
   - a. Without error
   - b. With error
5. Implementation of Stop and Wait Protocol and Sliding Window Protocol
6. Write a program for congestion control using leaky bucket algorithm.

### Course outcomes:

- Use the network simulator for learning and practice of networking algorithms.
- Illustrate the operations of network protocols and algorithms using C programming.
- Simulate the network with different configurations to measure the performance parameters.
- Implement the data link and routing protocols using C programming.
Conduct of Practical Examination:

- All laboratory experiments are to be included for practical examination.
- For examination one question from software and one question from hardware or only one hardware experiments based on the complexity to be set.
- Students are allowed to pick one experiment from the lot.
- Strictly follow the instructions as printed on the cover page of answer script for breakup of marks.
- Change of experiment is allowed only once and Marks allotted to the procedure part to be made zero.
Choice Based Credit System (CBCS) and Outcome Based Education (OBE)

SEMESTER – VII

VLSI LAB

<table>
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<th>18ECL77</th>
<th>CIE Marks</th>
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<tbody>
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<td>RBT Levels</td>
<td>L1, L2, L3</td>
<td>Exam Hours</td>
<td>03</td>
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</tbody>
</table>

CREDITS – 02

Course Learning Objectives: This course will enable students to:
- Design, model, simulate and verify CMOS digital circuits
- Design layouts and perform physical verification of CMOS digital circuits
- Perform ASIC design flow and understand the process of synthesis, synthesis constraints and evaluating the synthesis reports to obtain optimum gate level netlist
- Perform RTL-GDSII flow and understand the stages in ASIC design

Experiments can be conducted using any of the following or equivalent design tools:
- Cadence/Synopsis/Mentor Graphics/Microwind

Laboratory Experiments
Part – A
Analog Design
Use any VLSI design tools to carry out the experiments, use library files and technology files below 180 nm.

1. a) Capture the schematic of CMOS inverter with load capacitance of 0.1pF and set the widths of inverter with Wn = Wp, Wn = 2Wp, Wn = Wp/2 and length at selected technology. Carry out the following:
   a. Set the input signal to a pulse with rise time, fall time of 1ns and pulse width of 10ns and time period of 20ns and plot the input voltage and output voltage of designed inverter?
   b. From the simulation results compute tpHL, tpLH and td for all three geometrical settings of width?
   c. Tabulate the results of delay and find the best geometry for minimum delay for CMOS inverter?

1. b) Draw layout of inverter with Wp/Wn = 40/20, use optimum layout methods. Verify for DRC and LVS, extract parasitic and perform post layout simulations, compare the results with pre-layout simulations. Record the observations.

2. a) Capture the schematic of 2-input CMOS NAND gate having similar delay as that of CMOS inverter computed in experiment 1. Verify the functionality of NAND gate and also find out the delay td for all four possible combinations of input vectors. Table the results. Increase the drive strength to 2X and 4X and tabulate the results.
2.b) Draw layout of NAND with Wp/Wn = 40/20, use optimum layout methods. Verify for DRC and LVS, extract parasitic and perform post layout simulations, compare the results with pre-layout simulations. Record the observations.

3.a) Capture schematic of Common Source Amplifier with PMOS Current Mirror Load and find its transient response and AC response? Measures the Unity Gain Bandwidth (UGB), amplification factor by varying transistor geometries, study the impact of variation in width to UGB.

1. b) Draw layout of common source amplifier, use optimum layout methods. Verify for DRC and LVS, extract parasitic and perform post layout simulations, compare the results with pre-layout simulations. Record the observations.

4. a) Capture schematic of two-stage operational amplifier and measure the following:
   a. UGB
   b. dB bandwidth
   c. Gain margin and phase margin with and without coupling capacitance
   d. Use the op-amp in the inverting and non-inverting configuration and verify its functionality
   e. Study the UGB, 3dB bandwidth, gain and power requirement in op-amp by varying the stage wise
4. b) Draw layout of two-stage operational amplifier with minimum transistor width set to 300 (in 180/90/45 nm technology), choose appropriate transistor geometries as per the results obtained in 4.a. Use optimum layout methods. Verify for DRC and LVS, extract parasitic and perform post layout simulations, compare the results with pre-layout simulations. Record the observations.

