EVALUATION SCHEME & SYLLABUS

FOR

B. TECH. THIRD YEAR

ELECTRONICS AND INSTRUMENTATION ENGINEERING
INSTRUMENTATION AND CONTROL ENGINEERING
APPLIED ELECTRONICS AND INSTRUMENTATION
INSTRUMENTATION ENGINEERING

AS PER

AICTE MODEL CURRICULUM

[Effective from the Session: 2020-21]
# B.Tech. V Semester

**Electronics and Instrumentation Engineering**

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Course Code</th>
<th>Course Title</th>
<th>Periods</th>
<th>Evaluation Scheme</th>
<th>End Semester</th>
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**Notes:**

- **The Mini Project or Internship (4weeks) conducted during summer break after IV Semester and will be assessed during Vth Semester.**

## Course Code

### Department Elective-I

- **KIC-051** Transducer and Sensor Measurement System
- **KEC-051** Computer Architecture and Organization
- **KEC-052** Industrial Electronics
- **KEC-054** Advance Digital Design using Verilog

### Department Elective-II

- **KIC-052** Signal Processing
- **KIC-053** Artificial Neural Networks
- **KIC-054** Electrical Machine
- **KIC-058** Optical Communication
### B.Tech. VI Semester
#### Electronics and Instrumentation Engineering

<table>
<thead>
<tr>
<th>S. No.</th>
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**Course Code**  **Course Title**

**Department Elective-III**

- KIC-061 Opto Electronics
- KIC-062 Digital Measurement Techniques
- KEC-063 Data Communication Networks
- KEC-064 Analog Signal Processing
- KEC-065 Random Variables & Stochastic Process
B.Tech 3rd Year
V Semester
Syllabus
### KEC-501 INTEGRATED CIRCUITS

<table>
<thead>
<tr>
<th>Unit</th>
<th>Topics</th>
<th>Lectures</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>The 741 IC Op-Amp: General operational amplifier stages (bias circuit, the input stage, the second stage, the output stage, short circuit protection circuitry), device parameters, DC and AC analysis of input stage, second stage and output stage, gain, frequency response of 741, a simplified model, slew rate, relationship between ft and slew rate.</td>
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</tr>
<tr>
<td>II</td>
<td>Linear Applications of IC Op-Amps: Op-Amp based V-I and I-V converters, instrumentation amplifier, generalized impedance converter, simulation of inductors. Active Analog filters: Sallen Key second order filter, Designing of second order low pass and high pass Butterworth filter, Introduction to band pass and band stop filter, all pass active filters, KHN Filters. Introduction to design of higher order filters.</td>
<td>8</td>
</tr>
<tr>
<td>IV</td>
<td>Digital Integrated Circuit Design: An overview, CMOS logic gate circuits basic structure, CMOS realization of inverters, AND, OR, NAND and NOR gates. Latches and Flip flops: the latch, CMOS implementation of SR flip-flops, a simpler CMOS implementation of the clocked SR flip-flop, CMOS implementation of J-K flip-flops, D flip-flop circuits.</td>
<td>6</td>
</tr>
<tr>
<td>V</td>
<td>Integrated Circuit Timer: Timer IC 555 pin and functional block diagram, Monostable and Astable multivibrator using the 555 IC. Voltage Controlled Oscillator: VCO IC 566 pin and functional block diagram and applications. Phase Locked Loop (PLL): Basic principle of PLL, block diagram, working, EX-OR gates and multipliers as phase detectors, applications of PLL.</td>
<td>6</td>
</tr>
</tbody>
</table>

**Text Book:**
2. Behzad Razavi: Design of Analog CMOS Integrated Circuits, TMH

**Reference Books:**

**Course Outcomes:** At the end of this course students will demonstrate the ability to:

1. Explain complete internal analysis of Op-Amp 741-IC.
2. Examine and design Op-Amp based circuits and basic components of ICs such as various types of filter.
3. Implement the concept of Op-Amp to design Op-Amp based non-linear applications and wave-shaping circuits.
4. Analyse and design basic digital IC circuits using CMOS technology.
5. Describe the functioning of application specific ICs such as 555 timer, VCO IC 566 and PLL.
KEC-502  MICROPROCESSOR & MICROCONTROLLER  3L:1T:0P  4 Credits

<table>
<thead>
<tr>
<th>Unit</th>
<th>Topics</th>
<th>Lectures</th>
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</thead>
<tbody>
<tr>
<td>I</td>
<td><strong>Introduction to Microprocessor:</strong> Microprocessor architecture and its operations, Memory, Input &amp; output devices, The 8085 MPU- architecture, Pins and signals, Timing Diagrams, Logic devices for interfacing, Memory interfacing, Interfacing output displays, Interfacing input devices, Memory mapped I/O.</td>
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<tr>
<td>II</td>
<td><strong>Basic Programming concepts:</strong> Flow chart symbols, Data Transfer operations, Arithmetic operations, Logic Operations, Branch operation, Writing assembly language programs, Programming techniques: looping, counting and indexing, Additional data transfer and 16 bit arithmetic instruction, Logic operation: rotate, compare, counter and time delays, 8085 Interrupts.</td>
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<tr>
<td>III</td>
<td><strong>16-bit Microprocessors (8086):</strong> Architecture, Pin Description, Physical address segmentation, memory organization, Addressing modes. <strong>Peripheral Devices:</strong> 8237 DMA Controller, 8255 programmable peripheral interface, 8253/8254 programmable timer/counter, 8259 programmable interrupt controller, 8251 USART and RS232C.</td>
<td>8</td>
</tr>
<tr>
<td>IV</td>
<td><strong>8051 Microcontroller Basics:</strong> Inside the Computer, Microcontrollers and Embedded Processors, Block Diagram of 8051, PSW and Flag Bits, 8051 Register Banks and Stack, Internal Memory Organization of 8051, IO Port Usage in 8051, Types of Special Function Registers and their uses in 8051, Pins Of 8051. Memory Address Decoding, 8031/51 Interfacing With External ROM And RAM. 8051 Addressing Modes.</td>
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<tr>
<td>V</td>
<td><strong>Assembly programming and instruction of 8051:</strong> Introduction to 8051 assembly programming, Assembling and running an 8051 program, Data types and Assembler directives, Arithmetic, logic instructions and programs, Jump, loop and call instructions, IO port programming. Programming 8051 Timers. Serial Port Programming, Interrupts Programming, <strong>Interfacing:</strong> LCD &amp; Keyboard Interfacing, ADC, DAC &amp; Sensor Interfacing, External Memory Interface, Stepper Motor and Waveform generation.</td>
<td>8</td>
</tr>
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</table>

