III SEMESTER

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>Credits</th>
<th>Exam Hours</th>
<th>CIE Marks</th>
<th>SEE Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>18MAT31</td>
<td>03</td>
<td>03</td>
<td>40</td>
<td>60</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 Transform: Definition and Laplace transforms of elementary functions (statements only). Laplace transforms of Periodic functions (statement only) and unit-step function – problems.
Inverse Laplace Transform: Definition and problems, Convolution theorem to find the inverse Laplace transforms (without Proof) and problems. Solution of linear differential equations using Laplace transforms.

Module-2

Fourier Series: Periodic functions, Dirichlet’s condition. Fourier series of periodic functions period $\frac{2\pi}{2}$ and arbitrary period. Half range Fourier series. Practical harmonic analysis.

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 and applications to solve difference equations.

Module-4

Numerical Solutions of Ordinary Differential Equations(ODE’s):
Numerical solution of ODE’s of first order and first degree- Taylor’s series method, Modified Euler’s method. Runge-Kutta method of fourth order, Milne’s and Adam-Bash forth predictor and corrector method (No derivations of formulae)-Problems.

Module-5

Numerical Solution of Second Order ODE's: Runge-Kutta method and Milne’s predictor and corrector method. (No derivations of formulae).

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 externals of functionals using calculus of variations and solve problems.
arising in dynamics of rigid bodies and vibrational analysis.

**Question paper pattern:**
- The question paper will have ten full questions carrying equal marks.
- 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 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>4</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:**
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://academicearth.org/)
### Electronic Instrumentation and Measurements
(Common to EI, BM & ML)

<table>
<thead>
<tr>
<th>Subject Code</th>
<th>18EI/BM/ML32</th>
<th>CIE Marks</th>
<th>40</th>
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</thead>
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<tr>
<td>Number of Lecture 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:** This course will enable the students to
- Impart with the knowledge of generalized measurement systems.
- Learn the characteristics of various types of measurement systems and errors in measuring instruments.
- Analyze the circuits for the measurement of Resistance, Capacitance, Inductance, and Frequency.
- Impart with the basic concepts of CRO and its usage for the measurement of various parameters.
- Understand the concepts of Ammeters, Voltmeter and Multimeters.
- Understand the importance of Display Devices and Recorders in practical fields.

**Revised Bloom’s Taxonomy Levels:** L1 – Remembering, L2 – Understanding, L3 – Applying, L4 – Analyzing, L5 – Evaluating, and L6 - Creating

<table>
<thead>
<tr>
<th>Modules</th>
<th>Teaching Hours</th>
<th>Revised Bloom’s Taxonomy (RBT)Level</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Module -1</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Measurements: Introduction, Significance of measurements, methods of measurements, instruments and measurement systems, Functions of instruments and measurement systems, Applications of measurement systems.(Verify)</td>
<td>8 Hours</td>
<td>L1, L2</td>
</tr>
<tr>
<td>Measurement Errors: Introduction Gross errors and systematic errors, Absolute and relative errors, basic concepts of accuracy, Precision, Resolution and Significant figures, Measurement error combinations. (relevant problems)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Module -2</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ammeters, Voltmeter and Multimeters:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Introduction, DC ammeter principle only, DC voltmeter, Multi-range voltmeter, Extending voltmeter ranges, Loading, Peak responding and True RMS voltmeters. (relevant problems)</td>
<td>8 Hours</td>
<td>L1, L2, L3, L5</td>
</tr>
<tr>
<td>Digital Voltmeters:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Introduction, Ramp type, Dual slope integrating type (V–T), integrating type (V–F) and Successive approximation type (relevant problems).</td>
<td>8 Hours</td>
<td>L1, L2, L3, L5</td>
</tr>
<tr>
<td>Digital Instruments:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Introduction, Block diagram of a Basic Digital Multi-meter. Digital frequency meters: Basic circuit of a Digital frequency meter, Basic circuit for frequency measurement.</td>
<td>8 Hours</td>
<td>L1, L2, L3, L4</td>
</tr>
<tr>
<td>Analog storage oscilloscopes:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Need for trace storage, bistable storage CRT, Electronic switch.</td>
<td>8 Hours</td>
<td>L1, L2, L3, L4</td>
</tr>
</tbody>
</table>

**Modules Teaching Hours**

- **Module -1 Measurements:** 8 Hours
- **Module -2 Ammeters, Voltmeter and Multimeters:** 8 Hours
- **Module -3 Oscilloscopes:** 8 Hours
- **Module -3 Analog storage oscilloscopes:** 8 Hours
Variable persistence storage CRT.

**Digital storage oscilloscopes:** Basic DSO operation only.

<table>
<thead>
<tr>
<th>Module -4</th>
<th>8 Hours</th>
<th>L1,L2,L3,L5,L6</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Signal Generators:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Introduction, Fixed and variable AF oscillator, Standard signal generator, Modern laboratory signal generator, AF sine and Square wave generator, Function generator, Square and Pulse generator.</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Bridge Circuits for Measurement of R, L &amp; C:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DC bridges: Introduction, Wheatstone bridge, Kelvin Bridge</td>
<td></td>
<td></td>
</tr>
<tr>
<td>AC bridges: Capacitance Comparison Bridge, inductance Comparison Bridge, Maxwell’s bridge, Schering Bridge. (relevant problems)</td>
<td></td>
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</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Module -5</th>
<th>8 Hours</th>
<th>L1,L2,L3,L5</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Display Devices and Recorders:</strong></td>
<td></td>
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</tr>
</tbody>
</table>

| Course Outcomes: | | |
|---|---|
| After studying this course, students will able to: | | |
| • Analyze instrument characteristics, errors and generalized measurement system. | | |
| • Analyze and use the circuit for the measurement of R, L, C, F, I, V etc | | |
| • Use of Ammeters, Voltmeter and Multimeters and CRO for measurement | | |
| • Analyze and interpret different signal generator circuits for the generation of various waveforms | | |
| • Understand and use different display devices and recorders | | |

| Graduate Attributes (as per NBA) | | |
|---|---|
| • Engineering knowledge | | |
| • Problem analysis | | |
| • Design & Development of Solutions | | |
| • Modern tool usage | | |

| Question Paper Pattern: | | |
|---|---|
| • The question paper will have TEN questions. | | |
| • Each full question carry 20 marks | | |
| • There will be TWO full questions (with maximum of THREE sub questions) from each module. | | |
| • Each full question will have sub 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: | | |
|---|---|
| 1. “Electronic Instrumentation”, H. S. Kalsi, TMH, 2004 (Module- 2,3 & 4) | | |

| Reference Books: | | |
|---|---|
B.E. Electronics and Instrumentation Engineering (EI)
Choice Based Credit System (CBCS)
Semester - III

Analog Electronic Circuits
(Common to EI, BM & ML)

Subject Code: 18EI/BM/ML33
CIE Marks: 40
Number of Lecture + Tutorial Hours/Week: 02+02
SEE Marks: 60
Total Number of Lecture Hours: 40
Exam Hours: 03

Credits: 3

Course Learning Objectives: This course will enable the students to
- Describe the types of BJT/FET biasing, and Demonstrate use of BJT/FET amplifiers
- Understand the modeling of BJT/FET for analysis and Design of BJT/FET Amplifier,
- Understand and Demonstrate Generalize Frequency response of BJT and FET amplifiers.
- Design and analyze Power amplifier circuits.
- Understand the concept of Feedback and its effect on amplifier circuits and Oscillator circuits.


<table>
<thead>
<tr>
<th>Modules</th>
<th>Teaching Hours</th>
<th>(RBT)Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Module -1</td>
<td>DC Biasing – BJT’s</td>
<td>8 Hours</td>
</tr>
<tr>
<td>Introduction, operating point, Fixed-Bias configuration, Emitter-bias configuration, Voltage-Divider Biasing, Emitter Follower Configuration. Relevant problems.</td>
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</tr>
<tr>
<td>DC Biasing – FET’s</td>
<td>8 Hours</td>
<td>L1 L2</td>
</tr>
<tr>
<td>Module -2</td>
<td>BJT AC Analysis</td>
<td>8 Hours</td>
</tr>
<tr>
<td>BJT modeling, re transistor model: Common Emitter fixed Configuration, Voltage-Divider Bias, CE Emitter-Bias Configuration (Excluding P-spice Analysis), Emitter Follower Configuration, Cascaded Systems. The Hybrid Equivalent model, Approximate Hybrid Equivalent Circuit, Fixed bias configuration, Voltage-Divider configuration. Hybrid π Model.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Module -3</td>
<td>FET Amplifiers</td>
<td>8 Hours</td>
</tr>
<tr>
<td>Introduction, JFET Small Signal Model, JFET AC equivalent Circuit, Fixed-Bias Configuration, Self-Bias Configuration (with bypassed Rs only), Voltage-Divider Configuration, Source Follower Configuration.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>BJT and JFET Frequency Response:</td>
<td>8 Hours</td>
<td>L1, L2, L3</td>
</tr>
<tr>
<td>Introduction, General Frequency Considerations, Low Frequency Response of BJT Amplifier, Low Frequency Response of FET Amplifier, Miller Effect Capacitance, Multistage frequency effects.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Module -4</td>
<td>Power Amplifiers:-</td>
<td>8 Hours</td>
</tr>
<tr>
<td>Introduction: Definitions and Amplifier Types, Series Fed Class A Amplifier, Transformer Coupled Class A Amplifier, Class B Amplifier operation.</td>
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</tbody>
</table>
Class B amplifier circuits:- Transformer-Coupled Push-Pull Circuits, Complementary–Symmetry Circuits only, Amplifier Distortion, Class C and Class D Amplifier.

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<tr>
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<tbody>
<tr>
<td>8 Hours</td>
<td>L2, L3</td>
</tr>
</tbody>
</table>

Note: Relevant problems on all topics

**Course Outcomes:** After studying this course, students will able to:
- Explain the biasing of BJT and FET
- Model BJT/FET for ac/dc analysis
- Design Single stage, Multistage amplifier, with and without feedback
- Analyze Frequency response of BJT and FET.
- Acquire the knowledge of classifications of Power amplifier, operation, and able to design power amplifier.
- Apply the knowledge gained in designing of BJT/FET/UJT based Oscillators.

**Graduate Attributes (as per NBA)**
- Engineering Knowledge
- Problem Analysis
- Design / development of solutions (partly)
- Interpretation of data

**Question Paper Pattern:**
- The question paper will have TEN questions.
- Each full question carry 20 marks
- There will be TWO full questions (with maximum of THREE sub questions) from each module.
- Each full question will have sub 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 Book:**

**Reference Book:**
David A. Bell, “Electronic Devices and Circuits”, Oxford University Press
# Digital Design and HDL
(Common to EI, BM & ML)

<table>
<thead>
<tr>
<th>Subject Code</th>
<th>IA Marks</th>
<th>Number of Lecture + Tutorial Hours/Week</th>
<th>Exam Marks</th>
<th>Total Number of Lecture Hours</th>
<th>Exam Hours</th>
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<td>18EI/BM/ML34</td>
<td>40</td>
<td>02+02</td>
<td>60</td>
<td>40</td>
<td>03</td>
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</tbody>
</table>

**Credits – 3 (Each module – 8 Hours)**

**Course Learning Objectives:** This course will enable the students to
- To impart the concepts of simplifying Boolean expression using K-map techniques and Quine-McCluskey minimization techniques.
- To impart the concepts of designing and analyzing combinational logic circuits.
- To impart design methods and analysis of sequential logic circuits.
- To impart the concepts of HDL-Verilog data flow and behavioral models for the design of digital systems.

<table>
<thead>
<tr>
<th>Modules</th>
<th>Revised Bloom’s Taxonomy (RBT) Level</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Module -1</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Principles of Combinational Logic:</strong> Definition of combinational logic, Canonical forms, Generation of switching equations from truth tables, Karnaugh maps- up to 4 variables, Quine-McCluskey Minimization Technique. Quine-McCluskey using Don’t Care Terms. (Text 1, Chapter 3).</td>
<td>L2 L3 L4</td>
</tr>
<tr>
<td><strong>Module -2</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Logic Design with MSI Components and Programmable Logic Devices:</strong> Binary Adders and Subtractors, Comparators, Decoders, Encoders, Multiplexers, Programmable Logic Devices (PLDs), Programmable Read only Memories (PROMS). (Text 2, Chapter 5)</td>
<td>L1 L2 L3</td>
</tr>
<tr>
<td><strong>Module -3</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Module -4</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Simple Flip-Flops Applications:</strong> Registers, Binary Ripple Counters, Synchronous Binary Counters, Counters based on Shift Registers, Design of Synchronous mod-n Counter using clocked T, JK, D and SR flip-flops. (Text 2, Chapter 6)</td>
<td>L2 L3 L4</td>
</tr>
<tr>
<td><strong>Module -5</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Introduction to Verilog:</strong> Structure of Verilog module, Operators, Data Types, Styles of Description- Data flow description, Behavioral description. Implementation of half adder and full adder using Verilog data flow description. <strong>Verilog Behavioral description:</strong> Structure, Variable Assignment Statement, Sequential Statements, Loop Statements, Verilog Behavioral Description of Multiplexers (2:1,4:1,8:1). (Text 3, Chapters:1, 2, 3)</td>
<td>L3 L4 L5</td>
</tr>
</tbody>
</table>

**Course Outcomes:** After studying this course, students will be able to:
- Simplify Boolean functions using K-map and Quine-McCluskey minimization technique
- Analyze and design for combinational logic circuits.
- Analyze the concepts of Latches and Flip Flops. (SR, D, T and JK).
- Analyze and design the synchronous sequential circuits.
- Implement Combinational circuits (adders, subtractors, multiplexers) using Verilog descriptions.

### Graduate Attributes (as per NBA)
- Engineering knowledge
- Problem analysis
- Design & Development of Solutions
- Modern tool usage

### Question Paper Pattern
- The question paper will have TEN questions.
- Each full question carry 20 marks
- There will be TWO full questions (with maximum of THREE sub questions) from each module.
- Each full question will have sub 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 Book:
1. Digital Logic Applications and Design by John M Yarbrough, Thomson Learning, 2001

### Reference Books:
1. Fundamentals of logic design, by Charles H Roth Jr., Cengage Learning
Electronics and Instrumentation Engineering (EI)
Choice Based Credit System (CBCS)
Semester - III

Transducers and Instrumentation

<table>
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<th>Subject Code</th>
<th>18EI35</th>
<th>CIE Marks</th>
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<td>SEE Marks</td>
<td>: 60</td>
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<tr>
<td>Total Number of Lecture Hours</td>
<td>40</td>
<td>Exam Hours</td>
<td>: 03</td>
</tr>
</tbody>
</table>

Credits - 3

Course Learning Objectives:
- To provide the fundamental knowledge of transducers, instrumentation and measurement systems.
- To understand the functional elements of instrumentation/measurement systems.
- To impart the knowledge of static and dynamic characteristics of instruments, and understand the factors in selection of instruments for measurement.
- To discuss the principle, design and working of transducers for the measurement of displacement, level, strain, force, torque, pressure, sound and speed.


<table>
<thead>
<tr>
<th>Modules</th>
<th>Teaching Hours</th>
<th>Revised Bloom’s Taxonomy (RBT)</th>
<th>Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Module -1</td>
<td>Classification and Functional Elements of Instrument/ measurement system: Measurement, significance of measurement, instruments and measurement systems, mechanical, electrical and electronic instruments (Common to EIM), Deflection &amp; Null type instruments and their comparison, Analog and digital modes of operation, functions of instruments and measurement systems, applications of measurement systems, Elements of generalized measurement system, Input-output configuration of measuring instruments and measurement systems, methods of correction for interfering and modifying inputs. Transducers, Classifications of transducers-primary &amp; secondary, active &amp; passive, analog and digital transducers.</td>
<td>8 Hours</td>
<td>L1, L2</td>
</tr>
<tr>
<td>Module -2</td>
<td>Static and Dynamic Characteristics: Static calibration and error calibration curve, accuracy and precision, indications of precision, static error, scale range and scale span, reproducibility and drift, repeatability, signal to noise ratio, sensitivity, linearity, hysteresis, threshold, dead zone and dead time, resolution, signal to noise ratio, factors influencing the choice of transducers/instruments. Dynamic response – dynamic characteristics, time domain analysis &amp; different types of inputs, frequency domain analysis. Time domain response – zero order system, first order system, response of a first order system to step &amp; ramp input, frequency response of first order system.</td>
<td>8 Hours</td>
<td>L1, L2, L3, L4</td>
</tr>
<tr>
<td>Module -3</td>
<td>Measurement of Displacement: Introduction, Principles of Transduction,</td>
<td>8 Hours</td>
<td>L1, L2, L3, L4</td>
</tr>
</tbody>
</table>
Variable resistance devices, variable Inductance Transducer, Variable Capacitance Transducer, Hall Effect Devices, Proximity Devices, Digital Transducer

**Measurement of Level:** Capacitance probes, conductivity probes, differential pressure level detector, float level devices, optical level switches, ultrasonic level detector, thermal level sensors

<table>
<thead>
<tr>
<th>Module -4</th>
<th>Measurement of Strain: Introduction, Types of Strain Gauges, Theory of operation of resistance strain gauges, Types of Electrical Strain Gauges – Wire gauges, unbounded strain gauges, foil gauges, semiconductor strain gauges (principle, types &amp; list of characteristics only), Strain gauge Circuits – Wheatstone bridge circuit, Applications.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>8 Hours</td>
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<tr>
<td></td>
<td>L1, L2, L3, L4</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Module -5</th>
<th>Measurement of Pressure: Introduction, Diaphragms, Other elastic elements, Transduction methods – potentiometric device, strain gauge transducer, variable reluctance, LVDT type, variable capacitance device (principle &amp; working, no derivation), force balance transducer with analysis, piezoelectric pressure transducer, pressure multiplexer, pressure calibration.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>8 Hours</td>
</tr>
<tr>
<td></td>
<td>L1, L2, L3, L4</td>
</tr>
</tbody>
</table>

**Course Outcomes:** After studying this course, students will able to:
- Define the transducer, instrument, measurement and classify different types of transducers
- Explain the functional elements of instrumentation / measurement systems
- Discuss the input-output configuration of measurement systems
- Define, interpret and analyze the static and dynamic characteristics of instruments
- Explain the principle, design and analyze the transducers for the measurement of displacement, level, strain, force, torque, pressure, sound and speed.

**Graduate Attributes (as per NBA)**
- Engineering knowledge
- Problem analysis
- Design & Development of Solutions
- Engineer and society
- Environment & sustainability
- Lifelong learning

**Question Paper Pattern:**
- The question paper will have TEN questions.
- Each full question consists of 20 marks.
- There will be 2 full questions (with maximum of THREE sub questions) from each module.
- Each full question will have sub 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:
# Choice Based Credit System (CBCS)
## Semester – III
### Network Analysis
(Common to EI, BM & ML)

<table>
<thead>
<tr>
<th>Subject Code</th>
<th>CIE Marks</th>
<th>Number of Lecture + Tutorial Hours/Week</th>
<th>SEE Marks</th>
<th>Total Number of Lecture Hours</th>
<th>Exam Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>18EI/BM/ML36</td>
<td>40</td>
<td>03+02</td>
<td>60</td>
<td>50</td>
<td>03</td>
</tr>
</tbody>
</table>

**Credits –4 (Each module 10 Hrs)**

**Course Learning Objectives:** This course will enable the students to
- To introduce the Basic circuit laws, Network theorems and analyze the networks.
- To analyze the networks by using optimized methods
- To analyze the network behavior during switching states.
- To realize the network parameters.

**Revised Bloom’s Taxonomy Levels:** L1 – Remembering, L2 – Understanding, L3 – Applying, L4 – Analyzing, L5 – Evaluating, and L6 - Creating

<table>
<thead>
<tr>
<th>Modules</th>
<th>Teaching Hours</th>
<th>Revised Bloom’s Taxonomy (RBT) Level</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Module -1 Basic concepts:</strong> Sources of electrical energy, Source transformation, Loop and node analysis with dependent &amp; independent sources for DC networks, concept of super node and super mesh analysis for only independent sources for DC networks. Numerical on all Topics</td>
<td>10 Hours</td>
<td>L1, L2, L3, L4</td>
</tr>
<tr>
<td><strong>Module -2 Network theorems:</strong> Super position, reciprocity, Millman’s theorem Thevinin’s &amp; Norton’s theorem (for DC networks only), Maximum power transfer theorem (for AC &amp; DC networks) Numerical on all Topics</td>
<td>10 Hours</td>
<td>L1, L2, L3, L4</td>
</tr>
<tr>
<td><strong>Module -3 Transient behavior and initial conditions:</strong> Behavior of circuit elements under switching condition and their representation, evaluation of initial &amp; final conditions in RL, RC &amp;RLC circuits for DC excitations. Two port network parameters: Definitions and modeling of Z, Y, H &amp; transmission parameters Numerical on all Topics</td>
<td>10 Hours</td>
<td>L1, L2, L3, L4</td>
</tr>
<tr>
<td><strong>Module -4 Resonant Circuits:</strong> Series resonance: Variation of current and voltage with frequency, Selectivity &amp; Bandwidth, Q-factor Parallel resonance: General case-resistance present in both branches, Selectivity &amp; Bandwidth. Numerical on all Topics</td>
<td>10 Hours</td>
<td>L1, L2, L3, L4</td>
</tr>
<tr>
<td><strong>Module -5 Network topology:</strong> Graph of a network, concepts of: tree &amp; co-tree, incidence matrix, tie-set &amp; cut-set schedules, Principle of duality. Numerical on all Topics</td>
<td>10 Hours</td>
<td>L1, L2, L3, L4</td>
</tr>
</tbody>
</table>
**Course Outcomes:** After studying this course, students will able to:
- Apply the basic concepts (Laws, theorems) of networks to obtain solution.
- Choose the appropriate/specific technique to analyze the networks.
- Realize and Analyze the network behavior

**Graduate Attributes (as per NBA)**
- Applying the Engineering concepts to analyze the networks
- Realizing and solving the complex circuits

**Question Paper Pattern:**
- The question paper will have TEN questions.
- Each full question carry 20 marks
- In each full question, preferably 40% should be related to theoretical concepts/derivations and 60% should be related problems/solutions.
- There will be TWO full questions (with maximum of THREE sub questions) from each module.
- Each full question will have sub 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:**

**Reference Books:**
B.E. Electronics and Instrumentation Engineering (EI)
Choice Based Credit System (CBCS)
Semester - III

Analog Electronic Circuits Lab
(Common to EI, BM & ML)

<table>
<thead>
<tr>
<th>Subject Code</th>
<th>18 EI/BM/ML L37</th>
<th>CIE Marks</th>
<th>: 40</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of Tutorial+ Practical Hours/Week</td>
<td>02+02</td>
<td>SEE Marks</td>
<td>: 60</td>
</tr>
<tr>
<td>Total Number of Practical Hours</td>
<td>42</td>
<td>Exam Hours</td>
<td>: 03</td>
</tr>
</tbody>
</table>

Credits - 2

Course Learning Objectives:
This laboratory course enables students to get practical knowledge & experience in design, assembly and evaluation/testing of
- Rectifier circuits without and with filter
- BJT as Amplifier without and with feedback
- JFET Characteristics and as Amplifier.
- MOSFET Characteristics
- BJT as Power Amplifiers
- Oscillators using BJT and FET for frequency generation
- UJT characteristics
- Verification of Theorems and applications in practical fields


<table>
<thead>
<tr>
<th>Laboratory Experiments</th>
<th>Revised Bloom’s Taxonomy (RBT) Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>NOTE: The experiments are to be carried using discrete components only</td>
<td></td>
</tr>
<tr>
<td>1. To design and test Full Wave Rectifier (with center tap transformer) with and without filters.</td>
<td>L3, L4, L5, L6</td>
</tr>
<tr>
<td>2. To design and test Full Wave Bridge Rectifier with and without filters.</td>
<td>L3, L4, L5, L6</td>
</tr>
<tr>
<td>3. To plot characteristics of UJT and to determine its intrinsic stand-off ratio.</td>
<td>L1, L2, L3, L4</td>
</tr>
<tr>
<td>4. To design and test the common emitter amplifier (voltage divider bias) without feedback and determine input, output impedance, gain and bandwidth.</td>
<td>L3, L4, L5, L6</td>
</tr>
<tr>
<td>5. To design and test the Emitter follower amplifier (BJT) using voltage divider bias and determine input, output impedance, gain and bandwidth.</td>
<td>L3, L4, L5, L6</td>
</tr>
<tr>
<td>6. To plot the Drain and Transfer characteristic for the given FET and to find the Drain Resistance and Trans-conductance.</td>
<td>L1, L2, L3, L4</td>
</tr>
<tr>
<td>7. To plot the input and output characteristics of n-channel MOSFET and calculated drain resistance, mutual conductance and amplification factor.</td>
<td>L3, L4, L5, L6</td>
</tr>
<tr>
<td>8. To design, test and plot the frequency response of Common Source JFET/MOSFET amplifier, and to determine its bandwidth.</td>
<td>L1, L2, L3, L4</td>
</tr>
<tr>
<td>9. Wiring and testing of Complimentary symmetry class B push pull power amplifier and calculation of efficiency.</td>
<td>L1, L2, L3, L4</td>
</tr>
</tbody>
</table>
10. To design and test the RC-Phase shift Oscillator using BJT for the given frequency.  
11. To design and test the following tuned oscillator circuits for the given frequency. (a) Hartley Oscillator using BJT (b) Colpitts Oscillator using FET.  
12. Testing of crystal oscillator and to determine its frequency of oscillation.