**Part - B**

**Digital Design**

**Carry out the experiments using semicustom design flow or ASIC design flow, use technology library 180/90/45nm and below**

**Note:** The experiments can also be carried out using FPGA design flow, it is required to set appropriate constraints in FPGA advanced synthesis options

<table>
<thead>
<tr>
<th>Experiment</th>
<th>Details</th>
</tr>
</thead>
</table>
| 1. | Write verilog code for 4-bit up/down asynchronous reset counter and carry out the following:  
   a. Verify the functionality using test bench  
   b. Synthesize the design by setting area and timing constraint. Obtain the gate level netlist, find the critical path and maximum frequency of operation. Record the area requirement in terms of number of cells required and properties of each cell in terms of driving strength, power and area requirement.  
   c. Perform the above for 32-bit up/down counter and identify the critical path, delay of critical path, and maximum frequency of operation, total number of cells required and total area. |
| 2. | Write verilog code for 4-bit adder and verify its functionality using test bench. Synthesize the design by setting proper constraints and obtain the net list. From the report generated identify critical path, maximum delay, total number of cells, power requirement and total area required. Change the constraints and obtain optimum synthesis results. |
| 3. | Write verilog code for UART and carry out the following:  
   a. Perform functional verification using test bench  
   b. Synthesize the design targeting suitable library and by setting area and timing constraints  
   c. For various constrains set, tabulate the area, power and delay for the synthesized netlist  
   d. Identify the critical path and set the constraints to obtain optimum gate level netlist with suitable constraints |
| 4. | Write verilog code for 32-bit ALU supporting four logical and four arithmetic operations, use case statement and if statement for ALU behavioral modeling.  
   a. Perform functional verification using test bench  
   b. Synthesize the design targeting suitable library by setting area and timing constraints  
   c. For various constrains set, tabulate the area, power and delay for the synthesized netlist  
   d. Identify the critical path and set the constraints to obtain optimum gate level netlist with suitable constraints  
   Compare the synthesis results of ALU modeled using IF and CASE statements. |
| 5. | Write verilog code for Latch and Flip-flop, Synthesize the design and compare the synthesis report (D, SR, JK). |
| 6. | For the synthesized netlist carry out the following for any two above experiments:  
   a. Floor planning (automatic), identify the placement of pads  
   b. Placement and Routing, record the parameters such as no. of layers used for routing, flip method for placement of standard cells, placement of standard cells, routes of power and ground, and routing of standard cells  
   c. Physical verification and record the LVS and DRC reports  
   d. Perform Back annotation and verify the functionality of the design  
   e. Generate GDSII and record the number of masks and its color composition |

**Course Outcomes:** On the completion of this laboratory course, the students will be able to:

- Design and simulate combinational and sequential digital circuits using Verilog HDL
- Understand the Synthesis process of digital circuits using EDA tool.
- Perform ASIC design flow and understand the process of synthesis, synthesis constraints and evaluating the synthesis reports to obtain optimum gate level net list
- Design and simulate basic CMOS circuits like inverter, common source amplifier and differential amplifiers.
- Perform RTL-GDSII flow and understand the stages in ASIC design.
<table>
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<td>Exam Hours</td>
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</table>

**CREDITS – 03**

**Course Learning Objectives:** This course will enable students to:
- Describe essential elements of an electronic communication system.
- Understand Amplitude, Frequency & Phase modulations, and Amplitude demodulation.
- Explain the basics of sampling and quantization.
- Understand the various digital modulation schemes.
- The concepts of wireless communication.

**Module -1**

**Introduction to Electronic Communications:** Historical perspective, Electromagnetic frequency spectrum, signal and its representation, Elements of electronic communications system, primary communication resources, signal transmission concepts, Analog and digital transmission, Modulation, Concept of frequency translation, Signal radiation and propagation (Text 1: 1.1 to 1.10)

**RBT Level**
L1, L2

**Module -2**

**Noise:** Classification and source of noise (TEXT1:3.1)

**Amplitude Modulation Techniques:** Types of analog modulation, Principle of amplitude modulation, AM power distribution, Limitations of AM, (TEXT 1: 4.1, 4.2, 4.4, 4.6)

**Angle Modulation Techniques:** Principles of Angle modulation, Theory of FM-basic Concepts, Theory of phase modulation (TEXT1: 5.1, 5.2, 5.5)