**Text Books:**
2. D. V. Hall : Microprocessors Interfacing, TMH 3rd Edition,

**Reference Books:**

**Course Outcomes:** At the end of this course students will demonstrate the ability to
1. Demonstrate the basic architecture of 8085.
2. Illustrate the programming model of microprocessors & write program using 8085 microprocessor.
3. Demonstrate the basics of 8086 Microprocessor and interface different external Peripheral Devices like timer, USART etc. with Microprocessor (8085/8086).
4. Compare Microprocessors & Microcontrollers, and comprehend the architecture of 8051 microcontroller
5. Illustrate the programming model of 8051 and implement them to design projects on real time problems.
### KIC-501 MEASUREMENTS & INSTRUMENTATION

<table>
<thead>
<tr>
<th>Unit</th>
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</thead>
<tbody>
<tr>
<td>I</td>
<td><strong>Electrical Measurements:</strong> Measurement system, Characteristics of instruments, Methods of measurement, Errors in Measurement &amp; Measurement standards, Measurement error combination, <strong>Review of indicating and integrating instruments:</strong> PMMC instrument, Galvanometer, DC ammeter, DC voltmeter, Series ohm meter.</td>
<td>8</td>
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<tr>
<td>II</td>
<td><strong>Electronic Instruments:</strong> Transistor voltmeter circuits, AC electronic voltmeter, current measurement with electronic instruments, probes, <strong>Digital voltmeter systems:</strong> Digital multimeter, digital frequency meter System, Oscilloscope <strong>Instrument calibration:</strong> Comparison method, digital multimeter as standard instrument, Calibration instrument.</td>
<td>8</td>
</tr>
<tr>
<td>III</td>
<td><strong>Measuring Methods:</strong> Voltmeter and Ammeter methods, Wheatstone bridge, Measurement of low, medium and high resistances, Insulation resistance measurement, AC bridges for inductance and capacitance measurement, Q meter.</td>
<td>8</td>
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<tr>
<td>IV</td>
<td>Electronic Measurements: Electronic instruments: Wattmeter &amp; Energy meter. Time, Frequency and phase angle measurements using CRO; Storage oscilloscope, Spectrum &amp; Wave analyzer, Digital counter, Frequency meter.</td>
<td>8</td>
</tr>
<tr>
<td>V</td>
<td><strong>Instrumentation:</strong> Transducers, classification &amp; selection of transducers, strain gauges, Thermistors, Thermocouples, LVDT, Inductive &amp; capacitive transducers, Piezoelectric and Hall-effect transducers, Measurement of motion, force, pressure, temperature, flow and liquid level. Concept of signal conditioning and data acquisition systems, Concept of smart sensors and virtual instrumentation.</td>
<td>8</td>
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</table>

**Text Book:**

**Course Outcomes: At the end of this course students will demonstrate the ability to:**
1. Classify the Instrumentation and Measurement system and various measurement errors.
2. Analyze and design voltmeter circuits, AC electronic voltmeter, digital frequency meter and current measurement with electronic instruments.
3. Evaluate various resistance and impedance measuring methods using Bridges and Q-meter.
4. Analyze fundamental operation of CRO and some special type of oscilloscopes like DSO, Sampling oscilloscope.
5. Demonstrate calibration method to calibrate various instruments and classify transducers like for force, pressure, motion, temperature measurement etc.
<table>
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<th>Unit</th>
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<tbody>
<tr>
<td>II</td>
<td>MEASUREMENT OF DISPLACEMENT, FORCE, TORQUE &amp; SHAFT POWER: Principle of measurement of displacement. Resistive potentiometers, variable inductance &amp; variable reluctance pickups, LVDT, capacitance pickup. Principle of measurement of Force, Torque, Shaft power standards &amp; calibration; basic methods of force measurement; characteristics of elastic force transducer- Bonded strain gauge, differential transformer, piezo electric transducer, variable reluctance/FM-oscillator, digital systems. Loading effects; Torque measurement on rotating shafts, shaft power measurement (dynamometers).</td>
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<tr>
<td>III</td>
<td>TEMPERATURE MEASUREMENT: Standards &amp; calibration; thermal expansion methods- bimetallic thermometers, liquid-in-glass thermometers, pressure thermometers; thermoelectric sensor (thermocouple) – common thermocouple, special materials, configuration &amp; techniques; electrical resistance sensors – conductive sensor (resistance thermometers), bulk semiconductor sensors (thermistors); junction semiconductor sensors; digital thermometers. Radiation Methods – radiation fundamentals, radiation detectors, unchopped (dc) broadband radiation thermometers. Chopped (AC) selective band (photon) radiation thermometers, automatic null balance radiation thermometers (optical pyrometers). Two color radiation thermometers, Black body-tipped fibre optic radiation thermometer, IR imaging systems. Fluoroptic temperature measurement.</td>
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<tr>
<td>IV</td>
<td>PRESSURE MEASUREMENT: Standards &amp; calibration; basic methods of pressure measurement; dead weight gauges &amp; manometer, manometer dynamics; elastic transducers; high pressure measurement; low pressure (vaccum) measurement – Mcleod gage, Knudsen gage, momentum-transfer (viscosity) gages, thermal conductivity gages, ionization gages, dual gage technique.</td>
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</table>
Text Books:
3. Measurement systems application and design, ERNEST DOEBELIN, IV Edn.