<table>
<thead>
<tr>
<th>Course Outcomes: After studying this course, students will able to:</th>
<th>L3, L4, L5, L6</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Able to design Single stage, Multistage amplifier, with and without feedback</td>
<td></td>
</tr>
<tr>
<td>• Able to analyze Frequency response of BJT and FET.</td>
<td></td>
</tr>
<tr>
<td>• Acquire the knowledge of Power amplifiers, operation, and able to design power amplifier.</td>
<td></td>
</tr>
<tr>
<td>• Apply the knowledge gained in the design of BJT/FET circuits in Oscillators</td>
<td></td>
</tr>
<tr>
<td>• Knowledge of UJT characteristics and its application.</td>
<td></td>
</tr>
<tr>
<td>• Applications of theorems in various practical fields.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Graduate Attributes (as per NBA)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>• Engineering Knowledge.</td>
<td></td>
</tr>
<tr>
<td>• Problem Analysis.</td>
<td></td>
</tr>
<tr>
<td>• Design / development of solutions (partly)</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Conduct of Practical Examination:</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1. All laboratory experiments are to be included for practical examination.</td>
<td></td>
</tr>
<tr>
<td>2. Students are allowed to pick one experiment from the lot.</td>
<td></td>
</tr>
<tr>
<td>3. Strictly follow the instructions as printed on the cover page of answer script for breakup of marks.</td>
<td></td>
</tr>
<tr>
<td>4. Change of experiment is allowed only once and 15% Marks allotted to the procedure part to be made zero.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Reference Books:</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>2. Electronics Laboratory Primer - A Design Approach by S.Poorna Chandra, B.Sasikala, S Chand Pub.</td>
<td></td>
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</table>
### Digital Design and HDL Lab

(Common to EI, BM & ML)

<table>
<thead>
<tr>
<th>Subject Code</th>
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<td>CIE Marks</td>
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<td>Number of Tutorial-Practical Hours/Week</td>
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<td>CIE Marks</td>
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<td>Exam Hours</td>
<td>: 03</td>
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<tr>
<td>Total Number of Practical Hours</td>
<td>: 42</td>
</tr>
</tbody>
</table>

**Credits - 2**

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

- The operation of various logic gates and digital circuits and write the Verilog code.
- Design of logic circuits for combinational and sequential circuits and write Verilog code.
- Synthesis of digital circuits, FFs, shift registers and counters using ICs.
- To use FPGA/CPLD kits for downloading the Verilog code and test the output.

**Revised Bloom’s Taxonomy Levels:** L1 – Remembering, L2 – Understanding, L3 – Applying, L4 – Analyzing, L5 – Evaluating, and L6 - Creating

**Laboratory Experiments:**

**Note:**

1. Use discrete components to test and verify the logic gates.
2. Use FPGA/CPLD kits for downloading the Verilog code and test the output.

<table>
<thead>
<tr>
<th><strong>Laboratory Experiments:</strong></th>
<th><strong>Revised Bloom’s Taxonomy (RBT) Level</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Simplification, realization of Boolean expressions using logic gates/Universal gates</td>
<td>L1, L2, L3</td>
</tr>
<tr>
<td>2. To design and implement a) Adder/Subtractor – Full/half using logic gates. b) 4-bit Parallel Adder/subtractor using IC 7483.</td>
<td>L3, L4, L5, L6</td>
</tr>
<tr>
<td>3. To realize a) BCD to Excess-3 code conversion and vice versa b) Binary to Gray code conversion and vice versa</td>
<td>L2, L3, L4</td>
</tr>
<tr>
<td>4. To realize a) 4:1 Multiplexer using gates b) 1:8 Demux c) Priority encoder and 3:8 Decoder using IC74138 d) One / Two bit comparator</td>
<td>L2, L3, L4</td>
</tr>
<tr>
<td>5. To realize the following flip-flops using NAND Gates a) T type (b) JK Master slave (c) D type</td>
<td>L2, L3, L4</td>
</tr>
<tr>
<td>6. To realize the 3-bit counters as a sequential circuit and Mod-N Counter design (7476, 7490, 74192, 74193)</td>
<td>L2, L3, L4</td>
</tr>
<tr>
<td>7. Adder/Subtractor – Full/half using Verilog data flow description</td>
<td>L2, L3, L4</td>
</tr>
<tr>
<td>8. Code converters using Verilog Behavioral description a) Gray to binary and vice versa b) Binary to excess3 and vice versa</td>
<td>L2, L3, L4</td>
</tr>
<tr>
<td>9. Multiplexers/decoders/encoder using Verilog Behavioral description - 8:1 mux, 3:8 decoder, 8:3 encoder, Priority encoder - 1:8 Demux and verify using test bench - 2-bit Comparator using behavioral description</td>
<td>L2, L3, L4</td>
</tr>
<tr>
<td>10. Flip-flops using Verilog Behavioral description a) JK type b) SR type c) T type and d) D type</td>
<td>L2, L3, L4</td>
</tr>
<tr>
<td>Course Outcomes: After studying this course, students will able to:</td>
<td></td>
</tr>
<tr>
<td>---------------------------------------------------------------</td>
<td></td>
</tr>
<tr>
<td>- Realize Boolean expression using Universal gates / basic gates using ICs and Verilog</td>
<td></td>
</tr>
<tr>
<td>- Demonstrate the function of adder/subtractor circuits using gates/ICs &amp; Verilog.</td>
<td></td>
</tr>
<tr>
<td>- Design and analyze the Comparator, Multiplexers Decoders, Encoders circuits using ICs and Verilog.</td>
<td></td>
</tr>
<tr>
<td>- Design and analysis of different Flip-flops and counters using gates and FFs</td>
<td></td>
</tr>
<tr>
<td>- Able to use FPGA/CPLD kits for downloading Verilog codes for shift registers and counters and check output.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Graduate Attributes (as per NBA)</th>
</tr>
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<tbody>
<tr>
<td>- Engineering Knowledge.</td>
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<tr>
<td>- Problem Analysis.</td>
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<td>- Design/Development of solutions</td>
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<td>1. All laboratory experiments are to be included for practical examination.</td>
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<td>2. Students are allowed to pick one experiment from the lot.</td>
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</table>

<table>
<thead>
<tr>
<th>Reference Books:</th>
</tr>
</thead>
<tbody>
<tr>
<td>2. HDL Programming VHDL and Verilog By Nazeih M. Botros, 2009 reprint, Dreamtech press.</td>
</tr>
<tr>
<td>3. Digital Logic Applications and Design by John M Yarbrough, Thomson Learning, 2001</td>
</tr>
</tbody>
</table>
### Course Code: 18KAK28/39/49

**Teaching Hours/Week (L:T:P):** (0:2:0)  
**CIE Marks:** 100  
**Credits:** 01

<table>
<thead>
<tr>
<th>Course Code</th>
<th>18KAK28/39/49</th>
</tr>
</thead>
<tbody>
<tr>
<td>CIE Marks</td>
<td>100</td>
</tr>
<tr>
<td>Credits</td>
<td>01</td>
</tr>
</tbody>
</table>

**Outcome Based Education (OBE) and Choice Based Credit System (CBCS)**  
**SEMESTER-II / III / IV**  
**Aadalitha Kannada**

---

<table>
<thead>
<tr>
<th>Objective</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>•</td>
<td>Detailed information about the program's objectives.</td>
</tr>
<tr>
<td>•</td>
<td>Focus on the core competencies to be developed.</td>
</tr>
<tr>
<td>•</td>
<td>Comparative analysis of different teaching methods.</td>
</tr>
<tr>
<td>•</td>
<td>Relevant case studies and practical applications.</td>
</tr>
<tr>
<td>•</td>
<td>Integration of theoretical knowledge with real-world scenarios.</td>
</tr>
<tr>
<td>•</td>
<td>Continuous assessment and feedback mechanisms.</td>
</tr>
</tbody>
</table>

---

<table>
<thead>
<tr>
<th>Internal Evaluation</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Continuous Internal Evaluation)</td>
<td>Detailed internal evaluation methods and criteria.</td>
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</tbody>
</table>

---

<table>
<thead>
<tr>
<th>Notes</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>•</td>
<td>Regular attendance and participation.</td>
</tr>
<tr>
<td>•</td>
<td>Active participation in group discussions and activities.</td>
</tr>
<tr>
<td>•</td>
<td>Submission of assignments and projects on time.</td>
</tr>
<tr>
<td>•</td>
<td>Effective time management and study habits.</td>
</tr>
<tr>
<td>•</td>
<td>Self-assessment and reflection on learning outcomes.</td>
</tr>
</tbody>
</table>

---

<table>
<thead>
<tr>
<th>Course</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kannada for Administration</td>
<td>Integrated into the curriculum.</td>
</tr>
</tbody>
</table>

---

**Aadalitha Kannada**

---

<table>
<thead>
<tr>
<th>Additional Information</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>•</td>
<td>Additional resources and references.</td>
</tr>
<tr>
<td>•</td>
<td>Access to academic and career counseling.</td>
</tr>
<tr>
<td>•</td>
<td>Opportunities for extracurricular activities.</td>
</tr>
<tr>
<td>•</td>
<td>Support for students with disabilities.</td>
</tr>
</tbody>
</table>
## B. E. Common to all Programmes

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

**SEMESTER –II & III/IV**

### Vyavaharika Kannada

<table>
<thead>
<tr>
<th>Course Code</th>
<th>18KVK28/39/49</th>
<th>CIE Marks</th>
<th>100</th>
</tr>
</thead>
<tbody>
<tr>
<td>Credits</td>
<td>01</td>
<td></td>
<td></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 Alphabets 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.
<table>
<thead>
<tr>
<th>Course Code</th>
<th>18CPC39/49</th>
<th>CIE Marks</th>
<th>40</th>
</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:**

### 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>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>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>
</tbody>
</table>

**Reference Books**

| 3 | Introduction to the Constitution of India | Durga Das Basu | Prentice –Hall, | 2008 |
| 4 | Engineering Ethics | M. Govindarajan, S. Natarajan, V. S. Senthilkumar | Prentice –Hall, | 2004 |
B. E. Common to all Programmes
Choice Based Credit System (CBCS) and Outcome Based Education (OBE)
SEMESTER - III

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

<table>
<thead>
<tr>
<th>Course Code</th>
<th>CIE Marks</th>
<th>Teaching Hours/Week (L:T:P)</th>
<th>SEE Marks</th>
<th>Credits</th>
<th>Exam Hours</th>
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<tr>
<td>18MATDIP31</td>
<td>40</td>
<td>(2:2:0)</td>
<td>60</td>
<td>0</td>
<td>03</td>
</tr>
</tbody>
</table>

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).

Module-2

Module-3

Module-4
Integral Calculus: Review of elementary integral calculus. Reduction formulae for $\sin^n x, \cos^n x$ (with proof) and $\sin^m x \cos^n x$ (without proof) and evaluation of these with standard limits-Examples. Double and triple integrals-Simple examples.

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:
- The question paper will have ten full questions carrying equal marks.
- 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 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>
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<tbody>
<tr>
<td></td>
<td><strong>Textbook</strong></td>
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<td></td>
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<tr>
<td></td>
<td><strong>Reference Books</strong></td>
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</table>
IV SEMESTER
## COMPLEX ANALYSIS, PROBABILITY AND STATISTICAL METHODS

<table>
<thead>
<tr>
<th>Course Code</th>
<th>18MAT41</th>
<th>CIE Marks</th>
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</tr>
</thead>
<tbody>
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<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 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

### Module-2
**Conformal transformations:** Introduction. Discussion of transformations: \( w = z^2, w = e^z, \quad w = z + \frac{1}{z}, \quad (z \neq 0) \)
- 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
**Curve Fitting:** Curve fitting by the method of least squares- fitting the curves of the form 
\[ y = ax + b, \quad y = ax^b \quad \& \quad y = ax^2 + bx + c. \]
**Statistical Methods:** Correlation and regression-Karl Pearson’s coefficient of correlation and rank correlation-problems. Regression analysis- lines of regression –problems.

### 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:
- CO1: Use the concepts of analytic function and complex potentials to solve the problems arising in electromagnetic field theory.
- CO2: Utilize conformal transformation and complex integral arising in aerofoil theory, fluid flow visualization and image processing.
- CO3: Apply discrete and continuous probability distributions in analyzing the probability models arising in engineering field.
- CO4: Make use of the correlation and regression analysis to fit a suitable mathematical model for the statistical data.
- CO5: Construct joint probability distributions and demonstrate the validity of testing the hypothesis.

### Question paper pattern:
- The question paper will have ten full questions carrying equal marks.
- 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 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>
</table>

**Textbooks**

**Reference Books**

<table>
<thead>
<tr>
<th>Sl No</th>
<th>Title of the Book</th>
<th>Author/s</th>
<th>Publisher</th>
<th>Edition and Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>Advanced Engineering Mathematics</td>
<td>Chandrika Prasad &amp; 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
# Signal Conditioning and Data Acquisition Circuits

(Standard: B.E. Electronics and Instrumentation Engineering (EI)  
Choice Based Credit System (CBCS)  
Semester – IV)

<table>
<thead>
<tr>
<th>Subject Code</th>
<th>CIE Marks</th>
<th>Number of Lecture + Tutorial Hours/Week</th>
<th>SEE Marks</th>
<th>Total Number of Lecture Hours</th>
<th>Exam Hours</th>
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</tr>
</thead>
<tbody>
<tr>
<td>18 EI/BM/ML42</td>
<td>40</td>
<td>02+02</td>
<td>60</td>
<td>40</td>
<td>03</td>
<td></td>
</tr>
</tbody>
</table>

**Course Learning Objectives:** This course will enable the students to
- Define and describe Op Amp, basic concepts, characteristics and specifications
- Gain knowledge about Linear and nonlinear applications of op-amp.
- Design and develop circuits like, amplifiers, filters, Timers to meet industrial requirements.
- Get a firm grasp of basic principles of op-amp.

**Revised Bloom’s Taxonomy Levels:** L1 – Remembering, L2 – Understanding, L3 – Applying, L4 – Analyzing, L5 – Evaluating, and L6 – Creating

<table>
<thead>
<tr>
<th>Modules</th>
<th>Teaching Hours</th>
<th>Revised Bloom’s Taxonomy (RBT)Level</th>
</tr>
</thead>
</table>
| Module -1  
**Introduction to Operational Amplifiers:** Introduction, Block schematic of an Op-amp, Power supply connections, Characteristics of an Ideal OP-AMP, Inverting Amplifier, Non-inverting Amplifier, Voltage follower, Differential Amplifier, CMRR. (Relevant problems).  
**Operational Amplifier Characteristics:** DC characteristics – Input bias current, Input offset current, Input offset voltage, Total output offset voltage, Thermal drift. AC characteristics – Frequency response, Slew rate, PSRR.  
**Basic op-amp applications** – Scale changer/Inverter. Summing amplifier: Inverting summing amplifier, Non-inverting Summing amplifier, Subtractor, Instrumentation Amplifier. (Relevant problems). | 8 Hours | L1,L2, L3,L4 |
| Module -2  
**Operational Amplifier Applications:** V – I and I – V converter, Op-amp circuit using diodes, sample and hold circuit, Differentiator and Integrator.  
**Comparator and waveforms generator:** Comparator, Regenerative comparator (Schmitt Trigger), Astable multivibrator, Monostable multivibrator and Triangular waveform generator. Phase shift oscillator, Wien bridge oscillator. (Relevant problems). | 8 Hours | L1,L2, L3,L4 |
| Module -3  
**Voltage Regulators:** Introduction, Series Op-amp regulator, IC voltage regulators, 723 general purpose regulators, switching regulator.  
**Active filters:** First and Second order LPF, First and Second orders HPF, Band Pass Filters, Band Reject filters. (Design examples). | 8 Hours | L1,L2, L3,L4 |
| Module -4 | 8 Hours | L2,L3,L4, L5, |
### 555 Timer:

### Phase Locked Loops:
Basic Principles, Analog phase Detector/comparator, Voltage controlled oscillator.PLL applications: Frequency Multiplication/Division, Frequency translation, FM demodulation.

### Module -5

**Data Acquisition Systems:** Types of instrumentation systems, Components of analog data acquisition system, Digital data acquisition system.

**Data Converters:**

- **Digital to Analog Converters:** Basic DAC techniques, Weighted Resistor DAC, R – 2R Ladder DAC, DAC 0800 (Data sheet: Features and description only).
- **Analog to Digital Converters:** Functional diagram of ADC, Flash ADC, Counter type ADC, Successive approximation ADC, Dual slope ADC. ADC 0809 (Data sheet: Features, specifications and description only), DAC/ADC specifications.

**Course Outcomes:**
After studying this course, students will be able to:
1. Understand the basic principles and operation of op-amp.
2. Design and develop circuits to meet the practical applications
3. Implement and integrate the op-amp circuits in electronic gadgets.

**Graduate Attributes (as per NBA):**
- Engineering knowledge
- Problem analysis
- Design & development of solutions
- Investigation of Complex Problem

**Question Paper Pattern:**
- The question paper will have TEN questions.
- Each full question carry 20 marks
- There will be TWO full questions (with maximum of THREE sub questions) from each module.
- Each full question will have sub 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:**
1. “Linear Integrated Circuits”, D. Roy Choudhury and Shail B. Jain, 4<sup>th</sup> edition, Reprint 2010, New Age International. (Module -1,2,3,4 & 5)
2. “Op - Amps and Linear Integrated Circuits”, Ramakant A. Gayakwad, 4<sup>th</sup> edition, PHI (Module-3)

**Reference Books:**
# Embedded Controllers
(Common to EI, BM & ML)

<table>
<thead>
<tr>
<th>Subject Code</th>
<th>CIE Marks</th>
</tr>
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<tbody>
<tr>
<td>18 EI/BM/ML 43</td>
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<table>
<thead>
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<th>Number of Lecture + Tutorial Hours/Week</th>
<th>SEE Marks</th>
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<tr>
<td>02+02</td>
<td>60</td>
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<table>
<thead>
<tr>
<th>Total number of lecture hours</th>
<th>Exam hours</th>
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<tbody>
<tr>
<td>40</td>
<td>03</td>
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</tbody>
</table>

Credits - 3

**Course Learning Objectives:** This course enables students to understand:
- Basics of Microprocessor and Microcontroller
- 8051 Microcontroller architecture and Pin description
- 8051 Addressing modes and instruction set
- Programming of on-chip peripherals in 8051
- Design and develop applications using 8051 Assembly language and C program.
- MSP 430 Microcontroller architecture
- On-chip peripherals and program using Assembly language and C.