**Analog Transmission and Reception:** AM Radio transmitters, AM Radio Receivers (TEXT1:6.1, 6.2)

**Module -3**

**Sampling Theorem and pulse Modulation Techniques:** Digital Versus analog Transmissions, Sampling Theorem, Classification of pulse modulation techniques, PAM, PWM, PPM, PCM, Quantization of signals (TEXT 1: 7.1 to 7.8)

**Module -4**

**Digital Modulation Techniques:** Types of digital Modulation, ASK, FSK, PSK, QPSK (TEXT 1: 9.1 to 9.5)

**Source and Channel Coding:** Objective of source coding, source coding technique, Shannon’s source coding theorem, need of channel coding, Channel coding theorem, error control and coding (TEXT 1: 11.1 to 11.3, 11.8, 11.9, 11.12)

**Module -5**

**Evolution of wireless communication systems:** Brief History of wireless communications, Advantages of wireless communication, disadvantages of wireless communications, wireless network generations, Comparison of wireless systems, Evolution of next-generation networks, Applications of wireless communication(TEXT 2: 1.1 to 1.7)

**Principles of Cellular Communications:** Cellular terminology, Cell structure and Cluster, Frequency reuse concept, Cluster size and system capacity, Method of locating cochannel cells, Frequency reuse distance(TEXT 2: 4.1 to 4.7)
Course Outcomes: At the end of the course, students will be able:
- Describe operation of communication systems.
- Understand the techniques of Amplitude and Angle modulation.
- Understand the concept of sampling and quantization.
- Understand the concepts of different digital modulation techniques.
- Describe the principles of wireless communications system.

Question paper pattern:
- Examination will be conducted for 100 marks with question paper containing 10 full questions, each of 20 marks.
- Each full question can have a maximum of 4 sub questions.
- There will be 2 full questions from each module covering all the topics of the module.
- Students will have to answer 5 full questions, selecting one full question from each module.
- The total marks will be proportionally reduced to 60 marks as SEE marks is 60.

Text Book:

Reference Books:
### Course Code: 18EC752

**CIE Marks:** 40  
**Exam Marks:** 60  
**Total Number of Lecture Hours:** 40 (08 Hours per Module)  
**Exam Hours:** 03  
**Credits:** 03

### Course Learning Objectives:

This course will enable students to:

- Understand the basics of ANN and comparison with Human brain.
- Acquire knowledge on Generalization and function approximation of various ANN architectures.

### Module -1

**Introduction:** Biological Neuron – Artificial Neural Model -Types of activation functions – **Architecture:** Feedforward and Feedback, Convex Sets, Convex Hull and Linear Separability, Non-Linear Separable Problem. XOR Problem, Multilayer Networks.  
**Learning:** Learning Algorithms, Error correction and Gradient Descent Rules, Learning objective of TLNs, Perceptron Learning Algorithm, Perceptron Convergence Theorem.

### Module -2

**Supervised Learning:** Perceptron learning and Non Separable sets, $\alpha$-Least Mean Square Learning, MSE Error surface, Steepest Descent Search, $\mu$-LMS approximate to gradient descent, Application of LMS to Noise Cancelling, Multi-layered Network Architecture, Backpropagation Learning Algorithm, Practical consideration of BP algorithm.

### Module -3

**Support Vector Machines and Radial Basis Function:** Learning from Examples, Statistical Learning Theory, Support Vector Machines, SVM application to Image Classification, Radial Basis Function Regularization theory, Generalized RBF Networks, Learning in RBFNs, RBF application to face recognition.

### Module -4

**Attractor Neural Networks:** Associative Learning Attractor Associative Memory, Linear Associative memory, Hopfield Network, application of Hopfield Network, Brain State in a Box neural Network, Simulated Annealing, Boltzmann Machine, Bidirectional Associative Memory.

### Module -5

**Self -organization Feature Map:** Maximal Eigenvector Filtering, Extracting Principal Components, Generalized Learning Laws, Vector Quantization, Self -organization Feature Maps, Application of SOM, Growing Neural Gas.