Course Outcomes: At the end of this course students will demonstrate the ability to:

1. Explain the working of measurement systems and different types of sensors and transducers.
2. Formulate the sensor to measure various physical parameters used in Industry and normal measurement applications.
3. Analyze the working principle of resistive, inductive and capacitive transducers and their applications.
4. Differentiate the thermocouples, piezoelectric and pyro-electric transducers and apply them in various applications.
5. Describe acoustic, optical sensors and other sensors and their applications.
## KEC-051 Computer Architecture and Organization

<table>
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<tr>
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<th>Topics</th>
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<tbody>
<tr>
<td>I</td>
<td><strong>Introduction to Design Methodology</strong>: System Design – System representation, Design Process, the gate level (revision), the register level components and PLD (revision), register level design The Processor Level: Processor level components, Processor level design.</td>
<td>8</td>
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<tr>
<td>II</td>
<td><strong>Processor basics</strong>: CPU organization- Fundamentals, Additional features Data Representation - Basic formats, Fixed point numbers, Floating point numbers. Instruction sets - Formats, Types, Programming considerations.</td>
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<td>III</td>
<td><strong>Data path Design</strong>: Fixed point arithmetic - Addition and subtraction, Multiplication and Division, Floating point arithmetic, pipelining.</td>
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<td>IV</td>
<td><strong>Control Design</strong>: basic concepts - introduction, hardwired control, Micro programmed control -introduction, multiplier control unit, CPU control unit, Pipeline control- instruction pipelines, pipeline performance.</td>
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<td>V</td>
<td><strong>Memory organization</strong>: Multi level memories, Address translation, Memory allocation, Caches - Main features, Address mapping, structure vs performance, System Organization: Communication methods- basic concepts, bus control. Introduction to VHDL concept and programming.</td>
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### Text Book:

### Reference Books:

### Course Outcomes: At the end of this course students will demonstrate the ability to:
1. Discuss about the basic concepts of system design methodology and processor level design.
2. Explain the basics of processor and basic formats of data representation.
3. Perform fixed and floating point arithmetic operations.
4. Describe the basic concepts of control design and pipeline performance.
5. Explain the architecture and functionality of central processing unit.
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<tr>
<td>I</td>
<td>Introduction to Power Switching Devices: Description of working &amp; constructional features, Switching Characteristics, ratings and Applications of Power Transistor, Power MOSFET, SCR, DIAC, TRIAC, IGBT and MCT.</td>
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<td>II</td>
<td>SCR Performance and Applications: Protection of SCR, SCR Triggering and Commutation Circuits/Methods, Series and Parallel operation of SCR, two transistor model of SCR, Describe Construction &amp; Working of Opto-Isolators, Opto-TRIAC, Opto-SCR.</td>
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<td>III</td>
<td>Power Converter Performance &amp; Applications: Introduction to Basic Power Converters Architecture - Single Phase, there performance under different types of Loads, Average/RMS output Voltage &amp; Current, Freewheeling Diode, Feedback Diode, State Relay using Opto SCR, SMPS and UPS functioning through Block Diagrams.</td>
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<tr>
<td>V</td>
<td>Automation and Control: Data Communications for Industrial Electronics, Telemetry, SCADA &amp; Automation, AC &amp; DC Drives, Voltage &amp; Power Factor Control through Solid State Devices, Soft Switching, Industrial Robots.</td>
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**Text Books:**
Reference Books:

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

1. Describe the characteristics, operation of power switching devices and identify their ratings and applications.
2. Recognize the requirement of SCR Protection and describe the Functioning of SCR.
3. Analyze and design Power Converter based on SCR for various Industrial Applications.
4. Explain High Frequency Heating Systems, Timers, Relevant Sensors & Actuator and their application in industrial setting.
5. Explain and apply Data Communication, Telemetry & SCADA System in industrial applications.
ELECTRONICS AND INSTRUMENTATION ENGINEERING

KEC 054  ADVANCED DIGITAL DESIGN USING VERILOG  3L:0T:0P  3 Credits

<table>
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<th>Unit</th>
<th>Topic</th>
<th>Lecture(s)</th>
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<tbody>
<tr>
<td>I</td>
<td>Introduction to Mixed Logic, Logic Representation and Minimization with cost, Multiple output minimization, Entered Variable K- Map including don’t care handling, XOR Pattern Handling.</td>
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<tr>
<td>III</td>
<td>Synchronous Sequential Circuits Design, Mapping Algorithm, Synchronous State Machines, ASM Charts, Asynchronous Sequential Circuit Design, Races, Multi-level minimization and optimization.</td>
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<tr>
<td>IV</td>
<td>Factoring, Decomposition, BDD, Ordered BDD, LPDD, Fault Detection and Analysis in combinational and sequential systems, Path Sensitization method, Boolean Difference Method, Initial State Method.</td>
<td>8</td>
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<tr>
<td>V</td>
<td>Study of programmable logic families, PLD, CPLD, FPGA, ASIC, PLA, Architectures, Design of Combinational and sequential circuits using CPLD and FPGA, Design Examples.</td>
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Text Books:
2. Parag K. Lala, “Digital System Design Using PLDs”, PHI India Ltd.