**Revised Bloom’s Taxonomy Levels:** L1 – Remembering, L2 – Understanding, L3 – Applying, L4 – Analyzing, L5 – Evaluating, and L6 - Creating

## Modules

<table>
<thead>
<tr>
<th>Modules</th>
<th>Teaching Hours</th>
<th>Revised Bloom’s Taxonomy (RBT)Level</th>
</tr>
</thead>
</table>
| **Module -1**
Microprocessor and Microcontrollers:
| **Module -2**
Addressing modes directives instruction set of 8051 Microcontroller. Immediate and Register addressing modes. Accessing memory using various addressing modes. Bit addressing for I/o and RAM 8051 data types and directives. Jump Loop and CALL Instructions Arithmetic and Logic Instructions and programming I/o port programming. Assembly Language programs using various Instructions. | 8 Hours | L1,L2 |
| **Module -3**
8051 programming in C and interfacing. Data types and time delay in 8051 C, I/o programming, Logic operation, data conversion programs, accessing Code ROM Space, data serialization. 8051 interfacing to LCD and key board, DAC, stepper motor, DC Motor, Parallel and serial ADC. Elevator. | 8 Hours | L2,L3,L4 |
<table>
<thead>
<tr>
<th>Module -4</th>
<th>Timer/ Counter, Serial communication and Interrupts in 8051. Programming 8051 timer/ counter, programming timer 0 and 1 in 8051 C, Basics of serial communication, 8051 connections to <strong>RS-232</strong>. 8051 serial port programming in C. 8051 Interrupts, Programming Timer Interrupts, External hardware Interrupts and serial communication Interrupts. Interrupts priority &amp; Interrupt programming in C.</th>
<th>8 Hours</th>
<th>L2,L3,L4,L5</th>
</tr>
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</table>

<table>
<thead>
<tr>
<th>Module -5</th>
<th>Introduction to Advanced Microcontrollers. Salient Features of Advanced Microcontrollers. <strong>MSP430F2013</strong> Architecture and pin functions, Memory, Clock Generator, CPU Registers, Addressing modes, Instruction set and emulated Instruction set. Development Environment. Aspects of C for embedded system, Introduction to MSP 430 starter kit, parallel ports.</th>
<th>8 Hours</th>
<th>L1,L2,L3</th>
</tr>
</thead>
</table>

### Course Outcomes:
After studying this course, Student will be able to:
- Learn architecture of 8051 and MSP 430.
- Learn programming skills using Assembly language and C
- Design and interfacing of microcontroller based embedded systems.
- Build projects

### Graduate Attributes (as per NBA)
- Engineering Knowledge
- Problem Analysis
- Design and Development of solutions
- Modern Tool usage

### Question Paper Pattern:
- The question paper will have TEN questions.
- Each full question carry 20 marks
- There will be TWO full questions (with maximum of THREE sub questions) from each module.
- Each full question will have sub 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:

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<tr>
<th>Modules</th>
<th>Teaching Hours</th>
<th>Revised Bloom’s Taxonomy (RBT) Level</th>
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<tbody>
<tr>
<td><strong>Module -1</strong></td>
<td>10 Hours</td>
<td>L₁, L₂, L₃, L₄</td>
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<tr>
<td><strong>Modeling of Systems and Block diagram</strong>:</td>
<td></td>
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<tr>
<td>Introduction to Control Systems, Types of</td>
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<tr>
<td>Control Systems, with examples. Concept of</td>
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<tr>
<td>mathematical modeling of physical systems-</td>
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<tr>
<td>Mechanical, Translational (Mechanical</td>
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<tr>
<td>accelerometer, systems excluded), and</td>
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<tr>
<td>Rotational systems, Analogous systems based</td>
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<tr>
<td>on force voltage analogy and force current</td>
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<tr>
<td>analogy. Introduction to Block diagram</td>
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<tr>
<td>algebra. Numerical problems on all topics.</td>
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<tr>
<td><strong>Module -2</strong></td>
<td>10 Hours</td>
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<tr>
<td><strong>Signal Flow graph</strong>:</td>
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<tr>
<td>Introduction to Signal Flow graph, Mason’s</td>
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<tr>
<td>gain formula. Obtaining Transfer functions</td>
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<td>for the given SFG using Mason’s gain</td>
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<td>formula.</td>
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<tr>
<td><strong>Time response analysis</strong>:</td>
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<tr>
<td>Introduction. Standard test signals,</td>
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<td>response of first order &amp; second order</td>
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<td>systems for unit step input. Steady state</td>
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<td>errors &amp; Error constants. Numerical problems</td>
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<td>on all topics.</td>
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<tr>
<td><strong>Module -3</strong></td>
<td>10 Hours</td>
<td>L₂, L₃, L₄, L₅</td>
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<tr>
<td><strong>Concepts of stability</strong>:</td>
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<tr>
<td>The Concept of stability. Necessary</td>
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<tr>
<td>conditions for stability. Hurwitz stability</td>
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<td>criterion. Routh stability criterion.</td>
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<tr>
<td>Relative stability analysis using RH</td>
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<tr>
<td>Criterion.</td>
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<tr>
<td><strong>The Root Locus Technique</strong>:</td>
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<tr>
<td>Introduction. Root locus concepts.</td>
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<tr>
<td>Construction of root loci. Stability</td>
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<tr>
<td>analysis using Root locus Technique</td>
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<tr>
<td>Numerical problems on all topics.</td>
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<tr>
<td><strong>Module -4</strong></td>
<td>10 Hours</td>
<td>L₂, L₃, L₄, L₅</td>
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<tr>
<td><strong>Frequency domain Analysis</strong>:</td>
<td></td>
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<tr>
<td>Introduction to frequency domain analysis,</td>
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<tr>
<td>Correlation between time &amp; frequency</td>
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<tr>
<td>response, Bode plots. Numerical problems</td>
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<tr>
<td>on all topics.</td>
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<tr>
<td><strong>Polar Plot</strong>:</td>
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<tr>
<td>Introduction to Polar plot and Nyquist</td>
<td></td>
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</tr>
<tr>
<td>plots, Nyquist stability</td>
<td></td>
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</tr>
</tbody>
</table>
Stability analysis using Polar plot. Numerical problems on all topics.

| Module 5 |
|-------------------------|------------------|
| **State space Analysis:** Concept of state, state variables and state model. State diagrams and State models for Linear continuous-time systems (Electrical systems): State space representation using Physical and Phase variables. Derivation of transfer functions from the state model. Numerical problems on all topics. |
| 10 Hours | L2, L3, L4, L5 |

**Course Outcomes:** After studying this course, students will able to:
- Apply modeling knowledge in implementation physical systems.
- Understand the reduction of block diagram & analyze using Signal flow graph.
- Comment on performance of a system by evaluating various parameters.
- Model a system by applying the concept of State Space analysis

**Graduate Attributes (as per NBA)**
- Engineering knowledge
- Problem analysis
- Design & Development of Solutions
- Investigation of Complex Problem

**Question Paper Pattern:**
- The question paper will have TEN questions.
- Each full question consists of 20 marks.
- There will be 2 full questions (with maximum of THREE sub questions) from each module.
- Each full question will have sub 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:**
## Process Instrumentation

<table>
<thead>
<tr>
<th>Subject Code</th>
<th>CIE Marks</th>
<th>SEE Marks</th>
<th>Exam Hours</th>
<th>Number of Lecture + Tutorial Hours/Week</th>
<th>CIE Marks</th>
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<tr>
<td>18EI45</td>
<td>40</td>
<td>60</td>
<td>03</td>
<td>02+02</td>
<td>40</td>
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</tbody>
</table>

### Subject Code: 18EI45

#### CIE Marks: 40

#### SEE Marks: 60

#### Exam Hours: 03

#### Number of Lecture + Tutorial Hours/Week: 02+02

### Course Learning Objectives:

- To discuss the principle, design and working of transducers/sensors for the measurement of temperature, flow, vibration, density, viscosity, humidity and moisture.
- To provide the basic knowledge in selection of appropriate transducers/sensors for the measurement of above parameters based on their specifications, advantages and limitations.

### Revised Bloom’s Taxonomy Levels:


### Modules

<table>
<thead>
<tr>
<th>Module</th>
<th>Teaching Hours</th>
<th>Revised Bloom’s Taxonomy (RBT) Level</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Module -1</strong>&lt;br&gt;Measurement of Temperature:</td>
<td>8 Hours</td>
<td>L1, L2, L3, L4</td>
</tr>
<tr>
<td>Introduction, temperature scales, mechanical temperature sensors, resistance type temperature sensors, platinum resistance thermometer, thermistors (principle, types &amp; characteristics), thermocouples, solid state sensors – principle and working, brief discussion on AD590 (characteristics and features), LM35 (characteristics and features), Quartz thermometer, Temperature measurement by radiation methods, Optical pyrometer, Calibration of thermometers.</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Module -2</strong>&lt;br&gt;Flow Measurement:</td>
<td>8 Hours</td>
<td>L1, L2, L3, L4</td>
</tr>
<tr>
<td><strong>Module -3</strong>&lt;br&gt;Vibration Measurement:</td>
<td>8 Hours</td>
<td>L1, L2, L3, L4</td>
</tr>
<tr>
<td><strong>Measurement of Density</strong>: Definition &amp; units of density and specific gravity, Liquid density measurement – Ball type, capacitance type, displacement type, hydrometers, oscillating Coriolis, radiation type, sound velocity type. Gas density measurement – displacement type, electromagnetic suspension type.</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Module -4</strong></td>
<td>8 Hours</td>
<td>L1, L2, L3,</td>
</tr>
</tbody>
</table>

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Page 33 of 135
**Viscosity Measurement**: Definition and units, selection of viscometer, viscometer applications. Laboratory Viscometers – Capillary, capillary extrusion, Efflux cup (Saybolt viscometer), Falling ball, Rotational viscometer, Cone & plate viscometer. Industrial Viscometers - differential pressure continuous capillary viscometer, single and two float viscometer, cone and plate plastometer, vibrating reed viscometer.

**Turbidity**: Definition, transmission type turbidity meter, light scattering turbidity meter.

<table>
<thead>
<tr>
<th>Module -5</th>
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</thead>
<tbody>
<tr>
<td><strong>Humidity Measurement</strong>: Definition and terminologies, dry and wet bulb psychrometers (Sling psychrometer), hair hygrometers, thin film capacitance humidity sensor, dew-point hygrometers, electrolytic hygrometers.</td>
</tr>
</tbody>
</table>

**Course Outcomes**: After studying this course, students will be able to:
- Explain the principle, construction/design and analyze the transducers/sensors for the measurement of temperature, flow, vibration, density, viscosity, humidity and moisture.
- Select the appropriate transducers/sensors based on the needs of the process.
- Install and analyze the transducers/sensors for the measurement of above parameters.

<table>
<thead>
<tr>
<th>Graduate Attributes (as per NBA)</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Engineering knowledge</td>
</tr>
<tr>
<td>• Problem analysis</td>
</tr>
<tr>
<td>• Design &amp; Development of Solutions</td>
</tr>
<tr>
<td>• Engineer and society</td>
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<tr>
<td>• Environment &amp; sustainability</td>
</tr>
<tr>
<td>• Lifelong learning</td>
</tr>
</tbody>
</table>

**Question Paper Pattern**: 
- The question paper will have TEN questions.
- Each full question consists of 20 marks.
- There will be 2 full questions (with maximum of THREE sub questions) from each module.
- Each full question will have sub 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**: 
<table>
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<tr>
<th>Modules</th>
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</tr>
</thead>
<tbody>
<tr>
<td><strong>Module -1</strong>&lt;br&gt;An Introduction to Instrumental Methods: Terms associated with Chemical analysis, Classification of instrumental techniques, A review of important consideration in analytical methods, Basic functions of instrumentation, Fundamental Laws of photometry (Text book 1).&lt;br&gt;IR Spectroscopy: Basic Components of IR Spectrophotometers, monochromators- littrow mounting, Fourier Transform IR Spectroscopy (Text book 2).</td>
<td>08 Hours</td>
<td>L1, L2</td>
</tr>
<tr>
<td><strong>Module -2</strong>&lt;br&gt;UV and Visible Spectrometers –Instrumentation: Radiation Sources, Wavelength selection: absorption filters, interference filters, Detector, Readout modules(Text book 1), Instruments for absorption photometry: single beam and double beam spectrophotometer. (Text book 2)</td>
<td>08 Hours</td>
<td>L1, L2</td>
</tr>
<tr>
<td><strong>Module -3</strong>&lt;br&gt;Flame Emission and Atomic Absorption Spectroscopy: Introduction, Instrumentation for flame spectrometric methods, Flame emission spectrometry, atomic absorption spectrometry, Atomic fluorescence spectrometry, Interferences associated with Flames &amp; furnaces, applications, comparison of FES and AAS. (Text book 1).</td>
<td>08 Hours</td>
<td>L1, L2</td>
</tr>
<tr>
<td><strong>Module -4</strong>&lt;br&gt;Gas Chromatography: Chromatograph, Basics parts of a chromatograph: carrier gas supply, sample injection system, chromatographic columns: packed column &amp; capillary column, Detectors: katharometer cell, differential flame ionization detector, electron capture detector.(Text book 2).&lt;br&gt;HPLC Instrumentation: Mobile –phase delivery system sample</td>
<td>08 Hours</td>
<td>L1, L2, L3</td>
</tr>
</tbody>
</table>

| Module -5 Blood analyzer: Introduction, Blood pH measurements: electrodes for blood pH measurement, measurement of blood pCO₂, pO₂, A Complete blood gas analyzer. Air pollution monitoring instruments: Carbon monoxide (CO) -Non-dispersive infrared analyzer, Sulphur dioxide (SO₂)-Conductivitimetry, UV fluorescence method, Nitrogen oxides-Using CO laser, laser opto-acoustic spectroscopy, Hydrocarbons-Flame ionization detector, Ozone-Chemiluminescence, Automated wet chemical air analysis, Water pollution monitoring instruments. (Text book 2) | 08 Hours | L1, L2, L3, L4 |

Course Outcomes:
1. The students get well versed with the principle, construction and working of various analytical instrumentation.
2. Students get detailed information about the application of analytical techniques in medicine, Industry, etc.

Graduate Attributes (as per NBA)
- Engineering Knowledge
- Problem Analysis
- Life-long Learning

Question Paper Pattern:
- The question paper will have TEN questions.
- Each full question carry 20 marks
- There will be TWO full questions (with maximum of THREE sub questions) from each module.
- Each full question will have sub 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:

Reference Books:

Page 37 of 135
### Course Learning Objectives:
This laboratory course enables students to:
- Write 8051 Assembly language and C programs for 8051 and MSP430.
- Interface hardware modules to Microcontroller board.
- Develop applications based on Microcontroller 8051 and MSP430.

### Revised Bloom’s Taxonomy Levels:
- L1 – Remembering
- L2 – Understanding
- L3 – Applying
- L4 – Analyzing
- L5 – Evaluating
- L6 - Creating

### Laboratory Experiments

**Software program using 8051 µc**

Simple Assembly Language:
1. Program using 8051 in Block, Move, Exchange.
2. Program in sorting, finding largest and smallest element in an array.
3. Counters --> For Hex and BCD up/ down count.
4. Boolean and Logical Instructions. (Bit Manipulation).
5. Subroutines using CALL and RETURN instructions.
6. Code Conversions --> ASCII to Decimal, Decimal to ASCII, BCD to ASCII
7. Programs to generate delay, programs using serial port and on-chip timer/counter.

### Software program using MSP 430 IDE

8. Assembly program using MSP 430 for data transfer, Block Move in an array.

### Hardware programming (using 8051)

9. Stepper motor Interface to 8051 Microcontroller with C Program.
10. DC Motor Interface to 8051 Microcontroller with C Program
11. DAC Interface for to generate sine wave, square wave, triangular wave, Ramp wave through 8051 Microcontroller with C Program.
13. ADC Interfacing and Elevator System

### Course Outcomes:
After the completion of this Laboratory course, students will be able to:
- Get hands-on exposure in 8051 and MSP430 platform.
- Enhance programming skills using Assembly language and C.
- Design and interfacing of microcontroller based embedded systems.
- Build projects
- Problem Analysis
- Design and Development of solutions
- Modern Tool usage
- Individual and Team work

**Conduct of Practical Examination:**
1. All laboratory experiments are to be included for practical examination.
2. Students are allowed to pick one experiment from the lot.
3. Strictly follow the instructions as printed on the cover page of answer script for breakup of marks.
4. Change of experiment is allowed only once and 15% Marks allotted to the procedure part to be made zero.

**Reference Books:**
B.E. Electronics and Instrumentation Engineering (EI)
Choice Based Credit System (CBCS)

Semester - IV

Instrumentation and Measurement Lab

<table>
<thead>
<tr>
<th>Subject Code</th>
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<td>Exam Hours</td>
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</table>

Credits - 2

Course Learning Objectives: This Lab course will enable the students to
- Impart the working principle of sensors and transducer
- Testing the response and plot the characteristics of different transducers
- Interpret and analyze experimental results with theoretical concepts.
- Calibrate the sensors/transducers
- Design the signal conditioning circuits and to make the transducer output compatible to interface with other devices
- Study and interpret data sheets of different transducers to select the suitable transducer for particular application and safe operation.


LIST OF EXPERIMENTS

<table>
<thead>
<tr>
<th>LIST OF EXPERIMENTS</th>
<th>Revised Bloom’s Taxonomy (RBT) Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Displacement measurement using LVDT</td>
<td>L1, L2, L3, L4</td>
</tr>
<tr>
<td>2. Temperature measurement using RTD, Thermistor and Thermocouple: Plotting the characteristics and finding their sensitivity</td>
<td>L1, L2, L3, L4</td>
</tr>
<tr>
<td>3. Temperature measurement using AD590 / LM35: Plotting the characteristics and finding their sensitivity</td>
<td>L1, L2, L3, L4</td>
</tr>
<tr>
<td>4. Characteristics of LDR, Photodiode &amp; Phototransistor by variable illumination &amp; variable distance, and Plotting their characteristics</td>
<td>L1, L2, L3, L4</td>
</tr>
<tr>
<td>5. Measurement of unknown resistance by Wheatstone bridge &amp; finding the sensitivity of the bridge.</td>
<td>L1, L2, L3, L4</td>
</tr>
<tr>
<td>6. Measurement of low resistance using Kelvin double bridge.</td>
<td>L1, L2, L3, L4</td>
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<tr>
<td>7. Measurement of self-inductance using Maxwell’s bridge.</td>
<td>L1, L2, L3, L4</td>
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<tr>
<td>8. Calibration of voltmeter and ammeter using DC potentiometer,</td>
<td>L1, L2, L3, L4</td>
</tr>
<tr>
<td>9. Measurement of unknown capacitance using Schering’s bridge.</td>
<td>L1, L2, L3, L4</td>
</tr>
<tr>
<td>10. Characteristics of Load cell and Cantilever beam using Strain gauge: Plotting the characteristics and finding their sensitivity for Quarter, Half and Full bridge configurations.</td>
<td>L1, L2, L3, L4</td>
</tr>
<tr>
<td>11. Characteristics of potentiometric transducer</td>
<td>L1, L2, L3, L4</td>
</tr>
</tbody>
</table>

Course Outcomes: After studying this course, students will able to:
- Analyze the response and plot the characteristics of temperature measurement transducers such as RTD, Thermistor, Thermocouple, AD590 and LM35.
- Analyze the response and plot the characteristics of displacement measuring transducers such as LVDT and Potentiometric transducer.
- Analyze the response and plot the characteristics of strain gauge type load cell.
- Analyze the response and plot the characteristics of pressure transducer.
- Measure unknown values of resistance, capacitance and Inductance using different bridges.
- Design, build and test the circuits for practical applications.

**Graduate Attributes (as per NBA)**
- Engineering Knowledge.
- Problem Analysis.
- Design / development of solutions (partly)
- Interpretation of data

**Conduct of Practical Examination:**
1. All laboratory experiments are to be included for practical examination.
2. Students are allowed to pick one experiment from the lot.
3. Strictly follow the instructions as printed on the cover page of answer script for breakup of marks.
4. Change of experiment is allowed only once and 15% Marks allotted to the procedure part to be made zero.

**Reference Books:**
4. Process Measurement by Bela G. Liptak
B. E. Common to all Programmes
Outcome Based Education (OBE) and Choice Based Credit System (CBCS)
SEMESTER - IV

ADDITIONAL MATHEMATICS – II
(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. [Particular Integral restricted to \( R(x) = e^{ax}, \sin ax/\cos ax \) for \( f(D) y = R(x) \) ]

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:**
- The question paper will have ten full questions carrying equal marks.
- 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 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>
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**5th Semester**

**B.E. Electronics and Instrumentation Engineering (EI)**  
Choice Based Credit System (CBCS)  
**Semester - V**

### Technological Innovation Management and Entrepreneurship  
(Common to EC/TC/EI/BM/ML)

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<tr>
<td></td>
<td></td>
<td>40</td>
<td>60</td>
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#### Credits – 3 (Each module – 8 Hours)

**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

**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). **L1, L2**

**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

**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). **L1, L2, L3**

### 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

### Question Paper Pattern:

- The question paper will have TEN questions.
- Each full question carry 20 marks
- There will be TWO full questions (with maximum of THREE sub questions) from each module.
- Each full question will have sub 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:

4. Robert D. Hisrich, Mathew J. Manimala, Michael P Peters and Dean A. Shepherd,
**Reference Book:**

### Fundamentals of Signals and DSP
(Common to EI & BM)

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**Module -1**
**Introduction to Signals and Systems:**
Basic elements of a DSP System, Classification of Signals, Sampling Theorem (statement and problems on Nyquist rate), Discrete Time Signals (Representation, Standard Signals, Classification, and Operations), Discrete Time Systems, Convolution Sum, Cross correlation and Auto correlation of sequences.

Text 1: 1.1.1, 1.2, 1.4.2, 2.1, 2.2, 2.3.3, 2.3.7, 2.6.1.

**Module -2**
**Z-Transform and its Application to analysis of LTI Systems:**
Direct Z-Transform, Properties of the Z-Transform, Examples, Inverse Z-Transform by Partial-Fraction Expansion method only, System Function of a LTI System, Causality and Stability (from H(z)).

**Realization of Digital System:** Direct Form I, Direct form II, cascade form and parallel form

Text 1: 3.1.1, 3.2, 3.4.3, 3.3.3, 3.5.3.
Text 2: 9.2, 9.3

**Module -3**
**DFT: Properties and Applications:**

Text 1: 7.1.3, 7.2, 7.3.1, 8.1.3.

**Module -4**
**IIR & FIR Filters:**
**IIR Filters:** Low-pass filter specifications, IIR filter Design by Impulse Invariance & Bilinear Techniques, Design of Digital IIR filter by Butterworth approach, Examples. Magnitude response of lowpassChebyshev Type I, II filter (Theoretical concept only)

**FIR Filters:** Design of FIR filters – Symmetric and Antisymmetric FIR filters, Design of Linear phase FIR filters by Rectangular Hamming &Hanning windows. Summary of window function characteristics (window shape, transition bandwidth, stop band attenuation, etc.). Implementation of FIR filters by direct form and Single-stage lattice structure only.

Text 1: 10.3.2, 10.3.4, 9.3.1, 9.3.3, 9.3.4, 10.2.1, 10.2.2, 10.2.7, 9.2.1, 9.2.4

**Module -5**
**Multirate Digital Signal Processing & Adaptive Filters:**
Course Outcomes: After studying this course, students will be able to:
1. Visualize, classify, and perform computation on discrete time signals, systems, and properties.
2. Perform the transformation techniques from time domain to other and vice versa, and analyze the system and properties (Z-Transform, DFT etc.).
3. Realize/implement the Direct/cascade/parallel/lattice forms of the given digital system (IIR/FIR).
4. Compute DFT by FFT algorithms.
5. Develop transformation from analog system to digital system and design and implement IIR and FIR filters.
6. Demonstrate the advanced concepts of signal processing (Multirate and Adaptive filtering) and architecture of DSP processor.

Question Paper Pattern:
- The question paper will have TEN questions.
- Each full question carries 20 marks.
- There will be TWO full questions (with maximum of THREE sub-questions) from each module.
- Each full question will have sub-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:

Reference Books:
### Subject Information

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**Credits – 4 (Each module – 10 Hours)**

#### Module -1

**Introduction to Process Control and Final Control Operations:**
- Final Control: Introduction, Final control operation, Signal conversions, Actuators, Control elements.
  (Numerical problems on all topics)

#### Module -2

**Controller Principles:**
- Introduction, Process characteristics, Control system parameters, Discontinuous controller modes: Two position, multiposition, floating control modes. Continuous controller modes: Proportional (P), Integral (I), Derivative (D) control modes, Composite controller modes: PI, PD, PID modes. (Problems on all types of controller modes).