### Course Outcomes:

At the end of the course, students should be able to:

- Understand the role of neural networks in engineering, artificial intelligence, and cognitive modelling.
- Understand the concepts and techniques of neural networks through the study of the most important neural network models.
- Evaluate whether neural networks are appropriate to a particular application.
- Apply neural networks to particular application, and to know what steps to take to improve performance.
**Question paper pattern:**
- Examination will be conducted for 100 marks with question paper containing 10 full questions, each of 20 marks.
- Each full question can have a maximum of 4 sub questions.
- There will be 2 full questions from each module covering all the topics of the module.
- Students will have to answer 5 full questions, selecting one full question from each module.
- The total marks will be proportionally reduced to 60 marks as SEE marks is 60.

**Text Book:**

**Reference Books:**
Course Learning Objectives: This course will enable students to:

- Understand the concepts of propagation over wireless channels from a physics standpoint.
- Application of Communication theory both Physical and networking to understand GSM systems that handle mobile telephony.
- Application of Communication theory both Physical and networking to understand CDMA systems that handle mobile telephony.
- Application of Communication theory both Physical and networking to understand LTE-4G systems.

Module-1

Mobile Radio Propagation –
Large Scale Path Loss - Free Space Propagation Model, Relating Power to Electric Field, Three Basic Propagation Mechanisms – Reflection (Ground Reflection), Diffraction, Scattering, Practical Link Budget, (Text 1 - 2.2 and Ref1 - Chapter 4).
Fading and Multipath – Broadband wireless channel, Delay Spread and Coherence Bandwidth, Doppler Spread and Coherence Time, Angular spread and Coherence Distance (Text 1 – 2.4), Statistical Channel Model of a Broadband Fading Channel (Text 1 – 2.5.1)
The Cellular Concept – Cellular Concept, Analysis of Cellular Systems, Sectoring (Text 1-2.3)

Module-2

GSM and TDMA Technology
GSM System overview – Introduction, GSM Network and System Architecture, GSM Channel Concept.
GSM System Operations – GSM Identities, System Operations –Traffic cases, GSM Infrastructure Communications (Um Interface) (Text 2, Part1 and Part 2 of Chapter 5)

Module-3

CDMA Technology
CDMA System Overview – Introduction, CDMA Network and System Architecture
CDMA Basics – CDMA Channel Concepts, CDMA System (Layer 3) operations, 3G CDMA (Text 2-Part 1, Part2 and Part 3 of Chapter 6)

Module-4

LTE – 4G
Key Enablers for LTE 4G – OFDM, SC-FDE, SC-FDMA, Channel Dependant Multiuser Resource Scheduling, Multi-Antenna Techniques, Flat IP Architecture, LTE Network Architecture. (Text 1, Sec 1.4)
Multi-Carrier Modulation – Multicarrier concepts, OFDM Basics, OFDM in LTE, Timing and Frequency Synchronization, Peak to Average Ration, SC-Frequency Domain Equalization, Computational Complexity Advantage of OFDM and SC-FDE. (Text 1, Sec 3.1 – 3.7)

Module-5
**LTE - 4G**

**OFDMA and SC-FDMA** – Multiple Access for OFDM Systems, OFDMA, SCFDMA, Multiuser Diversity and Opportunistic Scheduling, OFDMA and SC-FDMA in LTE, OFDMA system Design Considerations.  
*(Text 1, Sec 4.1 – 4.6)*

*(Text 1, Sec 6.1 – 6.4)*

**Course Outcomes:** After studying this course, students will be able to:

- Explain concepts of propagation mechanisms like Reflection, Diffraction, Scattering in wireless channels.
- Develop a scheme for idle mode, call set up, call progress handling and call tear down in a GSM cellular network.
- Develop a scheme for idle mode, call set up, call progress handling and call tear down in a CDMA cellular network.
- Understand the Basic operations of Air interface in a LTE 4G system.

**Question paper pattern:**

- Examination will be conducted for 100 marks with question paper containing 10 full questions, each of 20 marks.
- Each full question can have a maximum of 4 sub questions.
- There will be 2 full questions from each module covering all the topics of the module.
- Students will have to answer 5 full questions, selecting one full question from each module.
- The total marks will be proportionally reduced to 60 marks as SEE marks is 60.

**Text Books:**


**Reference Books:**

### Course Learning Objectives:
This course will enable students to:
- Describe network security services and mechanisms.
- Understand Transport Level Security and Secure Socket Layer.
- Know about Security concerns in Internet Protocol security.
- Discuss about Intruders, Intrusion detection and Malicious Software.
- Discuss about Firewalls, Firewall characteristics, Biasing and Configuration.