Reference Books:

Course Outcome: After completion of the course student will be able to

1. Describe mixed logic circuits and their implementation.
2. Implement combinational circuits using mixed logic and Verilog.
3. Design sequential circuits using mixed logic and Verilog with mapping of Algorithm.
4. Understand faults and its elimination in sequential and combinational circuits.
5. Understand the working of programmable logic families.
## KIC-052  SIGNAL PROCESSING  3L:0T:0P  3 Credits

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<tr>
<td>I</td>
<td><strong>LTI Systems:</strong>&lt;br&gt;Definition, representation, impulse response, derivation for the output sequence, concept of convolution, graphical, analytical and overlap add methods to compute convolution supported with examples, properties of convolution, interconnections of LTI systems with physical interpretations, stability and causality conditions, recursive and non-recursive systems.</td>
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<tr>
<td>II</td>
<td><strong>Realisation of Digital Linear Systems:</strong>&lt;br&gt;IIR Filter Realization: Direct form, cascade realization, parallel form realization, Ladder structures- continued fraction expansion of H(z). FIR Filter Realization: Direct, Cascade, FIR Linear Phase Realization</td>
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<tr>
<td>III</td>
<td><strong>Discrete Fourier Transform:</strong>&lt;br&gt;Concept and relations for DFT/IDFT, Twiddle factors and their properties, computational burden on direct DFT, DFT/IDFT as linear transformations, DFT/IDFT matrices, computation of DFT/IDFT by matrix method, multiplication of DFTs, circular convolution, computation of circular convolution by graphical, DFT/IDFT and matrix methods, linear filtering using DFT, aliasing error, filtering of long data sequences – Overlap-Save and Overlap-Add methods with examples.</td>
<td>8</td>
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<tr>
<td>IV</td>
<td><strong>Filter Design:</strong>&lt;br&gt;Basic concepts of IIR and FIR filters, difference equations, design of Butterworth IIR analog filter using impulse invariant and bilinear transforms, frequency transformation. Design of FIR filters using windowing technique, Examples of Filter Designs Using Windows (Rectangular and Hamming windows).</td>
<td>8</td>
</tr>
<tr>
<td>V</td>
<td><strong>Digital Signal Processors</strong>&lt;br&gt;Introduction, Architecture, Features, Addressing Formats, Functional modes. Introduction to Commercial Digital Signal Processors.</td>
<td>8</td>
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### Text Books:

### Course Outcomes:
At the end of this course students will demonstrate the ability to:
1. Design and describe different types of realizations of digital systems (IIR and FIR) and their utilities.
2. Select design parameters of analog IIR digital filters (Butterworth and Chebyshev filters) and implement various methods such as impulse invariant transformation and bilinear transformation of conversion of analog to digital filters.
3. Design FIR filter using various types of window functions.
4. Define the principle of discrete Fourier transform & its various properties and concept of circular and linear convolution. Also, students will be able to define and implement FFT i.e. a fast computation method of DFT.
5. Define the concept of decimation and interpolation. Also, they will be able to implement it in various practical applications.
# Artificial Neural Networks

**KIC-053**  
**ARTIFICIAL NEURAL NETWORKS**  
**3L:0T:0P**  
**3 Credits**

<table>
<thead>
<tr>
<th>Unit</th>
<th>Topic</th>
<th>Lectures</th>
</tr>
</thead>
</table>
| I    | **Introduction to ANN:** Features, structure and working of Biological Neural Network Trends in Computing Comparison of BNN and ANN.  
**Basics of Artificial Neural Networks** - History of neural network research, characteristics of neural networks terminology, models of neuron McCulloch - Pitts model, Perceptron, Ada line model, Basic learning laws, Topology of neural network architecture | 8 |
| II   | **Back propagation networks:** (BPN) Architecture of feed forward network, single layer ANN, multilayer perceptron, back propagation learning, input - hidden and output layer computation, back propagation algorithm, applications, selection of tuning parameters in BPN, Numbers of hidden nodes, learning. | 8 |
| III  | **Activation & Synaptic Dynamics:** Introduction, Activation Dynamics models, synaptic Dynamics models, stability and convergence, recall in neural networks.  
**Basic functional units of ANN for pattern recognition tasks:** Basic feed forward, Basic feedback and basic competitive learning neural network. Pattern association, pattern classification and pattern mapping tasks. | 8 |
| IV   | a) **Feed forward neural networks** -- Linear responsibility X-OR problem and solution. - Analysis of pattern mapping networks summary of basic gradient search methods.  
 b) **Feedback neural networks** Pattern Storage networks, stochastic networks and simulated annealing, Boltzmann machine and Boltzmann learning. | 8 |
**Applications of ANN:** Pattern classification - Recognition of Olympic games symbols, Recognition of printed Characters. Neocognitron - Recognition of handwritten characters. NET Talk: to convert English text to speech. Recognition of consonant vowel (CV) segments, texture classification and segmentation | 8 |

### Text Book:

### Reference Books:

### Course Outcome:
After completion of the course student will be able to:
1. Recall the functionality of human brain neurons and design the basic artificial model for neuron.  
2. Understand the various learning process for artificial neural model.  
3. Construct the artificial neural model for pattern mapping, pattern recognition and pattern classification.  
4. Explain feed forward and feedback network for artificial neural network.  
5. Summarize the concept of artificial neural network and practical application of ANN.
## ELECTRICAL MACHINES

<table>
<thead>
<tr>
<th>Unit</th>
<th>Topics</th>
<th>Lectures</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td><strong>Basic concept of rotating machines:</strong> Introduction, Review of magnetic system, Energy in Magnetic system, Introduction to Elementary machines - synchronous machines, dc machine, Asynchronous machines: concept of Rotating magnetic field, generated emf, torque in round rotor machines, matching characteristics of electric machines and load.</td>
<td>8</td>
</tr>
<tr>
<td>II</td>
<td><strong>DC Machine:</strong> Introduction, emf equation, torque equation, power balance, linear magnetization, circuit model, generating mode, motoring mode, armature reaction, compensating winding, commutation, method of excitation, characteristics of dc shunt, series and compound motors and generators. Starting of dc motor, speed control of dc motor, breaking of dc motor.</td>
<td>8</td>
</tr>
<tr>
<td>III</td>
<td><strong>Synchronous machines:</strong> Introduction of basic synchronous machine model, circuit model of synchronous machine, determination of armature reaction ampere turn and leakage reactance of synchronous machine, synchronizing to infinite bus bar, operating characteristics, power flow equations, parallel operation of synchronous generators, hunting in synchronous machines.</td>
<td>8</td>
</tr>
<tr>
<td>IV</td>
<td><strong>Induction Motor:</strong> Introduction, construction, flux and mmf phasor in induction motors, slip and frequency of rotor currents, rotor emf, power, induction motor phasor diagram, torque slip characteristics, determination of equivalent circuit parameters, circle diagram, starting of induction motor, speed control.</td>
<td>8</td>
</tr>
<tr>
<td>V</td>
<td><strong>Single Phase Motors:</strong> Introduction, types of single-phase motor, single phase induction motor, split phase motors, single phase commutator motor, single phase synchronous motor, stepper motor.</td>
<td>8</td>
</tr>
</tbody>
</table>