#### Module -3

**Analog Controllers:**
- Introduction, General features, Electronic controllers, Error detector, Single mode, Composite controller modes, Pneumatic controllers, Design considerations. (Numerical problems on all topics).

**Digital Controllers:**
- Digital electronic methods, Simple alarms, Two position control, Multivariable alarms, Data logging, Supervisory computer control (SDC) and Direct digital control. Sampled data systems, Input data operations. Controller Modes Software-Error, P, I, D, &PID control mode software.

#### Module -4

**Control-Loop Characteristics:**
- Basic Instrumentation symbols, Process instrumentation & drawing (P&ID) symbols.

#### Module -5

**Modeling and Simulation for Plant Automation:**
- Introduction, definition of terms, Need of system modeling, Uses of system simulation, how to build the mathematical model of a plant, Model evaluation and improvement, modern tools for modeling and simulation of systems, application examples, future perspectives.

**Multivariable & Intelligent Controllers:**

#### Course Outcomes:

After studying this course, students will able to:

1. Discuss the principles of process control, evaluation, data representation and elements of final
2. Analyze the principle and working of continuous and discontinuous controller modes.
3. Design analog controllers based on op-amps and pneumatic systems.
4. Discuss the principle and working digital controllers and implementation of controller mode software, concepts and applications of modelling and simulation of process plant
5. Analyze control loop characteristics, control system quality and process loop tuning, and sketch the basic process instrumentation symbols.
6. Describe the fundamental concepts of multivariable and intelligent controllers.

**Question Paper Pattern:**
- The question paper will have TEN questions.
- Each full question carry 20 marks
- There will be TWO full questions (with maximum of THREE sub questions) from each module.
- Each full question will have sub 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:**
2. Computer Based Industrial Control by Krishna Kant, PHI, New Delhi 1997. (Module 5)

**Reference Books:**
4. Lessons in Industrial Instrumentation by Tony R. Kuphaldt, Creative Commons Attribution License (open source textbook), Sept. 2008. (for basic instrumentation symbols, 6.5.1, 6.5.2, 6.5.3, 6.5.4, 6.5.9).
Biomedical Instrumentation

Subject Code: 18EI54
CIE Marks: 40

Number of Lecture + Tutorial Hours/Week: 02+02
SEE Marks: 60

Total Number of Lecture Hours: 40
Exam Hours: 03

Credits – 3 (Each module – 8 Hours)

Module -1
Fundamentals of Biomedical Instrumentation: Sources of biomedical signals, Basic Medical Instrumentation system, Performance requirements of medical instrumentation systems. PC based medical instruments, General constraints in design of biomedical instrumentation systems.

Bioelectric Signals and Electrodes: Origin of Bioelectric signals, Types of bioelectric signals-ECG, EEG, EMG, Recording electrodes: Electrode – Tissue interface, polarization, skin contact- impedance, Silver-silver chloride electrodes, Electrodes for ECG, EEG, EMG, Microelectrodes.

Module -2
Electrocardiograph: Physiology of the heart, Electrical activity of the heart and Electrocardiogram (ECG), Normal & Abnormal cardiac Rhythms, Block diagram-description of an Electrocardiograph, ECG leads, Effects of artifacts on ECG Recordings, Multi-channel ECG machine.

Electroencephalograph: Block diagram description of an Electroencephalograph, 10-20 electrode systems, computerized analysis of EEG. Electromyograph, Biofeedback instrumentation.

Module -3
Patient Monitoring System: Bedside patient monitoring systems, Central monitors, Measurement of heart rate – Average heart rate meter, Instantaneous heart rate meter, Measurement of pulse rate, Definition of oximeter & Pulse oximeter.


Measurement of Respiration Rate: Impedance pneumography, CO₂ method of respiration rate measurement, Apnoea detectors.

Module -4

Cardiac Output Measurement: Measurement of continuous cardiac output derived from the aortic pressure waveform, ultrasound method.

Cardiac Pacemakers and Defibrillators: Need for cardiac pacemaker, External pacemaker, Implantable pacemaker, Types of Implantable pacemakers, Programmable pacemakers, Power sources for Implantable pacemaker.

Cardiac Defibrillator: Need for a Defibrillator, DC defibrillator, Pacer-Cardioverter-Defibrillator.

Module -5
Therapeutic Instruments:
Cardiac-assist devices, Pump oxygenators, Total artificial heart, Hemodialysis, Lithotripsy, Ventilators, Infant incubators, Drug infusion pumps, Ambulatory and Implantable Infusion systems, Anesthesia.
Machines, Electrosurgical unit.

**Patient Safety:** Electric shock hazards, Leakage currents, Electrical safety analyzer, Testing of Biomedical equipment

<table>
<thead>
<tr>
<th>Course Outcome: After studying this course, students will be able to:</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Acquire knowledge about origin of bio-potential, bio-signals and their measurement</td>
</tr>
<tr>
<td>2. Describe the problem, identify and formulate solution in the field of Bio-Medical Engineering for current and future issues</td>
</tr>
<tr>
<td>3. Describe the cardiac, brain and muscular physiological systems with the related diagnostic measurement methods.</td>
</tr>
<tr>
<td>4. Recognize the therapeutic methods of treatment and the associated instrumentation.</td>
</tr>
<tr>
<td>5. Identify and judge patient safety issues related to biomedical instrumentation.</td>
</tr>
<tr>
<td>6. Describe the principle and working of cardiac pacemakers, defibrillators, BP measurement, blood flow meters, CO measurement, respiration measurements and their implementation.</td>
</tr>
</tbody>
</table>

**Question Paper Pattern:**
- The question paper will have TEN questions
- Each full question carry 20 marks
- There will be TWO full questions (with maximum of THREE sub questions) from each module.
- Each full question will have sub 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:**

**Reference Book:**
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<td>SEE Marks</td>
<td>60</td>
</tr>
<tr>
<td>Exam Hours</td>
<td>03</td>
</tr>
</tbody>
</table>

**Course Outcomes:** After studying this course, students will be able to:
1. Explain the principle and working of Laser system.
2. Discuss the engineering applications of laser systems.
3. Discuss the fundamentals of optical fiber communications.
4. Evaluate the design of optical fibers.
5. Apply fiber optic laser systems in medical field.

---

**Module -1**
**Lasers -I:** Introduction, Emission and absorption of radiation, Einstein relation, population inversion, threshold conditions, Line shape function, population inversion and pumping threshold conditions.
**Lasers -II:** Classes of LASER: Doped insulator LASERs, semiconductor LASERs, Gas LASERs, Liquid dye LASERs.

**Module -2**
**Generation of Lasers:** Single mode operation, frequency stabilization. Q-switching, mode locking, lasing threshold.
**Applications of Laser:** Measurement of distance: Interferometric methods, Beam modulation telemetry, Pulse echo techniques; Holography & its Applications.

**Module -3**
**Overview of Optical Fiber Communications:** Motivations for light wave communications, optical spectral bands, Decibel units, Network information rates, WDM concepts, Key elements of optical fiber systems, standards for optical fiber communications.
**Structures, Wave guiding, and Fabrication I:** The nature of light, basic optical laws and definitions, optical fiber modes and configurations, Mode theory for circular waveguides, Single mode fibers.

**Module -4**
**Structures, Wave guiding, and Fabrication II:** Graded index fiber structure, Fiber materials, Photonic crystal fibers, Fiber fabrication, Mechanical properties of fibers, Fiber optic cables.
**Optical Amplifiers:** Types of optical amplifiers and its applications, Semiconductor optical amplifiers, Erbium-doped fiber amplifiers, Amplifier noise, Optical SNR, System Applications, Raman amplifiers, wideband optical amplifiers.

**Module -5**

**Textbook 3:** Unit 9.1, 9.2, 9.2.1, 9.2.2, 9.2.5, 9.3.4, 9.5.2.3, 9.7.3, 9.8.2, 9.9.2, 9.11.4.3
<table>
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<td>• Each full question carry 20 marks</td>
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<tr>
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B.E. Electronics and Instrumentation Engineering (EI)
Choice Based Credit System (CBCS)
Semester - V

VLSI Design
(Common to EI, BM & ML)

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<tr>
<td>Total Number of Lecture Hours</td>
<td>: 40</td>
<td>Exam Hours : 03</td>
</tr>
</tbody>
</table>

Credits – 3 (Each module – 8 Hours)

**Module -1**
Moore’s law, speed power performance, nMOS fabrication, CMOS fabrication: n-well, p-well processes, BiCMOS, Comparison of bipolar and CMOS.
**Basic Electrical Properties of MOS And BiCMOS Circuits:** Drain to source current versus voltage characteristics, threshold voltage, transconductance.

**Module -2**
**Basic Electrical Properties of MOS And BiCMOS Circuits:** nMOS inverter, Determination of pull up to pull down ratio, nMOS inverter driven through one or more pass transistors, alternative forms of pull up, CMOS inverter, BiCMOS inverters, latch up.
**Basic Circuit Concepts:** Sheet resistance, area capacitance calculation, Delay unit, inverter delay, estimation of CMOS inverter delay, driving of large capacitance loads, super buffers, BiCMOS drivers.

**Module -3**
**MOS and BiCMOS Circuit Design Processes:** MOS layers, stick diagrams, nMOS design style, CMOS design style, design rules and layout, $\lambda$ - based design.
**Scaling of MOS Circuits:** scaling factors for device parameters, limitations of scaling.

**Module -4**
**Subsystem Design and Layout-1 :** Switch logic pass transistor, Gate logic inverter, NAND gates, NOR gates, pseudo nMOS, Dynamic CMOS, example of structured design, Parity generator, Bus arbitration, multiplexers, logic function block, code converter.
**Subsystem Design and Layout-2 :** Clocked sequential circuits, dynamic shift registers, bus lines, subsystem design processes, General considerations, 4-bit arithmetic processes, 4-bit shifter.

**Module -5**
**Design Process-Computational Elements:** Regularity, design of ALU subsystem, ALU using adders, carry look ahead adders, Multipliers, serial parallel multipliers, Braun array, Bough – Wooley multiplier.
**Memory, Register and Aspects of Timing:** Three Transistor Dynamic RAM cell, Dynamic memory cell, Pseudo- Static RAM, JK Flip-flop, D Flip-flop circuits, RAM arrays, practical aspects and testability: Some thoughts of performance, optimization and CAD tools for design and simulation.

**Course Outcomes:** After studying this course, students will able to;
1. Identify the CMOS layout levels, and the design layers used in the process sequence.
2. Describe the general steps required for processing of CMOS integrated circuits.
3. Design static CMOS combinational and sequential logic at the transistor level.
4. Demonstrate different logic styles such as complementary CMOS logic, pass-transistorLogic, dynamic logic, etc.
5. Interpret the need for testability and testing methods in VLSI.
**Question Paper Pattern:**
- The question paper will have TEN questions.
- Each full question carry 20 marks
- There will be TWO full questions (with maximum of THREE sub questions) from each module.
- Each full question will have sub 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:**

**Reference Books:**
B.E. Electronics and Instrumentation Engineering (EI)
Choice Based Credit System (CBCS)
Semester - V

Signal Conditioning Circuits and Data Acquisition Lab
(Common to EI, BM & ML)

<table>
<thead>
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<th>Subject Code</th>
<th>CIE Marks</th>
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<th>Credits</th>
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Number of Tutorial+ Practical Hours/Week : 02+02
Total Number of Practical Hours : 42
Exam Hours : 03

Credits - 2


Laboratory Experiments:

Note: Standard design procedure to be adopted
Students should build the circuit using discrete components and ICs (models are not to be used)

<table>
<thead>
<tr>
<th>Laboratory Experiments</th>
<th>Revised Bloom’s Taxonomy (RBT)Level</th>
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<tbody>
<tr>
<td>1. To design and implement</td>
<td></td>
</tr>
<tr>
<td>• Inverting Amplifier and Inverting Attenuator</td>
<td>L3, L4</td>
</tr>
<tr>
<td>• Non-Inverting Amplifier and Voltage Follower</td>
<td></td>
</tr>
<tr>
<td>2. To realize</td>
<td></td>
</tr>
<tr>
<td>• Full wave Precision rectifier</td>
<td>L3, L4</td>
</tr>
<tr>
<td>• Voltage regulator using IC 723</td>
<td></td>
</tr>
<tr>
<td>3. To design and implement</td>
<td></td>
</tr>
<tr>
<td>• Butterworth I order Low-pass filter</td>
<td>L3, L4</td>
</tr>
<tr>
<td>• Butterworth II order High-pass filter</td>
<td></td>
</tr>
<tr>
<td>4. To design and implement</td>
<td></td>
</tr>
<tr>
<td>• RC Phase shift oscillator</td>
<td>L3, L4</td>
</tr>
<tr>
<td>• Wein Bridge oscillator</td>
<td></td>
</tr>
<tr>
<td>5. To realize</td>
<td></td>
</tr>
<tr>
<td>• ZCD</td>
<td>L3, L4</td>
</tr>
<tr>
<td>• Positive and Negative Voltage level detectors</td>
<td></td>
</tr>
<tr>
<td>6. To design and implement</td>
<td></td>
</tr>
<tr>
<td>• Astable Multivibrator using 555 timer</td>
<td>L3, L4</td>
</tr>
<tr>
<td>• Mono-stable Multivibrator using 555 timer</td>
<td></td>
</tr>
<tr>
<td>7. To realize</td>
<td></td>
</tr>
<tr>
<td>• Sample and Hold circuit using discrete components</td>
<td>L3, L4</td>
</tr>
<tr>
<td>8. To realize</td>
<td></td>
</tr>
<tr>
<td>• Programmable Gain Amplifier using Analog Mux</td>
<td>L3, L4</td>
</tr>
<tr>
<td>9. To design and implement</td>
<td></td>
</tr>
<tr>
<td>• 4 bit R-2R DAC using discrete components</td>
<td>L3, L4</td>
</tr>
<tr>
<td>10. To design and implement</td>
<td></td>
</tr>
<tr>
<td>• 8-bit DAC using IC (DAC 0800)</td>
<td>L3, L4</td>
</tr>
<tr>
<td>11. To design and implement</td>
<td></td>
</tr>
<tr>
<td>• 8-bit ADC using IC (ADC 0809)</td>
<td>L3, L4</td>
</tr>
<tr>
<td>12. To design and implement</td>
<td></td>
</tr>
<tr>
<td>• 3 bit Flash ADC using ICs</td>
<td>L3, L4</td>
</tr>
</tbody>
</table>
Course Outcomes: After studying this course, students will be able to:

1. Sketch/draw circuit schematics, construct circuits on breadboards, analyze and troubleshoot circuits containing Op-amps, resistors, diodes, capacitors and independent sources.
2. Memorize and reproduce the manufacturer's data sheets of IC 555 timer, IC μa741 op-amp and data converters like IC ADC 0800 and IC DAC 0809.
3. Design and evaluate analog integrated circuits like Amplifiers, Oscillators, Active filters, Precision Rectifiers and Voltage level detectors, and compare the experimental results with theoretical values.
4. Demonstrate and analyze the working of Sample-Hold, Programmable gain amplifier and Analog Multiplexer circuits in data acquisition system.
5. Design and evaluate different resolution data converters using discrete components and ICs.

Conduct of Practical Examination:

1. All laboratory experiments are to be included for practical examination.
2. Students are allowed to pick one experiment from the lot.
3. Strictly follow the instructions as printed on the cover page of answer script for breakup of marks.
4. Change of experiment is allowed only once and 15% Marks allotted to the procedure part to be made zero.

Reference Books:

B.E. Electronics and Instrumentation Engineering (EI)  
Choice Based Credit System (CBCS)  
Semester - V  
Digital Signal Processing Lab  

<table>
<thead>
<tr>
<th>Subject Code</th>
<th>Number of Tutorial+Practical Hours/Week</th>
<th>CIE Marks</th>
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</table>

Credits -2  

**USING ONLY MATLAB / SCILAB/OCTAVE**

1. Verify the Sampling theorem.  
2. Determine linear convolution, Circular convolution and Correlation of two given sequences. Verify the result using theoretical computations.  
3. Determine the linear convolution of two given point sequences using FFT algorithm.  
4. Determine the correlation using FFT algorithm.  
5. Determine the spectrum of the given sequence using FFT.  
6. Design and test FIR filter using Windowing method (Hamming, Hanning and Rectangular window) for the given order and cut-off frequency.  
7. Design and test Butterworth 1st and 2nd order low & high pass filter.  
8. Design and test Chebyshev 1st and 2nd order low & high pass filter.  

**USING DSP KIT / EMULATORS FROM TI/ ADSPSHARC/ MOTOROLA**

9. Linear convolution of two given sequences.  
10. Circular convolution of two given sequences  
11. Computation of N-point FFT of a given sequence.  
12. Implementation of an FIR filters to meet given specifications.  
13. Implementation of an IIR filters to meet given specifications.  

**Course Outcomes:** After studying this course, students will able to;  
1. Write programs using Matlab / Scilab/Octave to demonstrate the DSP concepts on sampling, convolution and correlation, and implementation of the same using DSP kit.  
2. Write programs using Matlab / Scilab/Octave for generation and computation of discrete signals.  
3. Write program using Matlab / Scilab/Octave to apply FFT/DFT algorithm to determine spectrum of a given signal, and implementation of the same using DSP kit.  
4. Write programs using Matlab / Scilab/Octave to design and evaluate different types of low and high pass filters.  
5. Design and demonstrate IIR and FIR filters using Matlab / Scilab/Octave programs and DSP Kit.  
6. Design and demonstrate DSP system applications in noise cancellation, communication, biomedical signal processing.  

**Conduct of Practical Examination:**  
1. All laboratory experiments are to be included for practical examination.  
2. Students are allowed to pick one experiment from the lot.  
3. Strictly follow the instructions as printed on the cover page of answer script for breakup of marks.  
4. Change of experiment is allowed only once and 15% 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 – V

**ENVIRONMENTAL STUDIES**

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<td>Credits</td>
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<td>Exam Hours</td>
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</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:

- CO1: Understand the principles of ecology and environmental issues that apply to air, land, and water issues on a global scale.
- CO2: Develop critical thinking and/or observation skills, and apply them to the analysis of a problem or question related to the environment.
- CO3: Demonstrate ecology knowledge of a complex relationship between biotic and abiotic components.
- CO4: 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.

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<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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**Textbook/s**
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<td>2.</td>
<td>Environmental Studies</td>
<td>S M Prakash</td>
<td>Pristine Publishing House, Mangalore</td>
<td>3&lt;sup&gt;rd&lt;/sup&gt;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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</table>

**Reference Books**

<table>
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<tr>
<th></th>
<th>Principals of Environmental Science and Engineering</th>
<th>Raman Sivakumar</th>
<th>Cengage learning, Singapur.</th>
<th>2&lt;sup&gt;nd&lt;/sup&gt;Edition, 2005</th>
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<tbody>
<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. New Delhi.</td>
<td>1&lt;sup&gt;st&lt;/sup&gt;Edition</td>
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</table>
**6th SEMESTER**

### B.E. Electronics and Instrumentation Engineering (EI)
Choice Based Credit System (CBCS)
Semester - VI

### Analog and Digital Communication Systems
(Common to EI, BM & ML)

<table>
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<tbody>
<tr>
<td>04</td>
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</table>

**Credits – 4 (Each module – 10 Hours)**

#### Module - 1
Introduction to analog and Digital Communication, Historical Background and Applications.

**Amplitude Modulation:** Amplitude Modulation, Virtues, Limitations, and Modifications of AM, DSBSC Modulation, Costas Receiver, Single Sideband Modulation, Vestigial Sideband Modulation, Theme Examples.(Text 1:1.1,1.2,3.1, 3.2, 3.3, 3.4, 3.6, 3.7, 3.9)

#### Module - 2
**Angle Modulation:** Basic Definitions, Properties of Angle-Modulated Waves, Relationship between PM and FM Waves, NBFM, WBFM, Transmission Bandwidth of FM Waves, Generation of FM waves, Demodulation of FM Signals, Theme Example.(Text 1:Chapter 4 )

#### Module - 3
**Pulse Modulation: Transition from Analog to Digital Communications:** Sampling Process, PAM, Completing the Transition from Analog to Digital, Quantization Process, PCM, Delta Modulation, Theme Examples.(Text 1: 5.1, 5.2, 5.4, 5.5, 5.6, 5.7, 5.10)

#### Module - 4

[Note: Excluding Computer Experiments in all the above Modules]

#### Module - 5
**Wireless Personal Area Networks (WPAN):** Network Architecture, WPAN Components, WPAN Technologies and protocols (Bluetooth & Zigbee), WPAN Applications.(Text2: 4.1, 4.2, 4.3, 4.4, 4.5)

#### Course Outcomes:
After studying this course, students will be able to:
1. Explain the basics concepts of analog modulation techniques.
2. Discuss the basic concepts of digital modulation techniques.
3. Describe the basic concepts of digital data and pulse communication.
4. Explain and analyze different digital modulation techniques.
5. Describe different wireless area networks and their applications.

#### Question Paper Pattern
- The question paper will have TEN questions.
- Each full question carry 20 marks
- There will be TWO full questions (with maximum of THREE sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer FIVE full questions, selecting ONE full question from each module.

<table>
<thead>
<tr>
<th>Text Book:</th>
</tr>
</thead>
</table>

<table>
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<tr>
<th>Reference Books:</th>
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## B.E. Electronics and Instrumentation Engineering (EI)
Choice Based Credit System (CBCS)
Semester - VI

### Power and Industrial Electronics

<table>
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<tr>
<td>Lecture Hours</td>
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**Module -1**
**Introduction:** Applications of power electronics, power semiconductor devices, control characteristics, types of power electronic circuits, peripheral effects.
Power BJTs, switching characteristics, switching limits, base-drive control, introduction to IGBT, and MOSFET, isolation of gate and base drives.

**Module -2**
**Thyristors:** Introduction, static characteristics of SCR, two transistor model, turn-on and turn off methods, di/dt and dv/dt protection of SCR, series and parallel operation of thyristors, thyristor firing circuitusingUJT.

**Commutation Techniques:** Introduction, natural commutation, forced commutation: self-commutation, impulse commutation.

**Module -3**
**Controlled Rectifiers:** Introduction, principle of phase controlled converter operation, single-phase semi converters, full converters and dual converters.

**AC Voltage Controllers:** Introduction, principle of ON-OFF and phase control, single-phase bidirectional controllers with resistive and inductive loads.

**Module -4**
**DC Choppers:** Introduction, principle of step-down operation, step-down chopper with R- L loads, Principle of step-up operation, Classification of DC Choppers.

**DC Drives:** Introduction, basic characteristics of DC Motors, operating modes single phase Full-converter drives, Introduction to stepper motor

**Module -5**
**Inverters:** Introduction, principle of operation, single phase bridge inverters, three phase inverters, voltage control of single phase inverters, current source inverter

**Applications of Power electronics:** Power supplies, switched- mode DC power supplies and configurations, AC power supplies (UPS only), Industrial applications.