### Module-1
**Attacks on Computers and Computer Security:** Need for Security, Security Approaches, Principles of Security Types of Attacks. *(Chapter1-Text 2)*

### Module-2
**Transport Level Security:** Web Security Considerations, Secure Sockets Layer, Transport Layer Security, HTTPS, Secure Shell (SSH)*(Chapter15- Text1)*

### Module-3
**IP Security:** Overview of IP Security (IPSec), IP Security Architecture, Modes of Operation, Security Associations (SA), Authentication Header (AH), Encapsulating Security Payload (ESP), Internet Key Exchange. *(Chapter19-Text 1)*

### Module-4
**Intruders, Intrusion Detection.** *(Chapter20-Text 1)*

### Module-5
**MALICIOUS SOFTWARE:** Viruses and Related Threats, Virus Countermeasures, *(Chapter21-Text 1)*

### Module-6
**Firewalls:** The Need for firewalls, Firewall Characteristics, Types of Firewalls, Firewall Biasing, Firewall location and configuration *(Chapter22-Text 1)*

### Course Outcomes:
After studying this course, students will be able to:
- Explain network security services and mechanisms and explain security concepts.
- Understand the concept of Transport Level Security and Secure Socket Layer.
- Explain Security concerns in Internet Protocol security.
- Explain Intruders, Intrusion detection and Malicious Software.
- Describe Firewalls, Firewall Characteristics, Biasing and Configuration.

### Question paper pattern:
- Examination will be conducted for 100 marks with question paper containing 10 full questions, each of 20 marks.
- Each full question can have a maximum of 4 sub questions.
- There will be 2 full questions from each module covering all the topics of the module.
- Students will have to answer 5 full questions, selecting one full question from each module.
- The total marks will be proportionally reduced to 60 marks as SEE marks is 60.
**TEXT BOOKS:**

**REFERENCE BOOKS:**
## Course Code: 18EC822
### CIE Marks: 40
### SEE Marks: 60
### Total Number of Lecture Hours: 40 (08 Hours / Module)

### Exam Hours: 03  
### Credits: 03

### Course Learning Objectives:
- Understand overview of microsystems, their fabrication and application areas.
- Working principles of several MEMS devices.
- Develop mathematical and analytical models of MEMS devices.
- Know methods to fabricate MEMS devices.
- Various application areas where MEMS devices can be used.

### Module-1

**Overview of MEMS and Microsystems**: MEMS and Microsystem, Typical MEMS and Microsystems Products, Evolution of Microfabrication, Microsystems and Microelectronics, Multidisciplinary Nature of Microsystems, Miniaturization. Applications and Markets.

### Module-2

**Working Principles of Microsystems**: Introduction, Microsensors, Microactuation, MEMS with Microactuators, Microaccelerometers, Microfluidics.

**Engineering Science for Microsystems Design and Fabrication**: Introduction, Molecular Theory of Matter and Inter-molecular Forces, Plasma Physics, Electrochemistry.

### Module-3


### Module-4

**Scaling Laws in Miniaturization**: Introduction, Scaling in Geometry, Scaling in Rigid-Body Dynamics, Scaling in Electrostatic Forces, Scaling in Fluid Mechanics, Scaling in Heat Transfer.

### Module-5


### Course Outcomes:
- Appreciate the technologies related to Micro Electro Mechanical Systems.
- Understand design and fabrication processes involved with MEMS Devices.
- Analyze the MEMS devices and develop suitable mathematical models.
- Know various application areas for MEMS device.

### Question paper pattern:
- Examination will be conducted for 100 marks with question paper containing 10 full questions, each of 20 marks.
- Each full question can have a maximum of 4 sub questions.
- There will be 2 full questions from each module covering all the topics of the module.
- Students will have to answer 5 full questions, selecting one full question from each module.
- The total marks will be proportionally reduced to 60 marks as SEE marks is 60.