### Text Book:

### Reference Book:

### Course Outcomes: At the end of this course students will demonstrate the ability to:
1. Explain the various types of torques produced in electrical machines and fundamental principles of operation of rotating electrical machines.
2. Categorize different phenomena occurring in DC machines.
3. Explain the working and performance characteristics of synchronous machines.
4. Develop the equivalent circuit and phasor diagram of induction motor and analyze their performance using the equivalent circuit.
5. Identify the types of single-phase motors with their working principle.
**KEC-058 | OPTICAL COMMUNICATION | 3L:0T:0P | 3 Credits**

<table>
<thead>
<tr>
<th>Unit</th>
<th>Topics</th>
<th>Lectures</th>
</tr>
</thead>
<tbody>
<tr>
<td>II</td>
<td><strong>Signal Loss in Optical Fibers:</strong> Attenuation, Material Absorption Losses (Intrinsic and Extrinsic absorption), types of Linear and Non-Linear Scattering Losses, Fiber Bending Losses, Kerr Effect. <strong>Dispersion:</strong> Introduction with its types: Chromatic / Intramodal Dispersion (Material and Waveguide Dispersion), Intermodal dispersion (for MSI and MGI fibers), Overall (Total) Fiber Dispersion in Multimode and Singe Mode Fiber, Dispersion Modified Single Mode Fibers, Polarization &amp; Fiber Birefringence.</td>
<td>08</td>
</tr>
<tr>
<td>III</td>
<td><strong>Optical Sources:</strong> LEDs-Introduction to LEDs &amp; Materials used for fabrication, LED Power and Efficiency, LED Structures, LED Characteristics, Modulation Bandwidth. <strong>Laser Diodes</strong>-Introduction, Optical Feedback &amp; Laser Oscillations, Resonant Frequencies, Laser Modes, and Threshold Condition for Laser Oscillation, Laser Diode Rate Equations, Semiconductor injection Laser- Efficiency, Laser Single Mode operation, Reliability of LED &amp; ILD.</td>
<td>08</td>
</tr>
<tr>
<td>IV</td>
<td><strong>Power Launching in Fiber:</strong> Source to Fiber Power Launching and Coupling Techniques, Power Launching Vs Wavelength, Equilibrium Numerical Aperture. <strong>Photo Detectors:</strong> Introduction, Physical Principles of Photodiodes: The PIN Photodetector, Avalanche Photodiodes, Temperature Effect on Avalanche Gain, Detector Response Time, Photo Detector Noise: Noise Sources, Signal to Noise Ratio, Comparison of Photo Detectors, Fundamental Receiver Operation with Digital Signal Transmission.</td>
<td>08</td>
</tr>
</tbody>
</table>

**Text Book:**

**Course Outcomes:** At the end of this course students will demonstrate the ability to:
1. Define and explain the basic concepts and theory of optical communication.
2. Describe the signal losses with their computation and dispersion mechanism occurring inside the optical fiber cable.
3. Differentiate the optical sources used in optical communication with their comparative study.
4. Identify different optical components on receiver side; assemble them to solve real world problems related to optical communication systems.
5. Evaluate the performance of an optical receiver to get idea about power budget and ultimately be an engineer with adequate knowledge in optical domain.
SUGGESTIVE LIST OF EXPERIMENTS:

1. Design the following using Op-Amp: *(Through Virtual Lab Link 1)*
   a) A unity gain amplifier.
   b) An inverting amplifier with a gain of “A”.
   c) A non-inverting amplifier with a gain of “A”
2. Study and design Log and antilog amplifiers.
3. Voltage to current and current to voltage converters.
4. Second order filters using operational amplifier for: *(Through Virtual Lab Link 1)*
   a) Low pass filter of cutoff frequency 1 KHz.
   b) High pass filter of frequency 12 KHz.
5. Realization of Band pass filter with unit gain of pass band from 1 KHz to 12 KHz.
6. Study and design voltage comparator and zero crossing detectors.
7. Function generator using operational amplifier (sine, triangular & square wave).
8. Design and construct astable multivibrator using IC 555 and
   a) Plot the output waveform
   b) Measure the frequency of oscillation *(Through Virtual Lab Link 2)*
9. Design and construct a monostable multivibrator using IC 555 and
   a) Plot the output waveform
   b) Measure the time delay *(Through Virtual Lab Link 2)*
10. Implement Schmitt Trigger Circuit using IC 555. *(Through Virtual Lab Link 2)*
11. Implement voltage-controlled oscillator using IC566 and plot the waveform. *(Through Virtual Lab Link 2)*
12. Study and design ramp generator using IC 566.

Virtual Lab Link:
2. http://hecoep.vlabs.ac.in/Experiment8/Theory.html?domain=ElectronicsandCommunications&lab=Hybrid%20Electronics%20Lab

Available on: http://www.vlab.co.in/broad-area-electronics-and-communications

Course Outcomes:
At the end of this course students will demonstrate the ability to:
1. Design different non-linear applications of operational amplifiers such as log, antilog amplifiers and voltage comparators.
2. Explain and design different linear applications of operational amplifiers such as filters.
3. Demonstrate the function of waveforms generator using op-Amp.
4. Construct multivibrator and oscillator circuits using IC555 and IC566 and perform measurements of frequency and time.
5. Design and practically demonstrate the applications based on IC555 and IC566.
SUGGESTIVE LIST OF EXPERIMENTS:

1. Write a program using 8085 Microprocessor for Decimal, Hexadecimal addition and subtraction of two Numbers. *(Through Virtual Lab Link)*
2. Write a program using 8085 Microprocessor for addition and subtraction of two BCD numbers. *(Through Virtual Lab Link)*
3. To perform multiplication and division of two 8 bit numbers using 8085. *(Through Virtual Lab Link)*
4. To find the largest and smallest number in an array of data using 8085 instruction set.
5. To write a program using 8086 to arrange an array of data in ascending and descending order. *(Through Virtual Lab Link)*
6. To convert given Hexadecimal number into its equivalent ASCII number and vice versa using 8086 instruction set.
7. To convert given Hexadecimal number into its equivalent BCD number and vice versa using 8086 instruction set.
8. To interface 8253 programmable interval timer and verify the operation of 8253 in six different modes.
9. To write a program to initiate 8251 and to check the transmission and reception of character.
10. Serial communication between two 8085 through RS-232 C port.
11. Write a program of Flashing LED connected to port 1 of the 8051 Micro Controller
12. Write a program to generate 10 kHz square wave using 8051.
13. Write a program to show the use of INT0 and INT1 of 8051.
14. Write a program for temperature & to display on intelligent LCD display.

Virtual Lab Link: [http://vlabs.iitb.ac.in/vlabs-dev/labs_local/microprocessor/labs/explist.php](http://vlabs.iitb.ac.in/vlabs-dev/labs_local/microprocessor/labs/explist.php)

Available on: [http://www.vlab.co.in/broad-area-electronics-and-communications](http://www.vlab.co.in/broad-area-electronics-and-communications)

Course Outcomes: At the end of this course students will demonstrate the ability to:

1. Use techniques, skills, modern engineering tools, instrumentation and software/hardware appropriately to list and demonstrate arithmetic and logical operations on 8 bit data using microprocessor 8085.
2. Examine 8085 & 8086 microprocessor and its interfacing with peripheral devices.
3. State various conversion techniques using 8085 & 8086 and generate waveforms using 8085.
4. Implement programming concept of 8051 Microcontroller.
5. Design concepts to Interface peripheral devices with Microcontroller so as to design Microcontroller based projects.
SUGGESTIVE LIST OF EXPERIMENTS:

1. Study of semiconductor diode voltmeter and its use as DC average responding AC Voltmeter.
2. Study of L.C.R. Bridge and determination of the value of the given components.
3. Characteristics of Thermocouples and RTD.
4. Study of the following transducer (i) PT-100 Transducer (ii) J-Type Transducer (iii) K-Type Transducer (iv) Pressure Transducer
5. Measurement of phase difference and frequency using CRO (Lissajous Figure)
6. Characteristics of LDR, Photo Diode, and Phototransistor:
   (i) Variable Illumination.
   (ii) Linear Displacement
7. Characteristics of LVDT.
8. Study of the transistor tester and determination of the parameters of the given transistors
10. Implementation of Color Sensor for differentiating frequencies

Through Virtual Lab:
11. Measurement of low resistance Kelvin’s double bridge.
12. To measure unknown capacitance of small capacitors by using Schering’s bridge.
13. To measure unknown Inductance using Hay’s bridge.
14. Measurement of capacitance by De Sauty Bridge.

Virtual Lab Link: [http://vlabs.iitkgp.ernet.in/asnm/#](http://vlabs.iitkgp.ernet.in/asnm/#)

Available on: [http://www.vlab.co.in/broad-area-electronics-and-communications](http://www.vlab.co.in/broad-area-electronics-and-communications)

Course Outcomes:
At the end of this course students will demonstrate the ability to:
1. Demonstrate voltage measurement using AC voltmeter and semiconductor diode voltmeter.
2. Measure the unknown resistance, capacitance and inductance using LCR Bridge, Kelvin double bridge, Schering bridge, Hay’s bridge, De sauty bridge.
3. Practically demonstrate the different types of transducers like J-type, K-type, PT-100 and RTD.
4. Interpret frequency and phase difference from Lissajous figure.
5. Interpret hybrid parameters of transistor and demonstrate different transducer like LDR and LVDT.
B.Tech 3rd Year
VI Semester
Syllabus
<table>
<thead>
<tr>
<th>Unit</th>
<th>Topics</th>
<th>Lectures</th>
</tr>
</thead>
</table>
| I    | Advanced concepts in 8051 architecture:  
Review of 8051 architecture, concept of synchronous serial communication, SPI and I2C communication protocols, study of SPI port on 89LP 51RD2, study of SAR ADC/DAC MCP3304 / MCP 33, interfacing concepts for SPI based ADC/DAC, study of watchdog timer, study of PCA timer in different modes like capture mode, PWM generation mode, High speed output toggle mode  
Embedded ‘C’ programming for the above peripherals. | 8 |
| II   | MSP430x5x Microcontroller: series block diagram, address space, on-chip peripherals (analog and digital), and Register sets. Instruction set, instruction formats, and various addressing modes of 16-bit microcontroller; Sample embedded system on MSP430 microcontroller. Memory Mapped Peripherals, programming System registers, I/O pin multiplexing, pull up/down registers, GPIO control. Interrupts and interrupt programming. | 8 |
| III  | Introduction to Embedded Systems: Describe what an embedded system is and its main components, Outline the different options available for building embedded systems, Explain the benefits, functions, and attributes of embedded systems, Examine the constraints specific to embedded systems and their impact  
Introduction to the Arm Cortex-M4 Processor Architecture, Identify key features of Arm architectures and processors, Explain the features and layout of the Arm Cortex-M4 processor. Explain the structure and purpose of specific registers in the Arm Cortex-M4 processor  
Introduction to Arm Cortex-M4 Programming, Compare the C and Assembly programming languages, Explain program-generation flow, including compilation and program images, Describe and compare different data formats and how they are stored in memory, Explain how mixed assembly and C programming can be performed, Introduction to the Mbed Platform and CMSIS. | 8 |
| IV   | Digital Input and Output (IO): Explain the relationship between electrical voltages and logic values, Describe the key features of GPIOs (General Purpose I/O pins) and how they can be used to control peripherals, Explain the key elements of GPIO design in relation to microcontrollers. Compare register-level GPIO programming to GPIO programming with the Mbed API. Interrupts and Low Power Features: Interrupts and Low Power Features, Serial Communication  
Introduction to the Internet of Things (IoT): Describe the concepts of IoT and understand the key elements of an IoT device, Outline the evolution of IoT, Describe the main technologies that enable IoT, Identify the key challenges facing IoT systems, and Evaluate the opportunities and risks that emerge with IoT adoption. | 8 |
| V    | Hardware Platforms for IoT: Identify the concepts of hardware platform and the factors influencing its design, Differentiate between various types of memory, Explain the principles of sensors and the role of I/O  
IoT Connectivity: Identify the concept of Bluetooth technology, Identify key features of the Bluetooth and Bluetooth Low Energy protocols, Explain how a Bluetooth connection is secured, Outline the new features that are introduced in the Bluetooth 5 specification, Explain the architecture and protocol stack used in ZigBee. | 8 |
Text Books:

Reference Books:

Course Outcomes: At the end of this course students will demonstrate the ability to:

1. Explain the advance concept of 8051 architectures and AVR family architecture and compare them for different applications.
2. To demonstrate the basics of MSP430x5x Microcontroller
3. To execute the I/O interfacing and peripheral devices associated with Microcontroller SoC (system on chip).
4. Explain the advance concept Arm Cortex-M4 Processor Architecture.
5. Demonstrate the ability to do Demonstrate the basics of Embedded Systems, IoT and its application and design IoT based projects on Arm based development boards
<table>
<thead>
<tr>
<th>Unit</th>
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</thead>
<tbody>
<tr>
<td>I</td>
<td><strong>Introduction to Control Systems</strong>: Basic Components of a control system, Feedback and its effect, types of feedback control systems. Block diagrams Reduction and signal flow graphs, Modeling of Physical systems: electrical networks, mechanical systems elements, free body diagram, analogous Systems, sensors and encoders in control systems, modeling of armature controlled and field controlled DC servomotor.</td>
<td>8</td>
</tr>
<tr>
<td>II</td>
<td><strong>State-Variable Analysis</strong>: Introduction, vector matrix representation of state equation, state transition matrix, state-transition equation, relationship between state equations and high-order differential equations, relationship between state equations and transfer functions, Decomposition of transfer functions, Controllability and observability, Eigen Value and Eigen Vector, Diagonalization.</td>
<td>8</td>
</tr>
<tr>
<td>III</td>
<td><strong>Time domain Analysis of Control Systems</strong>: Time response of continuous data systems, typical test signals for the time response of control systems, unit step response and time-domain specifications, time response of a first order system, transient response of a prototype second order system, Steady-State error, Static and dynamic error coefficients, error analysis for different types of systems.</td>
<td>8</td>
</tr>
<tr>
<td>IV</td>
<td><strong>Stability of Linear Control Systems</strong>: Bounded-input bounded-output stability continuous data systems, zero-input and asymptotic stability of continuous data systems, Routh Hurwitz criterion, Root-Locus Technique: Introduction, Properties of the Root Loci, Design aspects of the Root Loci.</td>
<td>8</td>
</tr>
<tr>
<td>V</td>
<td><strong>Frequency Domain Analysis</strong>: Resonant peak and Resonant frequency, Bandwidth of the prototype Second order system, effects of adding a zero to the forward path, effects of adding a pole to the forward path, polar plot, Nyquist stability criterion, stability analysis with the Bode plot, relative stability: gain margin and phase margin.</td>
<td>8</td>
</tr>
</tbody>
</table>

**Text Book:**

**Reference Books:**

**Course Outcomes: At the end of this course students will demonstrate the ability to:**
1. Describe the basics of control systems along with different types of feedback and its effect. Additionally, they will also be able to explain the techniques such as block diagrams reduction, signal flow graph, and modelling of various physical systems along with modelling of DC servomotor.
2. Explain the concept of state variables for the representation of LTI systems.
3. Interpret the time domain response analysis for various types of inputs along with the time domain specifications.
4. Distinguish the concepts of absolute and relative stability for continuous data systems along with different methods.
5. Interpret the concept of frequency domain response analysis and their specifications.
### KIC 603  
**INDUSTRIAL MEASURING INSTRUMENTS**  
3L:1T:0P  
4 Credits

<table>
<thead>
<tr>
<th>Unit</th>
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<th>Lectures</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Generalized configurations, functional descriptions and performance characteristics of measuring instruments: General concepts and terminology of measurement systems, transducer classification, general input-output configuration, static and dynamic characteristics of a measurement system, statistical analysis of measurement data. Standards and Calibration. <strong>Displacement measurement</strong>: Resistive potentiometers, Digital displacement transducers, Mechanical fly ball angular velocity sensor, Mechanical revolution counters and timers, stroboscopic method.</td>
<td>8</td>
</tr>
<tr>
<td>II</td>
<td><strong>Force and Pressure Measurement</strong>: Standards &amp; calibration; basic methods of force measurement; Characteristics of elastic force transducer-Bonded strain gauge, differential transformer, Piezoelectric transducer. Units of pressure; dead weight gauges &amp; manometer and its types, Bellows and force balance type sensors, Bourdon guages, Piezoelectric, Capacitive and Inductive Pressure pickups.</td>
<td>8</td>
</tr>
<tr>
<td>III</td>
<td><strong>Flow measurement</strong>: Differential pressure flowmeters: Bernoulli’s theorem: pitot tube, orifice, venturi, flow nozzle, Hot wire and hot film anemometers, variable area meters (rotameter), meters, Electromagnetic flowmeters, Ultrasonic flowmeters, Drag force flow meter, Vortex shedding flow meters. Measurement of level, Float type gauge, purge method, differential pressure method, conductive and capacitive method; electromechanical method.</td>
<td>8</td>
</tr>
<tr>
<td>IV</td>
<td><strong>Temperature measurements</strong>: Standards and calibration, thermal expansion methods, bimetallic thermometer, thermocouple, reference junction considerations, special materials, configuration &amp; techniques. Measurement of thermocouple output, Electrical resistance sensors and thermistors, Radiation thermometers.</td>
<td>8</td>
</tr>
<tr>
<td>V</td>
<td><strong>Miscellaneous Measurements: Viscosity, Density and Vacuum</strong>: <strong>Measurement of Viscosity</strong>: Definitions, units, Newtonian and Newtonian behaviour, measurement of viscosity using laboratory viscometers, industrial viscometers. Viscometer selection and application. <strong>Measurement of Density</strong>: Definitions, units, liquid density measurement, gas densitometers, its application and selection, <strong>Measurement of Vacuum</strong>: Meleod gauge, Pirani gauge, Knudsen gauge and Ionization gauge.</td>
<td>8</td>
</tr>
</tbody>
</table>