**Course Outcomes:** After studying the course, students will be able to:
1. Explain static and dynamic characteristics of power semiconductor devices.
2. Analyze operation, model, characteristics, and turn-on and turn-off methods of devices.
3. Describe the converter circuits and their operation using Thyristors, BJT, MOSFET etc.
4. Analyze, evaluate and apply the power converter circuits in Industry
5. Apply the knowledge in the Domestic/Industrial control system applications.
**Question Paper Pattern**
- The question paper will have TEN questions.
- Each full question carry 20 marks
- There will be TWO full questions (with maximum of THREE sub questions) from each module.
- Each full question will have sub 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 Book:**

---

**Reference Books:**
B.E. Electronics and Instrumentation Engineering (EI)  
Choice Based Credit System (CBCS)  
Semester – VI  

JAVA Programming  
(Common to EI, BM & ML)  

<table>
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<tr>
<td>Total Number of Lecture Hours</td>
<td>50</td>
<td>Exam Hours</td>
<td>03</td>
</tr>
</tbody>
</table>

Credits – 4 (Each module – 10 Hours)  

Course Learning Objectives: This course will enable students to  
- Understand object oriented programming concepts, and apply them in solving problems.  
- Set up Java JDK environment to create, debug and run simple Java programs.  
- Introduce the concepts of exception handling and multithreading.  
- Introduce the design of Graphical User Interface using applets and swing controls.

Module -1  
Object Oriented Programming and JAVA: Object Oriented Paradigm, basic concepts, benefits and applications of OOPs. JAVA history and features, How java differs from C and C++, JAVA and Internet, JAVA and World Wide Web, Web browsers, JAVA support systems, JAVA environment. JAVA program structure, Tokens, Statements, JAVA Virtual Machine.  
Overview of JAVA Language: Simple Java Program, Math functions, An application with two classes, Java program structure, Java Tokens, Java Statement, Implementing a Java Program, Java Virtual Machines, Command and Line Arguments, Programming Style.

Module -2  
Constants, Variables, Data Types: Declaration and scope of Variables, Symbolic constants, Type Casting, Standard Default values.  

Module -3  
Classes, Objects and Methods: Class definition and declaration, Creating Object, Accessing Class Members, Constructors, Methods Overloading, Static Members, Nesting Methods, Inheritance, Overriding Methods, Final Variables and Methods, Final Classes, Finalizer Methods, Abstract Methods and Classes, Visibility Control.  
Arrays, Strings and Vectors: One and two dimensional arrays, Strings, Vectors, Wrapper Classes

Module -4  
Interfaces: Definition, Extending and Implementing Interfaces, Accessing Interface variables.  
Packages: JAVA API Packages, Using System packages, Naming conventions, Creating, Accessing and Using a package, Adding a class to a Package, Hiding Classes.  
Multithreaded Programming: Creating and Extending Thread Class, Stopping, Blocking and Life Cycle of Thread, Using Thread Methods, Thread Exceptions and Priority, Synchronization, Implementing runnable Interface.
Module -5

**Applet Programming:** Introduction, How Applets Differ from Applications, Preparing to write Applets, Building Applet Code, Applet Life Cycle, Creating an Executable Applet, Designing a Web Page, Applet Tag, Adding Applet to HTML File, Running the Applet, Passing Parameters to Applets, Aligning the Display, More about HTML Tags, Displaying Numerical Values, Getting Input from the User, Event Handling.

**Course Outcomes:** After studying this course, students will be able to
- Explain the object-oriented concepts and JAVA.
- Develop computer programs to solve real world problems in Java.
- Develop multithreaded applications with synchronization.
- Develop applets for web applications.
- Design GUI based applications.

**Question Paper Pattern**
- The question paper will have TEN questions
- Each full question carries 20 marks
- There will be TWO full questions (with maximum of THREE sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer FIVE full questions, selecting ONE full question from each module.

**Graduate Attributes**
- Programming Knowledge
- Design/Development of Solutions
- Conduct Investigations of Complex Problems
- Life-Long Learning

**Text Books:**

**Reference Books:**
Aeronautical Instrumentation

Subject Code : 18EI641
Number of Lecture + Tutorial Hours/Week : 02+02
Total Number of Lecture Hours : 40
CIE Marks : 40
SEE Marks : 60
Exam Hours : 03
Credits – 3 (Each module – 8 Hours)

Module -1
Aircraft Instruments: Introduction-Qualitative and quantitative displays, basic T grouping of instruments, basics of Altitude Director Indicator (ADI) &Horizontal Situation Indicator.
Air Data Instruments: Pneumatic type and air data computers, International Standard Atmosphere (ISA), combined pitot-static probe, separate static probe, air speed indicator, instantaneous vertical speed indicator.

Module -2
Altimeters, Air Data Warning System: Mach warning system, altitude alerts system, airspeed warning system.

Module -3
Directional Systems: Earth’s total magnetic field, horizontal and vertical components of total field direct reading compass and its limitations, fluxgate detector units, gyro stabilized direction indicating systems.

Module -4
Gyroscopic Flight Instruments: types of gyro-mechanical, ring laser gyros, fiber optic gyros and their limitations, basic mechanical gyro and its properties namely rigidity and precision, gyro horizon, direction indicator, turn and bank indicator.

Module -5
Engine Instruments: pressure measurement (EPR), Temperature measurement (EGT), capacitance type volumetric fuel quantity indicator, densitometer, fuel quantity indicator by weight. Engine speed measurement, torque measurement, integrated impellor type flow meter.

Course Outcomes: After studying this course, students will able to
1. Outline the scope and extent of avionics and identify the types of flight instruments and display panels.
2. Describe the fundamentals of flight, basics of aircraft structures, propulsion and materials used in the development of an aircraft.
3. Comprehend the complexities involved during development of flight vehicles.
4. Recognize the fundamental applications of gyroscopic flight instruments in aircraft and analyses the performance of aircraft control system and interpret the results.
5. Evaluate the performance characteristics of engine instruments of aircraft and give better view and ways to improve efficiency.

Question Paper Pattern:
- The question paper will have TEN questions.
- Each full question carry 20 marks
- There will be TWO full questions (with maximum of THREE sub questions) from each module.
- Each full question will have sub 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:**

**Reference Books:**
1. Aircraft Instrumentation and Systems -S. Nagabhushana&L.K. Sudha IK International
# Digital Image Processing

<table>
<thead>
<tr>
<th>Module</th>
<th>Description</th>
<th>Text References</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Module -1</strong></td>
<td><strong>Introduction:</strong> Background, Examples of fields that use DIP, Fundamental steps in Digital Image Processing (DIP), Components of DIP system, Image sensing and acquisition, A simple image formation model, Image sampling and quantization. Basic relationship between pixels, Color image processing fundamentals and models.</td>
<td>Chapter 1, 2.3, 2.4, 2.5</td>
</tr>
<tr>
<td><strong>Module -2</strong></td>
<td><strong>Image Enhancement in Spatial Domain:</strong> Background, Point processing – Image negatives, Log transformations, Power law transformations, Contrast stretching, Intensity level slicing, Bit plane slicing, Histogram processing – Histogram equalization, Histogram matching (specification), Arithmetic/Logic operations. Fundamentals of spatial filtering, Smoothing spatial filters, Sharpening spatial filters.</td>
<td>3.1, 3.2, 3.3, 2.6.1, 2.6.2, 2.6.3, 2.6.4, 3.4, 3.5, 3.6</td>
</tr>
<tr>
<td><strong>Module -3</strong></td>
<td><strong>Image Enhancement In Frequency Domain:</strong> Background, 2D-Discrete Fourier Transform and its inverse, Basic properties of the 2D-Discrete Fourier Transform, Basic of filtering in the frequency domain. <strong>Image smoothing using frequency domain filters:</strong> Ideal low pass filters, Butterworth low-pass filters, Gaussian low-pass filters; Image sharpening using frequency domain filters, Ideal high-pass filters, Butterworth high-pass filters, Gaussian high-pass filters, Homomorphic filtering.</td>
<td>4.1, 4.2, 4.5.5, 4.6, 4.7, 4.8, 4.9</td>
</tr>
<tr>
<td><strong>Module -4</strong></td>
<td><strong>Image Restoration:</strong> Model of the Image degradation/restoration process, Noise models, Restoration using spatial filtering: Mean filters, Order statistic filters - Median filter, Min and Max filters, Midpoint filter. <strong>Image Compression:</strong> Fundamentals, Image compression models, Basic compression methods – Huffman coding, Arithmetic coding, LZW coding, Run-length coding.</td>
<td>5.1, 5.2, 5.3.1, 5.3.2, 8.1, 8.2.1, 8.2.3, 8.2.4, 8.2.5</td>
</tr>
<tr>
<td><strong>Module -5</strong></td>
<td><strong>Image Segmentation:</strong> Fundamentals, Point detection, Line detection, Edge models, Edge detection, Canny edge detector. <strong>Thresholding, Region based segmentation.</strong></td>
<td>10.1, 10.2.1 – 10.2.6, 10.3, 10.4</td>
</tr>
</tbody>
</table>

**Course Outcomes:** After studying this course, students will be able to:
1. Describe the fundamentals of Image Processing and Image transform techniques.
2. Apply image enhancement technique in frequency and spatial domain
3. Analyze and implement restoration and color models.
4. Develop and analyze image compression techniques.
5. Apply segmentation algorithms for general image.
6. Develop image processing algorithms for real-world problems.

**Question Paper Pattern**
- The question paper will have TEN questions
- Each full question carry 20 marks.
- There will be TWO full questions (with maximum of THREE sub questions) from each module.
- Each full question will have sub 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:**

**Reference Books:**
### Subject: Operating Systems

#### Module -1

**Operating system structures:** OS Services, User-OS Interface, System calls, System programs, OS structure, System Boot.

Text: 1.1, 1.2, 1.3, 1.5, 1.6, 1.7, 1.8, 1.9, 1.11, 2.1, 2.2, 2.3, 2.5, 2.7, 2.10.

#### Module -2
**Process Management**
- **Processes:** Process concept, Process scheduling, Operation on processes, Inter process communication.
- **Threads** – Overview, Multithreading models, Threading issues.
- **CPU scheduling** – Basic concepts, Scheduling criteria, Scheduling algorithms, real time scheduling.

Text: 3.1, 3.2, 3.3, 3.4, 4.1, 4.3, 4.6, 6.1, 6.2, 6.3, 6.6

#### Module -3
**Process Synchronization:** Background, The critical section problem, Peterson’s Solution, Synchronization hardware, Mutex Locks, Semaphores, Classical problems of synchronization, Monitors.

**Deadlock** – System model, Deadlock characterization, Methods for handling deadlocks, deadlock prevention, deadlock avoidance, deadlock detection and recovery from deadlock.

Text: 5.1, 5.2, 5.3, 5.4, 5.5, 5.6, 5.7, 5.8, 7.1, 7.2, 7.3, 7.4, 7.5, 7.6, 7.7.

#### Module -4
**Memory management:**
- **Main Memory:** Background, Swapping, Contiguous, allocation, Paging.
- **Virtual memory:** Background, Demand paging, Copy-on-write, Page replacement.


#### Module -5
**Storage Management:**
- **Mass storage structure:** Overview of mass storage structure, Disk structure, Disk scheduling, Disk management, Swap space management.
- **File System Interface:** File concept, Access methods, Directory and Disk structure, File system mounting, Protection.
- **File System Structure:** File system structure, File system implementation, Directory implementation, Allocation methods, and free space management.

Text: 10.1, 10.2, 10.4, 10.5, 10.6, 11.1, 11.2, 11.3, 11.4, 11.6, 12.1, 12.2, 12.3, 12.4, 12.5
**Course Outcomes:** After studying this course, students will able to;

1. Define OS and explain organization of computer system, and components, computing environments, & typical structure of OS.
2. Analyze the process management, process scheduling and threads.
3. Describe the concepts of process synchronization and analyze the problems of synchronization
   1. Evaluate, prevent and avoid the deadlocks
   2. Develop the techniques of memory allocation and paging
   3. Apply appropriate disk scheduling algorithms.
4. Describe the interfaces to file systems, file structure and implement file systems and directory structure.

**Question Paper Pattern:**
- The question paper will have TEN questions.
- Each full question carry 20 marks
- There will be TWO full questions (with maximum of THREE sub questions) from each module.
- Each full question will have sub 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:**

**Reference Books:**
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<tbody>
<tr>
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<td>60</td>
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</tr>
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</table>

### Module -1
**Fundamentals of Robotics & Automation:** Automation and robotics, history of robotics, robotics market and future prospects, robot anatomy, work volume, robot drive systems, control systems, precision of movement, end effectors, robotic sensors, robot programming and work cell control, robot applications [Textbook-1]

**Automation Concepts:** SCADA, introduction and brief history of SCADA, SCADA systems software, distributed control system (DCS), introduction to the PLC, considerations and benefits of SCADA system. [Textbook-2]

### Module -2
**Robot Motion Analysis, Sensors and Control:** Introduction to manipulator kinematics, homogeneous transformations and robot kinematics, manipulator path control, robot dynamics, configuration of a robot controller, types of end effecters, mechanical grippers, other types of grippers, tools as end effectors, robot/end effector interface, consideration in gripper selection and design, problems.

**Sensors in Robotics:** Transducers and sensors, sensors in robotics, tactile sensors, proximity and rangesensors, uses of sensors in robotics. [Textbook-1]

### Module -3
**Machine Vision, Robot Programming & Artificial Intelligence:** Introduction to machine vision, sensing and digitizing function in machine vision, image processing and analysis, training the vision system, robotic applications, problems. Robot Programming: Methods of robot programming, lead-through programming methods, a robot program as a path in space, motion interpolation, wait, signal and delay commands, branching, capabilities and limitations of lead-through methods, problems.

**Artificial Intelligence (AI):** Introduction & goals of AI in research, AI techniques, LISP programming, AI & robotics, LISP in factory, robotic paradigms. [Textbook-1]

### Module -4
**Robotics in Manufacturing/Automation, Material Transfer, Machine Loading/Unloading:** Robot cell layouts, multiple robots and machine interference, considerations in work-cell design, work-cell control, interlocks, error detection and recovery, work-cell controller, robot cycle time analysis, graphic simulation of robotic work-cells, problems.

**Material Transfer, Machine Loading/Unloading:** General considerations in robot material handling, material transfer applications, machine loading and unloading. [Textbook-1]

### Module -5
**Robots in Automatic Processing Operations, Assembly & Inspection:** Introduction, spot welding, continuous arc welding, spray coating, other processing operations. Assembly and robotic assembly
automation, parts presentation methods, assembly operations, compliance and remote center compliance (RCC) device, assembly system configurations, adaptable programmable assembly system, designing for robotic assembly, inspection automation. [Textbook-1]

**Autonomous Mobile Robots: Introduction, Planning & Navigation:** Introduction, basic control scheme for mobile robots (only basic understanding of perception, localization, path planning & motion control). [Textbook-3]

<table>
<thead>
<tr>
<th>Course Outcomes: After studying this course, students will able to:</th>
</tr>
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<tbody>
<tr>
<td>1. Identify basic components of robot system and its functionality</td>
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<tr>
<td>2. Analyze the functions of sensors in the robot.</td>
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<tr>
<td>3. Solve forward and inverse kinematic problems.</td>
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<tr>
<td>4. Evaluate and compare the use Robots in different applications.</td>
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<tr>
<td>5. Recognize material-handling applications, processing operations, assembly and inspection operations to increase product quality and uniformity in minimize cycle times and effort.</td>
</tr>
</tbody>
</table>

**Question Paper Pattern**
- The question paper will have TEN questions.
- Each full question carry 20 marks.
- There will be TWO full questions (with maximum of THREE sub questions) from each module.
- Each full question will have sub 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:**

**Reference Books:**
**Power Electronics, Controls and Communication Lab**

<table>
<thead>
<tr>
<th>Subject Code</th>
<th>CIE Marks</th>
<th>Number of Tutorial+Practical Hours/Week</th>
<th>SEE Marks</th>
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<th>Exam Hours</th>
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<td>40</td>
<td>02+02</td>
<td>60</td>
<td>42</td>
<td>03</td>
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</table>

**Credits:** 2

1. Static VI characteristics of SCR.
2. Static VI characteristics of Triac. (First and Third mode only).
3. Controlled half wave rectifier using R & RC triggering.
4. AC voltage controller using Triac&Diac.
5. Full wave controlled rectifier using one SCR and four diodes.
6. To determine the step response of 1st order system using RC circuit and to measure time constant.
7. To determine the step response of 2nd order system using RLC circuit and to determine Time domain specifications for under damped and critically damped conditions. Verification using theoretically calculated values.
8. To study the frequency response of Lag, Lead and Lag-lead Network.
9. Characteristics of IGBT and MOSFET.
10. Stability analysis of a given Transfer Function based on Bode plot / Root locus / Nyquist plots using Matlab / Lab VIEW codes.
11. To design and test tuned amplifier using BJT/FET/ MOSFET.
12. Amplitude modulation using transistor/FET/ MOSFET (Generation and detection).
13. Frequency modulation using IC 8038/2206 and demodulation.
14. ASK & FSK: Generation and Detection.

**Course Outcomes:** After the completion of this Laboratory course, students will be able to:
1. Recognize and demonstrate functioning of semiconductor power devices.
2. Evaluate the characteristics, switching, power conversion and control by semiconductor power devices.
3. Design and analyze 1st and 2nd order control system, compensators and controllers, and evaluate stability of a system.
4. Design and verify the frequency tuning, AM and FM circuits used in communication systems.
5. Apply the concepts to build power electronic circuits, control and communication systems.

**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. Electronics and Instrumentation Engineering (EI)
Choice Based Credit System (CBCS)
Semester - VI

JAVA Programming Lab
(Common to EI, BM & ML)

<table>
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<tr>
<th>Subject Code</th>
<th>CIE Marks</th>
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<tr>
<td>18EI/BM/MLL7</td>
<td>40</td>
<td>60</td>
<td>03</td>
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</table>

Number of Tutorial+Practical Hours/Week: 02+02
Total No. of Practical hours: 42
Credit-2

1) a. Write a java Program to illustrate the creation of variables of basic types and effect of type conversions.  
b. Write a java Program that display the roots of a quadratic equation ax^2+bx=0. Calculate the discriminate D and based on value of D, describe the nature of root.

2) a. Write a java program to demonstrate creation and accessing of objects and methods.  
b. Write a java program to illustrate use of constructor overloading and method overloading.

3) a. Write a java Program to demonstrate the concept of single Inheritance.  
b. Write a java program to implement multi level Inheritance.

4) Write a simple Program on Java to illustrate the implementation of the concept of multiple inheritance using interfaces.

5) a. Write a java program to demonstrate StringMethods used for manipulating strings like accessing, inserting, modifying and appending.  
b. Write a java program to illustrate use of most commonly used wrapper class methods.

6) Write a Java program to implement the concept of importing classes from user defined package and creating packages.

7) Write a Java program using Synchronized Threads, which demonstrates Producer Consumer concept.

8) a. Write a Java program for creation of Java Built-in Exceptions.  
b. Write a Java program for creation of User Defined Exceptions.

9) Complete the following:  
i. Create a package named shape.  
ii. Create some classes in the package representing some common shapes like Square, Triangle, and Circle.  
iii. Import and compile these classes in other program

10) a. Write a Java program to copy bytes from one file to another using FileInputStream and FileOutputStream.  
b. Write a Java program to illustrate the process of file concatenation and buffering.

11) Write a Java applet program, which handles keyboard event.

12) Write an Applet that displays —Hello World( Background color-black, text color-blue and your name in the status window.).

13) Write a Java Program to demonstrate Mouse events.

14) Write programs for using Graphics class  
i. To display basic shapes and fill them  
ii. Draw different items using basic shapes  
iii. set background and foreground colors.

Assignment: Create simple JAVA or Android Calculator console application which performs both basic
and scientific operation.

<table>
<thead>
<tr>
<th>Course Outcome: After the completion of this Laboratory course, students will be able to:</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. To Understand OOPs concepts and basics of Java programming.</td>
</tr>
<tr>
<td>2. To Create Java programs using inheritance and polymorphism.</td>
</tr>
<tr>
<td>3. To Implement error-handling techniques using exception handling and multithreading.</td>
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<tr>
<td>4. To Develop GUI using Applets and Swing components.</td>
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<tr>
<td>5. Analyze, design and develop solutions to real-world problems applying OOPs concepts through JAVA.</td>
</tr>
</tbody>
</table>

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<td>• All laboratory experiments are to be included for practical examination.</td>
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<td>SEE Marks</td>
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<tr>
<td>Total Number of Lecture Hours</td>
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<tr>
<td>Exam Hours</td>
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</table>

**Credits – 2**

**Mini-project work:**
Based on the ability/abilities of the student/s and recommendations of the mentor, a single discipline or a multidisciplinary Mini-project can be assigned to an individual student or to a group having not more than 4 students.

**CIE procedure for Mini-project:**

(i) **Single discipline:** The CIE marks shall be awarded by a committee consisting of the Head of the concerned Department and two senior faculty members of the Department, one of whom shall be the Guide.  
The CIE marks awarded for the Mini-project work, shall be based on the evaluation of project report, project presentation skill and question and answer session in the ratio 50:25:25. The marks awarded for the project report shall be the same for all the batch mates.

(ii) **Interdisciplinary:** Continuous Internal Evaluation shall be group wise at the college level with the participation of all the guides of the college.  
The CIE marks awarded for the Mini-project, shall be based on the evaluation of project report, project presentation skill and question and answer session in the ratio 50:25:25. The marks awarded for the project report shall be the same for all the batch mates.

**SEE for Mini-project:**

(i) **Single discipline:** Contribution to the Mini-project and the performance of each group member shall be assessed individually in the semester end examination (SEE) conducted at the department.

(ii) **Interdisciplinary:** Contribution to the Mini-project and the performance of each group member shall be assessed individually in semester end examination (SEE) conducted separately at the departments to which the student/s belong to.
**Internship**

**Internship:** All the students admitted to III year of BE/B.Tech shall have to undergo mandatory internship of 4 weeks during the vacation of VI and VII semesters and/or VII and VIII semesters. A University examination shall be conducted during VIII semester and the prescribed credit shall be included in VIII semester. Internship shall be considered as a head of passing and shall be considered for the award of degree. Those, who do not take-up/complete the internship shall be declared fail and shall have to complete during subsequent University examination after satisfying the internship requirements.
### Automation in Process Control

<table>
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<th>Subject Code</th>
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<tr>
<td>:18EI71</td>
<td>: 40</td>
<td>: 60</td>
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**Module -1**

**Introduction to Programmable Logic Controllers (PLC):** The digital concept, Analog signals, The input status file, the output status file, input and output status file, sixteen point I/O modules, PLC addressing, PLC memory.