### Text Book:
Tai-Ran Hsu, MEMS and Micro systems: Design, Manufacture and Nanoscale Engineering, 2nd Ed, Wiley.
Reference Books:

B. E. EC/TC
Choice Based Credit System (CBCS) and Outcome Based Education (OBE)
SEMESTER – VIII
RADAR ENGINEERING

Course Code 18EC823 CIE Marks 40
Number of Lecture Hours/Week 3 SEE Marks 60
Total Number of Lecture Hours 40 (08 Hours / Module) Exam Hours 03
CREDITS – 03

Course Learning Objectives: This course will enable students to:
- Understand the Radar fundamentals and analyze the radar signals.
- Understand various technologies involved in the design of radar transmitters and receivers.
- Learn various radars like MTI, Doppler and tracking radars and their comparison

Module-1

Module-2

Module-3

Module-4
Tracking Radar:
Tracking with Radar- Types of Tracking Radar Systems, Monopulse Tracking- Amplitude Comparison Monopulse(one-and two-coordinates), Phase Comparison Monopulse. Sequential Lobing, Conical Scan Tracking, Block Diagram of Conical Scan Tracking Radar, Tracking in Range, Comparison of Trackers. (Chapter 4: 4.1, 4.2, 4.3 of Text)

Module-5
TheRadarAntenna: Functions of the Radar Antenna, Antenna Parameters, Reflector Antennas and Electronically Steered Phased Array Antennas. (Chapter 9: 9.1, 9.29.4, 9.5 of Text) Radar Receiver: The Radar Receiver, Receiver Noise Figure, Super Heterodyne Receiver, Duplexers and Receivers Protectors, Radar Displays. (Chapter 11 of Text)

Course Outcomes: At the end of the course, students will be able to:
- Understand the radar fundamentals and radar signals.
- Explain the working principle of pulse Doppler radars, their applications and limitations.
- Describe the working of various radar transmitters and receivers.
- Analyze the range parameters of pulse radar system which affect the system performance.

Question paper pattern:
- Examination will be conducted for 100 marks with question paper containing 10 full questions, each of 20 marks.
Each full question can have a maximum of 4 sub questions.
There will be 2 full questions from each module covering all the topics of the module.
Students will have to answer 5 full questions, selecting one full question from each module.
The total marks will be proportionally reduced to 60 marks as SEE marks is 60.

TEXT BOOK:
Introduction to Radar Systems- Merrill I Skolink, 3e, TMH, 2001

REFERENCE BOOKS:
   Yesdee, 2013
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<tbody>
<tr>
<td></td>
<td>• Learn the basic principle of optical fiber communication with different modes of light propagation.</td>
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<tr>
<td></td>
<td>• Understand the transmission characteristics and losses in optical fiber.</td>
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<tr>
<td></td>
<td>• Study of optical components and its applications in optical communication networks.</td>
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<tr>
<td></td>
<td>• Learn the network standards in optical fiber and understand the network architectures along with its functionalities.</td>
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<th>RBT Level</th>
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<tbody>
<tr>
<td><strong>Optical fiber Communications:</strong> Historical development, The general system, Advantages of optical fiber communication, Optical fiber wave guides: Ray theory transmission, Modes in planar guide, Phase and group velocity. Cylindrical fiber: Modes, Step index fibers, Graded index fibers, Single mode fibers, Cutoff wavelength, Mode field diameter, effective refractive index. Fiber Materials, Photonic crystal fibers. (Text 2)</td>
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<td><strong>Transmission characteristics of optical fiber:</strong> Attenuation, Material absorption losses, Linear scattering losses, Nonlinear scattering losses, Fiber bend loss, Dispersion, Chromatic dispersion, Intermodal dispersion: Multimode step index fiber. <strong>Optical Fiber Connectors:</strong> Fiber alignment and joint loss, Fiber splices: Fusion Splices, Mechanical splices, Fiber connectors: Cylindrical ferrule connectors, Duplex and Multiple fiber connectors, Fiber couplers: three and four port couplers, star couplers, Optical Isolators and Circulators. (Text 2)</td>
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<td><strong>Optical sources:</strong> Light Emitting diodes: LED Structures, Light Source Materials, Quantum Efficiency and LED Power, Modulation. Laser Diodes: Modes and Threshold conditions, Rate equation, External Quantum Efficiency, Resonant Frequencies. <strong>Photodetectors:</strong> Physical principles of Photodiodes, Photo detector noise, Detector response time. <strong>Optical Receiver:</strong> Optical Receiver Operation: Error sources, Front End Amplifiers, Receiver sensitivity, Quantum Limit. (Text 1)</td>
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<td><strong>WDM Concepts and Components:</strong> Overview of WDM: Operational Principles of WDM, WDM standards, Mach-Zehnder Interferometer Multiplexers, Isolators and Circulators, Fiber grating filters, Dielectric Thin-Film Filters, Diffraction Gratings. Optical amplifiers: Basic application and Types, Semiconductor optical amplifiers, Erbium Doped Fiber Amplifiers, Raman Amplifiers, Wideband Optical Amplifiers. (Text 1)</td>
<td>L1, L2</td>
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<th>Module -5</th>
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**Course Outcomes:** At the end of the course, students will be able to:
- Classification and working of optical fiber with different modes of signal propagation.
- Describe the transmission characteristics and losses in optical fiber communication.
- Describe the construction and working principle of optical connectors, multiplexers and amplifiers.
- Describe the constructional features and the characteristics of optical Sources and detectors.
- Illustrate the networking aspects of optical fiber and describe various standards associated with it.