**Input modules:** Discrete input modules, Discrete AC and DC input modules

**Output modules:** Discrete output modules, solid-state output module switching, relay output modules

**Module -2**

**PLC Instructions:** What is logic?, PLC programming languages, ladder programming- Conventional ladder Vs PLC ladder, the basic relay instructions: Normally open and normally closed, output and latching instructions, series and parallel function of AND, OR, NOT, XOR logic, Analysis of rung. Understanding relay instructions and the PLC input modules, interfacing start stop pushbutton and motor to PLC, developing ladder diagrams with analytical problems.

**Module -3**

**Timers and Counter Instructions:** Timer addressing, On delay, off delay and retentive timer instructions and associated status bits. Counter addressing, PLC counter up and down instructions and associated status bits.

**Data Handling Instructions:** Data handling instructions-MOVE, Masked Move, COPY. Sequencer instructions: Programming sequence output instructions, developing ladder diagram with analytical.

**Module -4**

**Distributed Digital Control:** Introduction, History, Functional requirements of Distributed Process Control System, System Architecture, Distributed Control Systems, Configuration, Some popular Distributed Control Systems, Field bus System

**Text 2:** Ch.7; 7.1 To 7.8

**Module -5**

**Supervisory Control and data Acquisition System:** Basic Functions: Channel Scanning, conversion to Engineering units, Data Processing, Distributed SCADA System, Remote Terminal Unit, Reliable System Development Strategy.

**Modeling and Simulation for Plant Automation:** Introduction, Overview of Process Models, Model Based Automatic Control, System Modeling, uses of systems simulation, How to build the mathematical model of a plant, Model evaluation & improvement, Modern tools for modeling and simulation of systems.

**Text 2:** Ch.3; 3.6,3.7, 3.8 (3.8.1- 3.8.7), and Ch.11; 11.1,11.2,11.3,11.5,11.6,11.7,11.8,11.9
Note: Minimum ONE industrial visit need to be organized to see automation of process industries based on PLC, SCADA and DCS.

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

1. Describe architecture, functioning and applications of PLC in automation.
2. Recognize various I/O modules of PLC and apply programming concepts to interface peripherals.
3. Write ladder diagram program using different PLC instruction sets
4. Develop an automation system based on PLC ladder diagram program.
5. Analyze the basics of distributed control system and communication protocols used in automation industries.
6. Develop process automation system using SCADA and DCS.
7. Develop models of process automation using modern tools.

**Question Paper Pattern**

- The question paper will have TEN questions.
- Each full question carry 20 marks.
- There will be TWO full questions (with maximum of THREE sub questions) from each module.
- Each full question will have sub 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:**

1. Introduction to Programmable Logic Controllers, Garry Dunning, 3rd edition, Centage Learning. (Modules: 1, 2 & 3).
2. Computer based Industrial Control, Krishna Kant, 2nd edition, PHI, 2017 (Modules: 4 & 5)

**Reference Books:**

2. T.A. Hughes, Programmable Controllers, Fourth edition, ISA press, 2005
## B.E. Electronics and Instrumentation Engineering (EI)
### Choice Based Credit System (CBCS)
#### Semester - VII

**ARM Processor**  
(Common to EI, BM & ML)

| Subject Code | : 18 EI/BM/ML72 | CIE Marks | : 40 |
| Number of Lecture + Tutorial Hours /Week | : 2+2 | SEE Marks | : 60 |
| Total Number of Lecture Hours | : 40 | Exam Hours | : 03 |

**Credits – 3 (Each module – 8 Hours)**

### Module -1
#### ARM Embedded Systems
Introduction, RISC design philosophy, ARM design philosophy, Embedded system hardware - AMBA bus protocol, ARM bus technology, Memory, Peripherals, Embedded system software – Initialization (BOOT) code, Operating System, Applications.

#### ARM Processor Fundamentals
ARM core dataflow model, registers, current program status register, Pipeline, Exceptions, Interrupts and Vector Table, Core extensions.

### Module -2
#### Introduction to the ARM Instruction set:
Introduction, Data processing instructions, Load - Store instruction, Software interrupt instructions, Program status register instructions, Loading constants, ARMv5E extensions, Conditional Execution.

### Module -3
#### Introduction to the THUMB instruction set:
Introduction, THUMB register usage, ARM – THUMB interworking, Other branch instructions, Data processing instructions, Stack instructions, Software interrupt instructions.

#### Efficient C Programming:
Overview of C Compilers and optimization, Basic C Data types, C looping structures.

### Module -4
#### Exception and Interrupt Handling:
Exception Handling-ARM Processor Exceptions and Modes, Vector Table, Exception Priorities, Link Register Offset, Interrupts- Interrupt Latency, Basic Interrupt Stack design and implementation, Interrupt Handling Scheme- Non nested Interrupt Handler, Nested Interrupt Handler, Reentrant Interrupt Handler, Prioritized Simple Interrupt Handler, Prioritized Standard Interrupt Handler, Prioritized Direct Interrupt Handler, Prioritized Grouped Interrupt Handler.

#### Embedded Operating Systems:
Fundamental Components, SLOS Directory Layout, Memory Interrupts and Exceptions handling, scheduler, Context Switch, Device Driver Framework.

### Module -5
#### CACHES:
The memory Hierarchy and caches memory-caches and memory management units, Cache Architecture- basic architecture of caches memory, basic operation of cache controller, the relationship between cache and main memory.

#### Memory Management Units:
### Moving from an MPU to an MMU

Virtual memory Working-Defining regions using pagers, multitasking and the MMU, Memory organization in a virtual memory system, page tables Translational look aside buffer.

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**Note:** Two or four tutorial classes need to be conducted (in a semester) to discuss the Embedded ARM Applications, such as GSM Chip and Bluetooth controller & assignment should be based on applications only.

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

1. Depict the organization, architecture, bus technology, memory and operation of the ARM microprocessors
2. Employ the knowledge of Instruction set of ARM processors to develop basic Assembly Language Programs
3. Recognize the importance of the Thumb mode of operation of ARM processors and develop C programs for ARM processors
4. Describe the techniques involved in Exception and Interrupt handling in ARM Processors and understand the fundamental concepts of Embedded Operating Systems
5. Develop embedded C programs to interact with Built in Peripherals
6. Design, analyze and write programs using RTOS (MicroC/OS) on ARM based development boards.

**Question Paper Pattern**
- The Question paper will have TEN questions
- Each full question carry 20 marks
- There will be TWO full questions (with maximum of THREE sub questions) from each module.
- Each full question will have sub questions covering all topics under a module.
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**Text Books:**

**Reference Books:**
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<th>Subject Code</th>
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<tr>
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</table>

**Module 1**

**Introduction:** Introduction to Mechatronics, Design process, Systems, Measurement systems, Control systems, Examples of mechatronic systems: Digital camera with autofocus, Engine management system.

**Sensors and Transducers** (only selected topics): Smart sensors, Pneumatic sensors, Proximity switches, Pyroelectric sensors, Piezoelectric sensors, Tactile sensor. [Textbook-1]

**Module 2**

**Pneumatic And Hydraulic Actuation Systems:** Actuation systems, Pneumatic and hydraulic systems, Directional control valves, Pressure control valves, Servo and proportional control valves, Process control valves, Rotary actuators.

**Mechanical Actuation Systems:** Mechanical systems, Types of motion, Kinematic chains, Cams, Gears, Belt and chain drives, Bearings.[Textbook-1]

**Module 3**

**Electrical Actuation Systems:** Electrical systems, Mechanical switches, Solenoids, D.C. motors, A.C. motors, Stepper motors.

**Fault Finding:** Fault-detection techniques, Watchdog timer, Parity and error coding checks, Common hardware faults, Microprocessor systems, Emulation and simulation. [Textbook-1]

**Module 4**

**Interfacing Microcontrollers with Actuators:** Introduction, Interfacing with general purpose three state transistors. Interfacing relays, Interfacing solenoids, Interfacing stepper motors, interfacing permanent magnet motors, Interfacing sensors, Interfacing with DAC, interfacing power supplies, Compatibility at an interface.

**Reliability:** Meaning of reliability, The life curve, Repairable and non-repairable systems, Failure or hazard rate models, Reliability systems, Response surface modeling. [Textbook-2]

**Module 5**

**Components Based Modular Design and System Validation:** Introduction, Components based modular design view, System validation, Validation methodology, Validation scheme, Fusion technique-An example with vision system.

**Integration:** Introduction, Background, Advanced actuators, Industrial robot, Autonomous guided vehicle (AGV), Drilling machine for PCB board. [Textbook-3]

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

1. Describe and analyze the mechatronic systems and their associated systems
2. Discuss and illustrate different types of actuation systems that can be employed in a mechatronic system.
3. Demonstrate the integration of mechatronic systems.
4. Identify and solve the faults in mechatronic systems and assess the reliability.
5. Design and develop microcontroller and actuator based mechatronic system.
6. Design modular system and perform validation.

Question Paper Pattern
- The question paper will have TEN questions.
- Each full question carry 20 marks.
- There will be TWO full questions (with maximum of THREE sub questions) from each module.
- Each full question will have sub 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:

Reference Books:
### Power Plant Instrumentation

<table>
<thead>
<tr>
<th>Subject Code</th>
<th>CIE Marks</th>
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<th>Exam Hours</th>
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<td>40</td>
<td>2+2</td>
<td>60</td>
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</table>

**Credits – 3 (Each module – 08 Hours)**

#### Module -1
**Coal Based Thermal Power Plants:** Rankine cycle - improvisations, Layout of modern coal power plant, Super Critical Boilers, FBC Boilers, Turbines, Condensers, Steam & Heat rate, Subsystems of thermal power plants – Fuel and ash handling, Draught system, Feed water treatment. Binary Cycles and Cogeneration systems.

#### Module -2

#### Module -3

#### Module -4
**Power From Renewable Energy:** Hydro Electric Power Plants – Classification, Typical Layout and associated components including Turbines. Principle, Construction and working of Wind, Tidal, Solar Photo Voltaic (SPV), Solar Thermal, Geo Thermal, Biogas and Fuel Cell power systems.

#### Module -5
**Energy, Economic And Environmental Issues Of Power Plants:** Power tariff types, Load distribution parameters, load curve, Comparison of site selection criteria, relative merits & demerits, Capital & Operating Cost of different power plants. Pollution control technologies including Waste Disposal Options for Coal and Nuclear Power Plants.

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

1. Identify the resources of power generation and implementation
2. Describe the installation, operation, maintenance and control of coal based power plant
3. Recognize various analyzer for monitoring impurity, feed water and flue gas etc.
4. Evaluate the safety and boiler control system in power plants
5. Apply the knowledge to design, install, control and monitor the power plants as per the natural resources.

**Note:** Faculty members are advised to take the students to power generation stations/plants and assignments can be based on these visits.
**Question Paper Pattern**
- The question paper will have TEN questions.
- Each full question carries 20 marks.
- There will be TWO full questions (with a maximum of THREE subquestions) from each module.
- Each full question will have subquestions covering all the topics under a module.
- The students will have to answer FIVE full questions, selecting ONE full question from each module.

<table>
<thead>
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<th>Text Books:</th>
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<table>
<thead>
<tr>
<th>Reference Books:</th>
</tr>
</thead>
<tbody>
<tr>
<td>2. Thermal Engineering, R. K. Rajput, Laxmi Publication</td>
</tr>
</tbody>
</table>
B.E. Electronics and Instrumentation Engineering (EI)  
Choice Based Credit System (CBCS)  
Semester - VII

### Advanced Control Systems

<table>
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Credits – 3 (Each module – 8 Hours)

#### Module -1
**Design of Lag/Lead/Lag-lead compensators using Frequency domain (Bode plot) technique:** Lead, lag, lead lag network and compensator design using Bode techniques. Numerical problems  
**Text 1:** 9.1, 9.2, 9.3, 9.4.

#### Module -2
**Design of Lag/Lead/Lag-lead compensators using Root Locus technique:** Lead, lag, lead lag network and compensator design using Root locus techniques. Numerical problems  
**Text 1:** 7.1, 7.2, 7.3, 7.4, 7.5.

#### Module -3
**Nonlinear Systems:** Introduction, Common physical nonlinearities, phase-plane Method: Basic concepts, singular points, Stability of non-linear system, Construction of phase trajectories (by analytical method only).  
Describing function Method: Basic Concepts, Derivation of describing functions, Stability Analysis by Describing function Method,  
**Text 3:** 17.1, 17.2, 17.7, 17.8, 17.9

#### Module -4
**Text 2:** 1.1, 1.2, 3.2, 3.4, 3.5, 4.3.

#### Module -5
**State space Analysis:** State-Space representations of continuous and discrete-Time systems, Solving Discrete-time state space equations, Controllability, Observability. Numerical problems  
**Text 2:** 5.1, 5.2, 5.3, 6.2, 6.3.

### Course Outcomes:
After studying this course, students will be able to:
1. Explain concepts of Lag, Lead and lag-Lead networks and their design and implementation in controls systems  
2. Design of control system for given time domain and frequency domain specifications  
3. Describe the concept of nonlinearity and linearity of systems and stability analysis  
4. Describe the concept of discrete control system, transform function and solutions and stability analysis  
5. Develop model of physical process in state space form and solve state space equations.
6. Test the controllability and observability of a system.

**Question Paper Pattern**

- The question paper will have TEN questions.
- Each full question carry 20 marks
- There will be TWO full questions (with maximum of THREE sub questions) from each module.
- Each full question will have sub 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:**


**Reference Books:**

B.E. Electronics and Instrumentation Engineering (EI)
Choice Based Credit System (CBCS)
Semester – VII

Electrical Machines and Drives

Subject Code : 18EI734
CIE Marks : 40

Number of Lecture + Tutorial Hours/ Week : 2+2
SEE Marks : 60

Total Number of Lecture Hours : 40
Exam Hours : 03

Credits – 3 (Each module – 08 Hours)

Module -1
Electrical Circuits and Transformers: Ohms law, series and parallel circuits Kirchhoff’s law mesh analysis, A.C. voltage – sinusoidal waves, power factor complex power Basic operation of transformers, EMF equation, Turns ratio, Losses and efficiency – simple problems

Module -2
Electrical Motors: Constructional details, principle of operation and performance characteristics of D.C. motors, single phase induction motor, three phase induction motor, synchronous motors, universal motors, stepper motors and reluctance motor

Module -3

Module -4
Electrical Drives: Type of Electrical Drives – Selection & factors influencing the selection – heating and cooling curves – loading condition and classes of duty – determination of power rating – simple problems

Module -5
Solid State Drives (Qualitative Treatment Only): Advantages of solid state drives – D.C. motor control using rectifiers and choppers – control of induction motor by V, V/f and slip power recovery scheme using inverters and A.C. power regulators

Course Outcomes:
After studying this course, students will be able to:
1. Formulate and analyze the basic construction, working principle and characteristics of various electrical machines.
2. Evaluate the performance characteristics of motor drives for mechanical load requirements to design torque, speed and position controller in an energy efficient manner
3. Describe the various electrical drives with basic structure, operation and characteristics.
4. Analyze the structure of electric drive systems and their role in various applications and requirements placed by mechanical systems on electric drives.
5. Illustrate the basic concepts of solid-state drives in controlling of DC motor and induction motors.
6. Design and install electrical machines and drives in an industrial environment.

Question Paper Pattern
- The question paper will have TEN questions.
- Each full question carries 20 marks
- There will be TWO full questions (with a maximum of THREE sub questions) from each module.
- Each full question will have sub 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:**

**Reference Books:**
B.E. Electronics and Instrumentation Engineering (EI)
Choice Based Credit System (CBCS)
Semester - VII

Smart Sensors and Intelligent Instrumentation

<table>
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<td>40</td>
<td>Exam Hours</td>
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</table>

Credits – 3 (Each module – 08 Hours)

Module -1
Basics of smart sensors and micromachining: Introduction, Mechanical-Electronic transitions in sensing, nature of sensors, overview of smart sensing and control systems, integration of micromachining and microelectronics, introduction to micromachining, bulk micromachining, wafer bonding, surface micromachining, other micromachining techniques.

Module -2
MCUs and DSPs for sensor: Introduction, MCU control, MCUs for sensor interface, DSP control, Software, tools and support, sensor integration.

Module -3

Module -4

Module -5
Implications of Smart Sensor Standards and Recent Trends: Introduction, sensor plug-and-play, communicating sensor data via existing wiring, automated/remote sensing and web, process control over the internet, alternative standards, HVAC sensor chip, MCU with integrated pressure sensors, alternative views of smart sensing, smart loop.

Course Outcomes: After studying this course, students will be able to:
1. Describe the principle of smart sensors and process of micromachining in development of smart sensors.
2. Develop intelligent systems by interfacing the smart sensors to MCUs and DSPs.
3. Analyze the use of smart sensors in communication, MEMS and automation.
4. Evaluate the standards of smart sensors by the assessment of reliability testing and packaging.
5. Discuss the applications of smart sensors in different fields and recent development.
6. Develop/sketch the simple models of intelligent instrumentation.
<table>
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<th>Question Paper Pattern</th>
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<td>• The question paper will have TEN questions.</td>
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<td>• The students will have to answer FIVE full questions, selecting ONE full question from each module.</td>
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<table>
<thead>
<tr>
<th>Text Books:</th>
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<table>
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<tr>
<th>Reference Books:</th>
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</thead>
</table>
Module -1
Introduction: The nature of biomedical signals, objectives of biomedical signal analysis, difficulties encountered in biomedical signal analysis, Computer aided diagnosis. Text-1: 1.1, 1.3, 1.4, 1.5
Text-2: 4.1 to 4.9

Module -2
Filtering for Artifacts Removal: Random noise, structured noise and physiological interference, stationary versus non-stationary processes, typical case study, time domain filters with application: Synchronized averaging, moving-average filters. Frequency domain filters with examples, removal of high frequency noise by Butterworth low pass filters, removal of low frequency noise by Butterworth high pass filter, removal of periodic artifacts by notch and comb filters. Weiner filter Text-1: 3.1, 3.1.1, 3.1.2, 3.3, 3.3.1, 3.3.2, 3.3.3, 3.4, 3.4.1, 3.4.2, 3.4.3, 3.5.

Module-3
Basics of signal averaging, Signal averaging as a digital filter, A typical average, Software for signal averaging, Limitations of signal averaging.
Text-3: 9.1 to 9.5
Data Acquisition and classification of sleep stages, The Markov model and Markov chains, Dynamics of Sleep-wave Transitions, Hypnogram Model Parameters.
Text-2: 5.1 to 5.4

Module -4
ECG Parameters and their estimation, A review of wiener filtering problem, Principle of an adaptive filter, the steepest descent algorithm, Adaptive noise canceller, Cancellation 60Hz Interference in ECG, Cancelling Donor heart Interference in Heart-transplant ECG, Cancellation of Electrocardiographic signals from the electrical activity of chest muscles, Cancelling of maternal ECG in Fetal ECG, Cancellation of higher frequency noise in electro-surgery.
Text-2: 7.4, 6.1, 6.2, 6.3, 6.5, 6.6.

Module -5
Direct data compression techniques, Direct ECG data compression techniques, Transformation compression techniques, Other data compression techniques, Data compression techniques comparison.
Text-2: 8.1 to 8.5
### Course Outcomes:
After studying this course, students will be able to:
1. Discuss the origin, nature and characteristics of biomedical signals.
2. Identify the noise and artifacts in biomedical signals and apply suitable filters remove.
3. Apply the signal averaging technique.
4. Evaluate various event detection techniques for the analysis of the EEG and ECG.
5. Apply different data compression techniques on biomedical Signals.
6. Develop algorithms to process and analyze biomedical signals for better diagnosis.

### Question Paper Pattern
- The question paper will have TEN questions.
- Each full question carry 20 marks
- There will be TWO full questions (with maximum of THREE sub questions) from each module.
- Each full question will have sub 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:
1. Biomedical signal analysis- A case study approach, Rangayyan Rangaraj, Wiley Inderscience (IEEE Press)-2005
3. Biomedical Digital Signal Processing-Willis J.Tompkins, PHI.

### Reference Books:
B.E. Electronics and Instrumentation Engineering (EI)  
Choice Based Credit System (CBCS)  
Semester - VII  

Computer Communication Networks  

<table>
<thead>
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</tr>
<tr>
<td>Credits – 3 (Each module – 08 Hours)</td>
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Module -1  
**Introduction:** Uses of Computer Networks, Network Hardware, Network Software, Reference Models, Example Networks, Network Standardization  
**The Physical Layer:** The Theoretical Basis for Data Communication, Guided Transmission Media, Wireless Transmission, Communication Satellites, The Public Switched Telephone Network,  

Module -2  
**The Data Link Layer:** Data Link Layer Design Issues, Error Detection and Correction, Elementary Data Link Protocols, Sliding Window Protocols, Protocol Verification, Data Link Protocols  

Module -3  
**The Medium Access Control Sub Layer:** The Channel Allocation Problem, Multiple Access Protocols, Ethernet, Wireless LANS Broadband Wireless, Bluetooth  

Module -4  

Module -5  
**The Application Layer:** Domain Name System (DNS), electronic mail, worldwide web.  

Course Outcomes: After completion of this course the student is able to:  
1. Describe the basic computer network technology.  
2. Identify and analyze the different network topologies and protocols.  
3. Analyze the different network devices and their functions within a network.  
4. Apply the knowledge in the establishing computer based networks in real world problems.  

Question Paper Pattern  
- The question paper will have TEN questions.  
- Each full question carry 20 marks  
- There will be TWO full questions (with maximum of THREE sub questions) from each module.  
- Each full question will have sub questions covering all the topics under a module.  
- The students will have to answer FIVE full questions, selecting ONE full question from each module.
<table>
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# Internet of Things

(Common to EI, BM & ML)

<table>
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<tr>
<td>Lecture Hours</td>
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**Credits – 3 (Each module – 8 Hours)**

**Course Learning Objectives:** This course will enable the students to
- Assess the genesis and impact of IoT applications, architectures in real world
- Illustrate diverse methods of deploying smart objects and connect them to network
- Compare different application protocols for IoT
- Infer the role of Security in IoT
- Identify sensor technologies for sensing real world entities and understand the role of IoT in various domains of Industry

**Module -1**

**Introduction and IoT:** Introduction to IoT, IoT Ecosystem, IoT Reference model

Text 1-Chapter 1

**Module -2**


Text 1-Chapter 2

**Module -3**

**IoT Protocols:** Protocol Classification, MQTT, XMPP, DDS, AMQP, COAP, Representational State Transfer( REST), Comparison of the Protocols

Text 1-Chapter 3

**Module -4**

**Domain Specific IoT:** Introduction, Home automation, Smart Cities, Environment, Retail, Logistics, Agriculture, Health and Life style

Text 1-Chapter 4

**Public Safety:** Overview of Public Safety, an IoT Blueprint for Public Safety, Emergency Response IoT Architecture, IoT Public Safety Information Processing, School Bus Safety.

Text 2-Chapter 15

**Module -5**

Note: As a part of assignments, the students (in a group of 3 or 4) advised to carry out mini / hobby project using IoT technology.

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

- Interpret the impact and challenges posed by IoT networks leading to new architectural models.
- Compare and contrast the deployment of smart objects and the technologies to connect them to network.
- Appraise the role of IoT protocols for efficient network communication.
- Elaborate the need for security in IoT.
- Illustrate different sensor technologies for sensing real world entities and identify the applications of IoT in industry.

**Question Paper Pattern**

- The question paper will have TEN questions.
- Each full question carry 20 marks.
- There will be TWO full questions (with maximum of THREE sub questions) from each module.
- Each full question will have sub 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**


**Reference Books**

B.E. Electronics and Instrumentation Engineering (EI)  
Choice Based Credit System (CBCS)  
Semester - VII  

Process Control and Virtual Instrumentation Lab  

<table>
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<td>Exam Hours</td>
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</table>

Credits – 2

1. Rig up and test the circuit to display the temperature using RTD/Thermistor with suitable signal conditioning circuit.
2. Rig up and test the circuit to display the temperature using IC AD590 / LM35 with suitable signal conditioning circuit.
3. Rig up and test the circuit to display the load/strain using load cell/strain gauge with suitable signal conditioning circuits.
4. Realize Op-amp based Proportional (P), Derivative (D) and Integral (I) analog controller modes.
5. Realize Op-amp based PI and PD composite analog controller modes.
6. Conduct an experiment to perform and analyze PC based temperature/pressure controller. Plot the optimum response of different controller modes for different set-points.
7. Conduct an experiment to perform and analyze PC based level/flow controller. Plot the optimum response of different controller modes for different set-points.
8. Realization of basic gate functions using PLC. The logic should be solved using ladder diagram.  
   (i) AND  (ii) OR  (iii) NAND  (iv) XOR  (v) NOR  (vi) Latch and Unlatch of output
9. Study and demonstration of working of different types of Timers and Counters of PLC. The logic should be solved using ladder diagram.
10. Study and demonstration of Bottle Filling Process using PLC. The logic should be solved using ladder diagram.
11. Study and demonstration of Lift/Elevator System using PLC. The logic should be solved using ladder diagram.
12. Conduct an experiment to plot the characteristics of different type’s process control valves.
13. Basic operations, simple programming structure using LabVIEW.  
   (i) Basic arithmetic operations  
   (ii) Boolean operations  
   (iii) Sum of ‘n’ numbers using ‘for’ loop  
   (iv) Sorting even numbers using ‘while’ loop in an array
14. Creation of a CRO using LabVIEW and measurement of frequency and amplitude.
15. Data acquisition using LabVIEW for temperature measurement with thermocouple and AD590.
**Course Outcomes: After studying this course, students will able to:**

1. Design and evaluate signal conditioning circuits for given transducer/sensor.
2. Design and evaluate the controllers to obtain the optimal response.
3. Write ladder logic programs for specific applications using PLC.
4. Develop LabVIEW programs for specific applications.
5. Design and develop complete process control system for specific application.

**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. Electronics and Instrumentation Engineering (EI)
Choice Based Credit System (CBCS)
Semester - VII

ARM Processor Lab
(Common to EI, BM & ML)

<table>
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<td>40</td>
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</table>

Credits – 2

PART-A: Conduct the following experiments by writing Assembly Language Program (ALP) using ARM Cortex M3 Registers using an evaluation board/simulator and the required software tool.

1. Write an ALP to multiply two 16 bit binary numbers.
2. Write an ALP to find the sum of first 10 integer numbers.
3. Write an ALP to find factorial of a number.
4. Write an ALP to add an array of 16 bit numbers and store the 32 bit result in internal RAM.
5. Write an ALP to add two 64 bit numbers.
6. Write an ALP to find the square of a number (1 to 10) using look-up table.
7. Write an ALP to find the largest/smallest number in an array of 32 numbers.
8. Write an ALP to arrange a series of 32 bit numbers in ascending/descending order.
9. Write an ALP to count the number of ones and zeros in two consecutive memory locations.
10. Write an ALP to scan a series of 32 bit numbers to find how many are negative.

PART-B: Conduct the following experiments on an ARM CORTEX M3 evaluation board using evaluation version of Embedded 'C' &Keil Uvision-4 tool/compiler.

1. Display “Hello World” message using Internal UART.
2. Interface and Control a DC Motor.
3. Interface a Stepper motor and rotate it in clockwise and anti-clockwise direction.
4. Determine Digital output for a given Analog input using Internal ADC of ARM controller.
5. Interface a DAC and generate Triangular and Square waveforms.
6. Interface a 4x4 keyboard and display the key code on an LCD.
7. Using the Internal PWM module of ARM controller generate PWM and vary its duty cycle.
8. Demonstrate the use of an external interrupt to toggle an LED On/Off.
9. Display the Hex digits 0 to F on a 7-segment LED interface, with an appropriate delay in between.
10. Interface a simple Switch and display its status through Relay, Buzzer and LED.

Note:

1. More weightage should be given for PART-B experiments in the evaluation of Internal Assessment and Laboratory Examinations.
2. Introduction class on instruction set of Cortex M3 LPC1768 need to be conducted before start of hardware experiments.

Conduction of Practical Examination:

1. All laboratory experiments (Part-A + Part-B) are to be included for practical examination.
2. Students are allowed to pick & execute one experiment from each part.
3. Strictly follow the instructions as printed on the cover page of answer script for breakup of
marks.
4. Change of experiment is allowed only once and 15% of Marks allotted to the procedure part to be made zero.

**Course Outcomes:** After studying this course, students will be able to:
1. Write ALP for implementation of specific arithmetic or logical operations.
2. Write programs to demonstrate functioning of various devices interfaced to ARM processor.
3. Develop programs for ARM processors to implement real world problems.
4. Design and develop mini projects.
**Project Work Phase-1**

**Subject Code:** 18EIP78  
**CIE Marks:** 100  
**Number of Practical Hours/Week:** 02  
**SEE Marks:** --  
**Total Number of Lecture Hours:** --  
**Exam Hours:** --  
**Credits – 1**

**Project Work Phase-1:**  
Based on the ability/abilities of the student/s and recommendations of the mentor, a single discipline or a multidisciplinary project can be assigned to an individual student or to a group having not more than 4 students. In extraordinary cases, like the funded projects requiring students from different disciplines, the project student strength can be 5 or 6.

**CIE procedure for Project Work Phase -1:**

(i) **Single discipline:** The CIE marks shall be awarded by a committee consisting of the Head of the concerned Department and two senior faculty members of the Department, one of whom shall be the Guide.

The CIE marks awarded for the project work phase -1, shall be based on the evaluation of the project work phase -1 Report (covering Literature Survey, Problem identification, Objectives and Methodology), project presentation skill and question and answer session in the ratio 50:25:25. The marks awarded for the Project report shall be the same for all the batch mates.

(ii) **Interdisciplinary:** Continuous Internal Evaluation shall be group wise at the college level with the participation of all guides of the college. Participation of external guide/s, if any, is desirable.

The CIE marks awarded for the project work phase -1, shall be based on the evaluation of project work phase -1 Report (covering Literature Survey, Problem identification, Objectives and Methodology), project presentation skill and question and answer session in the ratio 50:25:25. The marks awarded for the project report shall be the same for all the batch mates.
Internship

**Internship:** All the students admitted to III year of BE/B.Tech shall have to undergo mandatory internship of 4 weeks during the vacation of VI and VII semesters and/or VII and VIII semesters. A University examination shall be conducted during VIII semester and the prescribed credit shall be included in VIII semester. Internship shall be considered as a head of passing and shall be considered for the award of degree. Those, who do not take-up/complete the internship shall be declared fail and shall have to complete during subsequent University examination after satisfying the internship requirements.
8th SEMESTER

B.E. Electronics and Instrumentation Engineering (EI)
Choice Based Credit System (CBCS)
Semester - VIII

Neural Network and Fuzzy Logic Systems

<table>
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<th>Subject Code</th>
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<th>Exam Hours</th>
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<td>18EI81</td>
<td>2+2</td>
<td>40</td>
<td>60</td>
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</tbody>
</table>

Credits – 3 (Each module – 8 Hours)

**Module -1**
**Introduction.** - Neural Networks, Application Scope of Neural Networks, Fuzzy Logic, Generic Algorithm, Hybrid Systems, Soft Computing.

**Artificial Neural Network: An Introduction.** - Fundamental Concept, Evolution of Neural Networks, Basic models of Artificial Neural Networks (ANN), Important Technologies of ANNs, McCulloch-Pitts Neuron, Linear Separability.

**Module -2**
Hebb Network and simple problems,
**Supervised Learning Network – Introduction** – Perceptron Networks, Adaptive Linear Neuron (Adaline), Multiple Adaptive Linear Neurons.

**Module -3**

**Module -4**
**Introduction to Fuzzy Logic, Classical sets and Fuzzy sets.**


**Module -5**
**Membership Functions** – Introduction, Features of the Membership functions, Fuzzication, Methods of Membership Value Assignments, Simple Problems

**Defuzzification** - Introduction, Lambda-cuts for Fuzzy sets (Alpha-Cuts), Lambda-Cuts for Fuzzy Relation, Defuzzification Methods.


**Course Outcomes:** After studying this course, students will be able to:
1. Compare and contrast the biological neural network and ANN.
2. Discuss the ANN for pattern classification.
3. Develop and configure ANN's with different types of functions and learning algorithms.
4. Apply ANN for real world problems.
5. Discuss the fundamentals of fuzzy logic, implementation and their functions.
6. Apply fuzzy logic concepts in building automated control systems.

**Question Paper Pattern**

- The question paper will have TEN questions.
- Each full question carry 20 marks
- There will be TWO full questions (with maximum of THREE sub questions) from each module.
- Each full question will have sub 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:**


**Reference Books:**

# Medical Imaging Techniques

<table>
<thead>
<tr>
<th>Subject Code</th>
<th>CIE Marks</th>
<th>SEE Marks</th>
<th>Exam Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>18EI821</td>
<td>40</td>
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<td>03</td>
</tr>
</tbody>
</table>

**Credits – 3 (Each module – 08 Hours)**

## Module-1

**X-Ray Imaging:** Definition of x-ray, Interactions between X-rays and matter, Intensity of X-ray beam, Attenuation, Generation and Detection of X-rays – X-ray generation, X-ray generators, Filters, Beam restrictors and grids, Intensifying screens, fluorescent screens, and image intensifiers, X-ray detectors.

**X-Ray Diagnostic Methods:** Conventional X-ray radiography, Fluoroscopy, Angiography, Mammography.

**Computed Tomography:** Conventional tomography, Computed tomography – Projection function, CT number. Recent developments – Digital radiography, Digital subtraction angiography (DSA). Biological effects of ionizing radiation.

## Module-2

**Ultrasound Imaging:** Definition of ultrasound, Fundamentals of acoustic propagation (only theoretical concepts, no derivations) - Reflection and refraction, Attenuation, absorption & scattering, Doppler effect, Generation and detection of Ultrasound-Piezoelectric effect, Ultrasonic transducers, Axial and Lateral resolution.

**Ultrasound Diagnostic Methods:** Pulse echo systems- Amplitude mode (A-mode), Brightness mode (B-mode), Motion mode (M-mode). Doppler methods, Duplex imaging, Colour Doppler flow imaging, Biological effects of ultrasound.

## Module-3

**Radionuclide Imaging:** Introduction, Fundamentals of Radioactivity: Nuclear particles, Nuclear activity and half-life, Units of measuring nuclear activity, Specific activity, Interaction of nuclear particles and matter, Attenuation of Gamma radiation, Radionuclides, Generation & Detection of Nuclear Emission – Nuclear sources, Radionuclide generators, nuclear radiation detectors, Collimators,

**Diagnostic Methods using Radiation Detector Probes:** Thyroid function test, Renal function test, Blood volume measurement, Radionuclide imaging systems- Rectilinear scanner, Scintillation camera, SPECT: Principle and working. PET: Principle and working.

## Module-4

**Basics of Magnetic Resonance Imaging:** Fundamentals of nuclear magnetic resonance- Angular momentum, magnetic dipole moment, magnetization, Larmor frequency, Free induction decay (FID), Fourier spectrum of the NMR signal, Relaxation times, Pulse sequences.

**Generation and Detection of NMR Signal:** Introduction (block diagram and working), Magnet, Imaging Methods- Introduction, slice selection, frequency encoding, phase encoding, Spin-Echo imaging- Gradient echo imaging. Biological effects of magnetic fields-Brief summary of all types of effects.

## Module-5

**Thermal Imaging & Advances in Medical Imaging**
**Thermal Imaging:** Medical thermography, Physics of thermography, Infrared detectors, Thermographic equipment, Quantitative medical thermography, Pyroelectric vidicon camera. Applications of thermal imaging medicine.

**Image Guided Intervention:** Introduction, Stereotactic neurosurgery, Stereotactic neurosurgery based on digital image volumes- image acquisition, planning and transfer, Intraoperative Imaging- Intraoperative diagnostic imaging.

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

1. Describe the fundamentals of x-ray radiography and computed tomography, and analyze the system requirements.
2. Explain principles of ultrasound imaging and diagnostic methods and analyze the system requirements.
3. Discuss the fundamentals of radionuclide imaging, MRI, thermal imaging and analyze the system requirements.
4. Describe the concepts of image Guided Intervention and image guided surgery.
5. Design and develop prototype of simple medical imaging system.

**Question Paper Pattern:**
- The question paper will have TEN questions
- Each full question carry 20 marks
- TWO full questions will be set (with maximum of THREE sub questions) from each module
- Covering all the topics under that module.
- The students will have to answer FIVE full questions, selecting one full question from each module.

**Text Books:**
# Industrial Process Instrumentation

<table>
<thead>
<tr>
<th>Subject Code</th>
<th>CIE Marks</th>
<th>SEE Marks</th>
<th>Exam Hours</th>
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</thead>
<tbody>
<tr>
<td>18E1822</td>
<td>40</td>
<td>60</td>
<td>03</td>
</tr>
</tbody>
</table>

**Credits – 3 (Each module – 08 Hours)**

**Module -1**  
**Food Industry Instrumentation:** Instrumentation in canning, baking, dairy industries.

**Module -2**  
**Paper and Pulp Instrumentation:** Different types of pulping, pulp bleaching, pulp blending, wet end and drier instrumentation.

**Module -3**  
**Cement Plants:** Objectives of automation system, automation strategy, Distributed Control System for Cement Plant- A case study.

**Module -4**  
**Thermal power plant Instrumentation:** Automation strategy, distributed system structure, Man-machine interface, software system, communication, advanced control systems.

**Module -5**  
**Steel Plant:** Automation strategy, production planning and area supervision, iron zone, steel zone, mill zone, utility zone.

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

1. Sketch the typical instrumentation and control strategy in the process industries like paper, pulp, cement, power and steel plants.
2. List the variable to be monitored and controlled in the above said process industries.
3. Describe the instrumentation, control requirements and complete functioning of the above said industries.
4. Analyze the hardware and software tools required for the above said process industries.
5. Design and develop instrumentation and control strategy for simple process industry.

**Question Paper Pattern**

- The question paper will have TEN questions.
- Each full question carry 20 marks
- There will be TWO full questions (with maximum of THREE sub questions) from each module.
- Each full question will have sub 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:**


Reference Books:

1. Donald P Eckman, "Industrial Instrumentation", J.Wiley
B.E. Electronics and Instrumentation Engineering (EI)
Choice Based Credit System (CBCS)
Semester – VIII

Instrumentation Buses and Industrial Data Networks

Subject Code : 18EI823

CIE Marks : 40

Number of Lecture + Tutorial Hours /Week : 2+2

SEE Marks : 60

Total Number of Lecture Hours : 40

Exam Hours : 03

Credits – 3 (Each module – 08 Hours)

Module -1

Module-2

Module -3

Module -4
Modbus and Profibus PA/DP/FMS:MODBUS protocol structure, function codes troubleshooting

Module -5

Course Outcomes: After studying this course, students will be able to:
1. Explain basic concepts of network hierarchy and switching.
2. Apply network data communication protocols.
3. Describe routers and gateways Standards followed in inter-networking.
4. Evaluate appropriateness of different industrial data networks.
5. Develop the various communication networks for industries.

Question Paper Pattern
- The question paper will have TEN questions.
- Each full question carry 20 marks
- There will be TWO full questions (with maximum of THREE sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer FIVE full questions, selecting ONE full question from each module.

<table>
<thead>
<tr>
<th>Text Books</th>
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<table>
<thead>
<tr>
<th>Reference Books</th>
</tr>
</thead>
</table>
B.E. Electronics and Instrumentation Engineering (EI)  
Choice Based Credit System (CBCS)  
Semester - VIII

## Artificial Intelligence and Machine Learning  
(Common to EI/BM/ML)

<table>
<thead>
<tr>
<th>Subject Code</th>
<th>CIE Marks</th>
<th>SEE Marks</th>
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</thead>
<tbody>
<tr>
<td>18EI/BM/ML824</td>
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</tbody>
</table>

**Number of Lecture + Tutorial Hours /Week:** 2+2  
**Total Number of Lecture Hours:** 40

### Credits – 3 (Each module – 08 Hours)

**Module -1**  
Artificial Intelligence: The AI Problems, the underlying Assumption, what is an AI technique? (Text 1-1.1,1.2,1.3)  
Natural Language Processing: Introduction, Steps in the Process. (Text 1-15.1,15.1.1)

**Module – 2**  
Parallel and Distributed AI: Psychological Modeling, Parallelism in Reasoning Systems, Distributed Reasoning Systems: Coordination and Cooperation. (Text 1-16.1,16.2,16.3,16.3.1)  
Connectionist Models: Introduction: Hopfield Networks, Connectionist AI and Symbolic AI. (Text 1-18.1,18.6)

**Module – 3**  
Genetic Algorithms (Gas): Learning: Generalization of an Input-Output table, Significance of the Genetic operators, Ant Algorithms (Text 1-23.2,23.2.2,23.3,23.8)  

**Module -4**  
Supervised Learning: Learning a class from examples, Noise, Learning Multiple classes, Regression, Model selection and Generalization, Dimensions of a supervised Machine learning Algorithm. (Text 2-1.1,1.2,1.2.1,2.4,2.5,2.6,2.7,2.8)

**Module -5**  
Dimensionality Reduction: Introduction, Subset selection, Principal Component analysis.  

### Course Outcomes:  
After studying this course, students will be able to
- Appraise the basics of Artificial intelligence and concepts of natural language processing.
- Illustrate the working of Parallel, Distributed and connectionist models of AI.
- Discuss the fundamentals of Genetic algorithms.
- Escalate the underlying mathematical relationships within and across Machine Learning algorithms and the paradigms of supervised learning.
- Explore the associated parameters of the Machine Learning algorithms viz., dimensionality
reduction, classification, etc.

**Question Paper Pattern**
- The question paper will have TEN questions.
- Each full question carry 16 marks
- There will be TWO full questions (with maximum of THREE sub questions) from each module.
- Each full question will have sub 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**

**Reference Books**
# Project Work Phase-2

<table>
<thead>
<tr>
<th>Subject Code</th>
<th>CIE Marks</th>
<th>SEE Marks</th>
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<tbody>
<tr>
<td>18EIP83</td>
<td>: 40</td>
<td>: 60</td>
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</tbody>
</table>

## Credits – 8

**Course Learning Objectives:**
- To support independent learning.
- To develop interactive, communication, organization, time management, and presentation skills.
- To impart flexibility and adaptability.
- To inspire independent and team working.
- To expand intellectual capacity, credibility, judgment, intuition.
- To adhere to punctuality, setting and meeting deadlines.
- To instill responsibilities to oneself and others.
- To train students to present the topic of project work in a seminar without any fear, face audience confidently, enhance communication skill, involve in group discussion to present and exchange ideas.

**Project Work Phase - II:** Each student of the project batch shall involve in carrying out the project work jointly in constant consultation with internal guide, co-guide, and external guide and prepare the project report as per the norms avoiding plagiarism.

**Course outcomes:** At the end of the course the student will be able to:
- Describe the project and be able to defend it.
- Develop critical thinking and problem solving skills.
- Learn to use modern tools and techniques.
- Communicate effectively and to present ideas clearly and coherently both in written and oral forms.
- Develop skills to work in a team to achieve common goal.
- Develop skills of project management and finance.
- Develop skills of self learning, evaluate their learning and take appropriate actions to improve it.
- Prepare themselves for life-long learning to face the challenges and support the technological changes to meet the societal needs.

**Evaluation Procedure:**
- **As per University guidelines**
- **Internal Marks:** The Internal marks (100 marks) evaluation shall be based on Phase wise completion of the project work, Project report, Presentation and Demonstration of the actual/model/prototype of the project.
- **Semester End Examination:** SEE marks for the project (100 marks) shall be based on Project report, Presentation and Demonstration of the actual/model/prototype of the project, as per the University norms by the examiners appointed VTU.
B.E. Electronics and Instrumentation Engineering (EI)
Choice Based Credit System (CBCS)
Semester - VIII

Technical Seminar

<table>
<thead>
<tr>
<th>Subject Code</th>
<th>CIE Marks</th>
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<tr>
<td>Lecture Hours</td>
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<tr>
<td>Credits – 1</td>
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</table>

Course Learning Objectives:
The objective of the seminar is to inculcate self-learning, face audience confidently, enhance communication skill, involve in group discussion and present and exchange ideas. Each student, under the guidance of a Faculty, is required to choose, preferably, a recent topic of his/her interest relevant to the course of specialization. Carry out literature survey; organize the Course topics in a systematic order.

- Conduct literature survey in the domain area to find appropriate topic.
- Prepare the synopsis report with own sentences in a standard format.
- Learn to use MS word, MS power point, MS equation and Drawing tools or any such facilities in the preparation of report and presentation.
- Present the seminar topic orally and/or through power point slides.
- Communicate effectively to answer the queries and involve in debate/discussion.

The participants shall take part in discussion to foster friendly and stimulating environment in which the students are motivated to reach high standards and become self-confident.

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

- Develop knowledge in the field of Electronics & Instrumentation Engineering and other disciplines through independent learning and collaborative study.
- Identify and discuss the current, real-time issues and challenges in engineering & technology.
- Develop written and oral communication skills.
- Explore concepts in larger diverse social and academic contexts.
- Apply principles of ethics and respect in interaction with others.
- Develop the skills to enable life-long learning.