**Question paper pattern:**
- Examination will be conducted for 100 marks with question paper containing 10 full questions, each of 20 marks.
- Each full question can have a maximum of 4 sub questions.
- There will be 2 full questions from each module covering all the topics of the module.
- Students will have to answer 5 full questions, selecting one full question from each module.
- The total marks will be proportionally reduced to 60 marks as SEE marks is 60.

**Text Books:**

**Reference Book:**
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**Course Learning Objectives:** This course will enable students to:
- Describe the origin, properties and suitable models of important biological signals such as ECG and EEG.
- Know the basic signal processing techniques in analysing biological signals.
- Acquire mathematical and computational skills relevant to the field of biomedical signal processing.
- Describe the basics of ECG signal compression algorithms.
- Know the complexity of various biological phenomena.
- Understand the promises, challenges of the biomedical engineering.

**Module -1**

**Introduction to Biomedical Signals:** The nature of Biomedical Signals, Examples of Biomedical Signals, Objectives and difficulties in Biomedical analysis.

**Electrocardiography:** Basic electrocardiography, ECG leads systems, ECG signal characteristics.

**Signal Conversion:** Simple signal conversion systems, Conversion requirements for biomedical signals, Signal conversion circuits (Text-1)

**Module -2**

**Signal Averaging:** Basics of signal averaging, signal averaging as a digital filter, a typical averager, software for signal averaging, limitations of signal averaging.

**Adaptive Noise Cancelling:** Principal noise canceller model, 60-Hz adaptive cancelling using a sine wave model, other applications of adaptive filtering (Text-1)

**Module -3**

**Data Compression Techniques:** Turning point algorithm, AZTEC algorithm, Fan algorithm, Huffman coding, data reduction algorithms The Fourier transform, Correlation, Convolution, Power spectrum estimation, Frequency domain analysis of the ECG (Text-1)

**Module -4**

**Cardiological signal processing:**
- Basic Electrocardiography, ECG data acquisition, ECG lead system, ECG signal characteristics (parameters and their estimation), Analog filters, ECG amplifier, and QRS detector, Power spectrum of the ECG, Bandpass filtering techniques, Differentiation techniques, Template matching techniques, A QRS detection algorithm, Real-time ECG processing algorithm, ECG interpretation, ST segment analyzer, Portable arrhythmia monitor. (Text -2)

**Module -5**

**Neurological signal processing:** The brain and its potentials, The electrophysiological origin of brain waves, The EEG signal and its characteristics (EEG rhythms, waves, and transients), Correlation.

**Analysis of EEG channels:** Detection of EEG rhythms, Template matching for EEG, spike and wave detection (Text-2)

**Course Outcomes:** At the end of the course, students will be able to:
- Possess the basic mathematical, scientific and computational skills necessary to analyse ECG and EEG signals.
- Apply classical and modern filtering and compression techniques for ECG and EEG signals
- Develop a thorough understanding on basics of ECG and EEG feature extraction.
**Question paper pattern:**
- Examination will be conducted for 100 marks with question paper containing 10 full questions, each of 20 marks.
- Each full question can have a maximum of 4 sub questions.
- There will be 2 full questions from each module covering all the topics of the module.
- Students will have to answer 5 full questions, selecting one full question from each module.
- The total marks will be proportionally reduced to 60 marks as SEE marks is 60.

**Text Books:**

**Reference Book:**
*Biomedical Signal Analysis* - Rangaraj M. Rangayyan, John Wiley & Sons 2002.