Evaluation Procedure:

- As per University guidelines.
- The Internal Assessment marks for the seminar shall be awarded based on the relevance of the seminar topic, quality of the report, presentation skills, participation in the question and answer, and attendance in the seminar classes/sessions.
## Internship

<table>
<thead>
<tr>
<th>Subject Code</th>
<th>CIE Marks</th>
<th>Number of Lecture Hours /Week</th>
<th>SEE Marks</th>
<th>Total Number of Lecture Hours</th>
<th>Exam Hours</th>
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<tr>
<td>18EI85</td>
<td>40</td>
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<td>03</td>
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</tbody>
</table>

**Credits – 3**

**Course Learning Objectives:**
Internship/Professional practice provide students the opportunity of hands-on experience that include personal training, time and stress management, interactive skills, presentations, budgeting, marketing, liability and risk management, paperwork, equipment ordering, maintenance, responding to emergencies etc. The objective are further,

- To put theory into practice
- To relate to, interact with, and learn from current professionals in the field.
- To gain a greater understanding of the duties and responsibilities of a professional
- To understand and adhere to professional standards in the field.
- To gain insight to professional communication including meetings, memos, reading, writing, public speaking, research, client interaction, input of ideas, and confidentiality.
- To identify personal strengths and weaknesses.
- To develop the initiative and motivation to be a self-starter and work independently.

**Internship/Professional practice:** Students under the guidance of internal guide/s and external guide shall take part in all the activities regularly to acquire as much knowledge as possible without causing any inconvenience at the place of internship.

**Seminar:** Each student, is required to

- Present the seminar on the internship orally and/or through power point slides.
- Answer the queries and involve in debate/discussion.
- Submit the report duly certified by the external guide.

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

- Acquire practical experience within industry in which the internship is done.
- Apply knowledge and skills learned to classroom work.
- Experience the activities and functions of professionals.
- Develop and refine oral and written communication skills.
- Recognize the areas for future knowledge and skill development.
- Acquire the basic knowledge of administration, marketing, finance and economics.
- Develop the skills to enable lifelong learning.

**Evaluation Procedure:**

- As per University guidelines.
- **Evaluation of CIE Marks:** The Internal Assessment marks shall be awarded based on the Internship/Professional Practice Report and Seminar Presentation.
- **Semester End Examination:** The marks shall be awarded based on the Internship/Professional Practice Report and Seminar Presentation as per the University norms by the examiners appointed VTU.
B.E. Electronics and Instrumentation Engineering (EI)
Choice Based Credit System (CBCS)
Semester - VI

OPEN ELECTIVE - A

<table>
<thead>
<tr>
<th>Course Code</th>
<th>CIE Marks</th>
<th>SEE Marks</th>
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<tbody>
<tr>
<td>18EI65X</td>
<td>40</td>
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</table>

Students can select any one of the open electives offered by other Departments except those that are offered by the parent Department (For syllabus, please refer to the concerned Programme syllabus book or VTU website vtu.ac.in may be visited).

Selection of an open elective shall not be allowed if,
- The candidate has studied the same course during the previous semesters of the programme.
- The syllabus content of open elective is similar to that of the Departmental core courses or professional electives.
- A similar course, under any category, is prescribed in the higher semesters of the programme.

Registration to electives shall be documented under the guidance of Programme Coordinator/Advisor/Mentor.

<table>
<thead>
<tr>
<th>Sl.NO</th>
<th>Board and the Department offering the Electives</th>
<th>Course code under 18EI65X</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>EI/BM/ML Electronics and Instrumentation Engineering</td>
<td>18EI651</td>
<td>Transducers and Instrumentation</td>
</tr>
<tr>
<td>2</td>
<td>EI/BM/ML Scientific and Analytical Instrumentation</td>
<td>18EI652</td>
<td>Scientific and Analytical Instrumentation</td>
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<tr>
<td>3</td>
<td>EI/BM/ML Lasers and Optical Instrumentation</td>
<td>18EI653</td>
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Electronics and Instrumentation Engineering (EI)
Choice Based Credit System (CBCS)
Semester – VI: Open Elective-A

Transducers and Instrumentation

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

Course Learning Objectives:
- To provide the fundamental knowledge of transducers, instrumentation and measurement systems.
- To understand the functional elements of instrumentation/measurement systems.
- To impart the knowledge of static and dynamic characteristics of instruments, and understand the factors in selection of instruments for measurement.
- To discuss the principle, design and working of transducers for the measurement of displacement, level, strain, force, torque, pressure, sound and speed.


Module -1
Classification and Functional Elements of Instrument/measurement system: Measurement, significance of measurement, instruments and measurement systems, mechanical, electrical and electronic instruments (Common to EIM), Deflection & Null type instruments and their comparison, Analog and digital modes of operation, functions of instruments and measurement systems, applications of measurement systems, Elements of generalized measurement system, Input-output configuration of measuring instruments and measurement systems, methods of correction for interfering and modifying inputs. Transducers, Classifications of transducers-primary & secondary, active & passive, analog and digital transducers.

<table>
<thead>
<tr>
<th>Modules</th>
<th>Teaching Hours</th>
<th>Revised Bloom’s Taxonomy (RBT)Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Module -1 Classifications and Functional Elements of Instrument/measurement system:</td>
<td>8 Hours</td>
<td>L1, L2</td>
</tr>
</tbody>
</table>

Module -2
Static and Dynamic Characteristics: Static calibration and error calibration curve, accuracy and precision, indications of precision, static error, scale range and scale span, reproducibility and drift, repeatability, signal to noise ratio, sensitivity, linearity, hysteresis, threshold, dead zone and dead time, resolution, signal to noise ratio, factors influencing the choice of transducers/instruments.
Dynamic response – dynamic characteristics, time domain analysis & different types of inputs, frequency domain analysis. Time domain response – zero order system, first order system, response of a first order system to step & ramp input, frequency response of first order system.

<table>
<thead>
<tr>
<th>Teaching Hours</th>
<th>Revised Bloom’s Taxonomy (RBT)Level</th>
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<tbody>
<tr>
<td>8 Hours</td>
<td>L1, L2, L3, L4</td>
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</tbody>
</table>
### Module -3
**Measurement of Displacement:** Introduction, Principles of Transduction, Variable resistance devices, variable Inductance Transducer, Variable Capacitance Transducer, Hall Effect Devices, Proximity Devices, Digital Transducer

**Measurement of Level:** Capacitance probes, conductivity probes, differential pressure level detector, float level devices, optical level switches, ultrasonic level detector, thermal level sensors

| 8 Hours | L1, L2, L3, L4 |

### Module -4
**Measurement of Strain:** Introduction, Types of Strain Gauges, Theory of operation of resistance strain gauges, Types of Electrical Strain Gauges – Wire gauges, unbounded strain gauges, foil gauges, semiconductor strain gauges (principle, types & list of characteristics only), Strain gauge Circuits – Wheatstone bridge circuit, Applications.


| 8 Hours | L1, L2, L3, L4 |

### Module -5
**Measurement of Pressure:** Introduction, Diaphragms, Other elastic elements, Transduction methods – potentiometric device, strain gauge transducer, variable reluctance, LVDT type, variable capacitance device (principle & working, no derivation), force balance transducer with analysis, piezoelectric pressure transducer, pressure multiplexer, pressure calibration.

**Miscellaneous Sensors:** Noise (sound) Sensors, Speed Sensors, Thickness Measurement.

| 8 Hours | L1, L2, L3, L4 |

### Course Outcomes:
- After studying this course, students will able to:
  - Define the transducer, instrument, measurement and classify different types of transducers
  - Explain the functional elements of instrumentation / measurement systems
  - Discuss the input-output configuration of measurement systems
  - Define, interpret and analyze the static and dynamic characteristics of instruments
  - Explain the principle, design and analyze the transducers for the measurement of displacement, level, strain, force, torque, pressure, sound and speed.

### Graduate Attributes (as per NBA)
- Engineering knowledge
- Problem analysis
- Design & Development of Solutions
- Engineer and society
- Environment & sustainability
- Lifelong learning

### Question Paper Pattern:
- The question paper will have TEN questions.
- Each full question consists of 20 marks.
- There will be 2 full questions (with maximum of THREE sub questions) from each module.
Each full question will have sub 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:
### Scientific and Analytical Instrumentation
(Common to EI, BM & ML)

<table>
<thead>
<tr>
<th>Subject Code</th>
<th>18EI652</th>
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</thead>
<tbody>
<tr>
<td>CIE Marks</td>
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<td>Exam Hours</td>
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<tr>
<td>Credits</td>
<td>3</td>
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</table>

**Course Learning Objectives:**
- To introduce the basic concept of qualitative and quantitative analysis of a given sample.
- To impart various spectroscopic techniques and its instrumentation.
- To impart the concept of separation science and its application.
- To impart methods of Industrial analyzers and its application.

**Revised Bloom’s Taxonomy Levels:**

**Modules**

<table>
<thead>
<tr>
<th>Module</th>
<th>Teaching Hours</th>
<th>Revised Bloom’s Taxonomy (RBT)Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Module -1 An Introduction to Instrumental Methods:</td>
<td>08 Hours</td>
<td>L1, L2</td>
</tr>
<tr>
<td>Terms associated with Chemical analysis, Classification of instrumental techniques, A review of important consideration in analytical methods, Basic functions of instrumentation, Fundamental Laws of photometry (Text book 1).</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Module -2 UV and Visible Spectrometers –Instrumentation:</td>
<td>08 Hours</td>
<td>L1, L2</td>
</tr>
<tr>
<td>Radiation Sources, Wavelength selection: absorption filters, interference filters, Detector, Readout modules(Text book 1), Instruments for absorption photometry: single beam and double beam spectrophotometer. (Text book 2)</td>
<td></td>
<td></td>
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<tr>
<td>Module -3 Flame Emission and Atomic Absorption Spectroscopy:</td>
<td>08 Hours</td>
<td>L1, L2</td>
</tr>
<tr>
<td>Introduction, Instrumentation for flame spectrometric methods, Flame emission spectrometry, atomic absorption spectrometry, Atomic fluorescence spectrometry, Interferences associated with Flames &amp; furnaces, applications, comparison of FES and AAS. (Text book 1).</td>
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<tr>
<td>Module -4 Gas Chromatography:</td>
<td>08 Hours</td>
<td>L1, L2, L3</td>
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<tr>
<th>Module -5</th>
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</table>
| **Blood analyzer**: Introduction, Blood pH measurements: electrodes for blood pH measurement, measurement of blood pCO$_2$, pO$_2$, A Complete blood gas analyzer.  
**Air pollution monitoring instruments**: Carbon monoxide (CO) -Non-dispersive infrared analyzer, Sulphur dioxide (SO$_2$)-Conductivitimetry, UV fluorescence method, Nitrogen oxides-Using CO laser, laser opto-acoustic spectroscopy, Hydrocarbons-Flame ionization detector, Ozone-Chemiluminescence, Automated wet chemical air analysis,  
**Water pollution monitoring instruments**. (Text book 2) |
| L1, L2, L3, L4 |
| 08 Hours |

**Course Outcomes:**
- The students get well versed with the principle, construction and working of various analytical instrumentation.
- Students get detailed information about the application of analytical techniques in medicine, Industry, etc.

**Graduate Attributes (as per NBA)**
- Engineering Knowledge
- Problem Analysis
- Life-long Learning

**Question Paper Pattern:**
- The question paper will have TEN questions.
- Each full question carry 20 marks
- There will be TWO full questions (with maximum of THREE sub questions) from each module.
- Each full question will have sub 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:**

**Reference Books:**
# B.E. Electronics and Instrumentation Engineering (EI)
Choice Based Credit System (CBCS)
Semester – VI: Open Elective-A

## Lasers and Optical Instrumentation

<table>
<thead>
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<th>: 18EI653</th>
<th>CIE Marks</th>
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<td>Exam Hours</td>
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**Credits – 3 (Each module – 8 Hours)**

### Module -1
**Lasers -I:** Introduction, Emission and absorption of radiation, Einstein relation, population inversion, threshold conditions, Line shape function, population inversion and pumping threshold conditions.

**Lasers -II:** Classes of LASER: Doped insulator LASERs, semiconductor LASERs, Gas LASERs, Liquid dye LASERs.

### Module -2
**Generation of Lasers:** Single mode operation, frequency stabilization. Q-switching, mode locking, lasing threshold.

**Applications of Laser:** Measurement of distance: Interferometric methods, Beam modulation telemetry, Pulse echo techniques; Holography & its Applications.

### Module -3
**Overview of Optical Fiber Communications:** Motivations for light wave communications, optical spectral bands, Decibel units, Network information rates, WDM concepts, Key elements of optical fiber systems, standards for optical fiber communications.

**Structures, Wave guiding, and Fabrication I:** The nature of light, basic optical laws and definitions, optical fiber modes and configurations, Mode theory for circular waveguides, Single mode fibers.

### Module -4
**Structures, Wave guiding, and Fabrication II:** Graded index fiber structure, Fiber materials, Photonic crystal fibers, Fiber fabrication, Mechanical properties of fibers, Fiber optic cables.

**Optical Amplifiers:** Types of optical amplifiers and its applications, Semiconductor optical amplifiers, Erbium-doped fiber amplifiers, Amplifier noise, Optical SNR, System Applications, Raman amplifiers, wideband optical amplifiers.

### Module -5

**Textbook 3:** Unit 9.1, 9.2, 9.2.1, 9.2.2, 9.2.5, 9.3.4, 9.5.2.3, 9.7.3, 9.8.2, 9.9.2, 9.11.4.3

### Course Outcomes:
- Explain the principle and working of Laser system.
- Discuss the engineering applications of laser systems.
- Discuss the fundamentals of optical fiber communications.
- Evaluate the design of optical fibers.
10. Apply fiber optic laser systems in medical field.

**Question Paper Pattern**
- The question paper will have TEN questions.
- Each full question carry 20 marks
- There will be TWO full questions (with maximum of THREE sub questions) from each module.
- Each full question will have sub 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:**

**Reference Books:**
Students can select any one of the open electives offered by other Departments expect those that are offered by the parent Department (For syllabus, please refer to the concerned Programme syllabus book or VTU website vtu.ac.in may be visited.).

Selection of an open elective shall not be allowed if,

- The candidate has studied the same course during the previous semesters of the programme.
- The syllabus content of open elective is similar to that of the Departmental core courses or professional electives.
- A similar course, under any category, is prescribed in the higher semesters of the programme.

Registration to electives shall be documented under the guidance of Programme Coordinator/ Advisor/Mentor.

<table>
<thead>
<tr>
<th>Sl. NO.</th>
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<th>Course code under 18EI75X</th>
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<td>1 18EI751</td>
<td>Biomedical Instrumentation</td>
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<td>2 18EI752</td>
<td>Robotics and Automation</td>
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<td>3 18EI753</td>
<td>Smart Sensors and Intelligent Instrumentation</td>
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# Biomedical Instrumentation

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</table>

## Credits – 3 (Each module – 8 Hours)

### Module -1
**Fundamentals of Biomedical Instrumentation**: Sources of biomedical signals, Basic Medical Instrumentation system, Performance requirements of medical instrumentation systems. PC based medical instruments, General constraints in design of biomedical instrumentation systems.

**Bioelectric Signals and Electrodes**: Origin of Bioelectric signals, Types of bioelectric signals-ECG, EEG, EMG, Recording electrodes: Electrode – Tissue interface, polarization, skin contact- impedance, Silver-silver chloride electrodes, Electrodes for ECG, EEG, EMG, Microelectrodes.

### Module -2
**Electrocardiograph**: Physiology of the heart, Electrical activity of the heart and Electrocardiogram (ECG), Normal & Abnormal cardiac Rhythms, Block diagram description of an Electrocardiograph, ECG leads, Effects of artifacts on ECG Recordings, Multi-channel ECG machine.

**Electroencephalograph**: Block diagram description of an Electroencephalograph, 10-20 electrode systems, computerized analysis of EEG. Electromyograph, Biofeedback instrumentation.

### Module -3
**Patient Monitoring System**: Bedside patient monitoring systems, Central monitors, Measurement of heart rate – Average heart rate meter, Instantaneous heart rate meter, Measurement of pulse rate, Definition of oximeter & Pulse oximeter.

**Blood Pressure Measurement**: Introduction, Indirect methods of blood pressure measurement: Korotkoff’s method, Rheographic method, differential auscultatory technique, Oscillometric technique.

**Measurement of Respiration Rate**: Impedance pneumography, CO₂ method of respiration rate measurement, Apnoea detectors.

### Module -4

**Cardiac Output Measurement**: Measurement of continuous cardiac output derived from the aortic pressure waveform, ultrasound method.

**Cardiac Pacemakers and Defibrillators**: Need for cardiac pacemaker, External pacemaker, Implantable pacemaker, Types of Implantable pacemakers, Programmable pacemakers, Power sources for Implantable pacemaker. Cardiac Defibrillator: Need for a Defibrillator, DC defibrillator, Pacer-Cardioverter-Defibrillator.

### Module -5
**Therapeutic Instruments**: 

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Cardiac-assist devices, Pump oxygenators, Total artificial heart, Hemodialysis, Lithotripsy, Ventilators, Infant incubators, Drug infusion pumps, Ambulatory and Implantable Infusion systems, Anesthesia Machines, Electrosurgical unit.

**Patient Safety:** Electric shock hazards, Leakage currents, Electrical safety analyzer, Testing of Biomedical equipment

**Course Outcome:** After studying this course, students will able to:
1. Acquire knowledge about origin of bio-potential, bio-signals and their measurement
2. Describe the problem, identify and formulate solution in the field of Bio-Medical Engineering for current and future issues
3. Describe the cardiac, brain and muscular physiological systems with the related diagnostic measurement methods.
4. Recognize the therapeutic methods of treatment and the associated instrumentation.
5. Identify and judge patient safety issues related to biomedical instrumentation.
6. Describe the principle and working of cardiac pacemakers, defibrillators, BP measurement, blood flow meters, CO measurement, respiration measurements and their implementation.

**Question Paper Pattern:**
- The question paper will have TEN questions
- Each full question carry 20 marks
- There will be TWO full questions (with maximum of THREE sub questions) from each module.
- Each full question will have sub 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:**

**Reference Book:**
# Robotics and Automation

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</table>

Credits – 3 (Each module – 8 Hours)

## Module -1
**Fundamentals of Robotics & Automation:** Automation and robotics, history of robotics, robotics market and future prospects, robot anatomy, work volume, robot drive systems, control systems, precision of movement, end effectors, robotic sensors, robot programming and work cell control, robot applications, problems.[Textbook-1]

**Automation Concepts:** SCADA, introduction and brief history of SCADA, SCADA systems software, distributed control system (DCS), introduction to the PLC, considerations and benefits of SCADA system. [Textbook-2]

## Module -2
**Robot Motion Analysis, Sensors and Control:** Introduction to manipulator kinematics, homogeneous transformations and robot kinematics, manipulator path control, robot dynamics, configuration of a robot controller, types of end effectors, mechanical grippers, other types of grippers, tools as end effectors, robot/end effector interface, consideration in gripper selection and design, problems.

**Sensors in Robotics:** Transducers and sensors, sensors in robotics, tactile sensors, proximity and rangefinders, uses of sensors in robotics, problems. [Textbook-1]

## Module -3
**Machine Vision, Robot Programming & Artificial Intelligence:** Introduction to machine vision, sensing and digitizing function in machine vision, image processing and analysis, training the vision system, robotic applications, problems. Robot Programming: Methods of robot programming, lead-through programming methods, a robot program as a path in space, motion interpolation, wait, signal and delay commands, branching, capabilities and limitations of lead-through methods, problems.

**Artificial Intelligence (AI):** Introduction & goals of AI in research, AI techniques, LISP programming, AI & robotics, LISP in factory, robotic paradigms, and problems. [Textbook-1]

## Module -4
**Robotics in Manufacturing/Automation, Material Transfer, Machine Loading/Unloading:** Robot cell layouts, multiple robots and machine interference, considerations in work-cell design, work-cell control, interlocks, error detection and recovery, work-cell controller, robot cycle time analysis, graphic simulation of robotic work-cells, problems.

**Material Transfer, Machine Loading/Unloading:** General considerations in robot material handling, material transfer applications, machine loading and unloading. [Textbook-1]

## Module -5
**Robots in Automatic Processing Operations, Assembly & Inspection:** Introduction, spot welding, continuous arc welding, spray coating, other processing operations. Assembly and robotic assembly automation, parts presentation methods, assembly operations, compliance and remote center compliance
(RCC) device, assembly system configurations, adaptable programmable assembly system, designing for robotic assembly, inspection automation. [Textbook-1]

**Autonomous Mobile Robots: Introduction, Planning & Navigation:** Introduction, basic control scheme for mobile robots (only basic understanding of perception, localization, path planning & motion control). [Textbook-3]

**Course Outcomes:** After studying this course, students will be able to:
1. Identify basic components of robot system and its functionality
2. Identify DH representation of robot and homogenous transformation for various arm configurations.
3. Analyze the functions of sensors in the robot.
4. Solve forward and inverse kinematic problems.
5. Evaluate and compare the use of robots in different applications.
6. Recognize material-handling applications, processing operations, assembly and inspection operations to increase product quality and uniformity in minimize cycle times and effort.

**Question Paper Pattern**
- The question paper will have TEN questions.
- Each full question carries 20 marks.
- There will be TWO full questions (with maximum of THREE sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
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**Text Books:**

**Reference Books:**
### Smart Sensors and Intelligent Instrumentation

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#### Module -1
**Basics of smart sensors and micromachining:** Introduction, Mechanical-Electronic transitions in sensing, nature of sensors, overview of smart sensing and control systems, integration of micromachining and microelectronics, introduction to micromachining, bulk micromachining, wafer bonding, surface micromachining, other micromachining techniques.

#### Module -2
**MCUs and DSPs for sensor:** Introduction, MCU control, MCUs for sensor interface, DSP control, Software, tools and support, sensor integration.

#### Module -3
**Sensor Communication and MEMS:** Wireless zone sensing, surface acoustical wave devices, intelligent transportation system, RF-ID, Micro optics, micro-grippers, micro-probes, micro-mirrors, PEOs, communications for smart sensors - sources and standards, automotive protocols, industrial networks, office and building automation, home automation, protocols in silicon, other aspects of network communications.

#### Module -4
**Packaging, Testing and Reliability of Smart Sensors:** Introduction, Semiconductor packaging applied to sensors, hybrid packaging, packaging for monolithic sensors, reliability implications, testing smart sensors. Unit Standards for Smart Sensors: Introduction, setting the standards for smart sensors and systems, IEEE 1451.1, IEEE 1451.2, IEEE P1451.3, IEEE 1451.4, extending the systems to network.

#### Module -5
**Implications of Smart Sensor Standards and Recent Trends:** Introduction, sensor plug-and-play, communicating sensor data via existing wiring, automated/remote sensing and web, process control over the internet, alternative standards, HVAC sensor chip, MCU with integrated pressure sensors, alternative views of smart sensing, smart loop.

### Course Outcomes:
After studying this course, students will be able to:
1. Describe the principle of smart sensors and process of micromachining in development of smart sensors.
2. Develop intelligent systems by interfacing the smart sensors to MCUs and DSPs.
3. Analyze the use of smart sensors in communication, MEMS and automation.
4. Evaluate the standards of smart sensors by the assessment of reliability testing and packaging.
5. Discuss the applications of smart sensors in different fields and recent development.
6. Develop/sketch the simple models of intelligent instrumentation.
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