**Text Books:**


**Reference Books:**

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

1. Describe the basic fundamentals, terms, and characteristics of measurement system.
2. Explain the working principle of various transducers used for the measurement of force and pressure.
3. Recognize the physics of pressure, temperature, level and flow measurement used to control dynamics of processes.
4. Assemble commonly used temperature measurement devices through proper selection, identification, design, installation and principle of operation in industries.
5. Develop critical and creative thinking to bring the technology, problem-solving skills in trouble shooting problems with the measurement and control of industrial instrumentation work.
KIC-061  |  OPTO-ELECTRONICS  |  3L:0T:0P  |  3 Credits

<table>
<thead>
<tr>
<th>Unit</th>
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</thead>
<tbody>
<tr>
<td>I</td>
<td>Introduction to optical waveguide, Photo sources and detectors: Optical wave guide modes-Theory of Dielectrics lab waveguides- Symmetric and Asymmetric Slab waveguide, Channel waveguide Light emitting diode (LED), materials, constructions, Drive circuitry, Fundamentals of lasers and its applications</td>
<td>8</td>
</tr>
<tr>
<td>II</td>
<td>Electro Optic Effects: Birefringence phenomenon EO Retardation, EO Amplitude and Phase Modulator, Electro optic Intensity Modulators, Beam deflection, Acousto-optics, A-O Modulators, Integrated optic spectrum analyzer.</td>
<td>8</td>
</tr>
<tr>
<td>III</td>
<td>Optical Fiber Sensors: Multi mode fiber Sensors-Displacement, pressure, stress, strain. Intensity modulated sensors, Active multimode FO sensors, Micro-bend optical fiber sensor, Current sensors, Magnetic sensors, Single mode FO sensors, Phase modulated, Polarization modulated, Fibre Optic Gyroscope</td>
<td>8</td>
</tr>
<tr>
<td>IV</td>
<td>Optical detection principles: Absorption Quantum efficiency Responsivity, Long wavelength cutoff, Photon detectors: Photodiodes, PIN photodiode, APD, photomultipliers, Thermal detector: Bolometers and thermisters, Pyroelectric detector</td>
<td>8</td>
</tr>
<tr>
<td>V</td>
<td>Optical Computing: Analog arithmetic operation- addition/subtraction, multiplication, division, averaging, differentiation and integration. Digital logic: modified signed digit number system, residue number system, logarithmic number system. Arithmetic operations: MSD, residue, signed logarithmic arithmetic, threshold logic, threshold devices, spatial light modulators.</td>
<td>8</td>
</tr>
</tbody>
</table>

Text Books:

Reference Books:
2. Emmanuel Rosencher and BorgeVinter, "Optoelectronics", Cambridge University Press. 2012

Course Outcomes:At the end of this course students will demonstrate the ability to:

1. Explain the basic learning of Optical waveguides, photo source and detectors.
2. Demonstrate the concept of Electro Optic effects.
3. Analyze the working of optical fiber sensor.
4. Interpret the basics of optical detection principles
5. Express the basics of optical computing.
1. KIC-062 DIGITAL MEASUREMENT TECHNIQUES 3L:0T:0P 3 Credits

<table>
<thead>
<tr>
<th>Unit</th>
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<tbody>
<tr>
<td>I</td>
<td>Philosophy of digital measurements. Digital Time Measurement Techniques: Measurement of time interval between two events, Error in time interval measurement, Vernier technique for small time measurement, Measurement of time interval with constraints, Measurement of periodic time, phase, Time interval between two events defined by voltage levels, Capacitance, Quality factor of ringing circuit, Decibel meter</td>
<td>8</td>
</tr>
<tr>
<td>II</td>
<td>Digital Frequency Measurement Techniques: Measurement of frequency, Ratio of two frequencies, Product of two frequencies, High frequency, average Frequency difference, Deviation of power frequency, Peak frequency. Fast low-frequency measurement.</td>
<td>6</td>
</tr>
<tr>
<td>III</td>
<td>Digitally Programmable Circuits: Single mode switching, Group mode switching, Resistors, Potentiometers, Amplifiers, Schmitt trigger, Dual polarity gain amplifiers. Programmable gain amplifier with dual output, Two stage programming, Programmable Biquads.</td>
<td>9</td>
</tr>
<tr>
<td>IV</td>
<td>Digital to Analog Converters: Output Input relation, DACs derived from programmable gain amplifiers, Weighted-resistor DAC, Weighted current DAC, Weighted reference voltage DAC, Ladder DAC, Switches.</td>
<td>9</td>
</tr>
<tr>
<td>V</td>
<td>Digital Voltage Measurement Techniques: Sampling theorem, Time-division multiplexing, Quantization, Indirect type A/D converters, Direct type A/D converters, Input circuitry of a digital voltmeter.</td>
<td>8</td>
</tr>
</tbody>
</table>

Text Books:

Reference Books:
1. A.K. Maini, All in One Electronics Simplified, Khanna Publishing House, Delhi

Course Outcomes: At the end of this course students will demonstrate the ability:
1. To describe the basic knowledge of Digital Measurement Technique.
2. To demonstrate the concepts of DMT involved in term of frequency.
3. To explain the concepts of programmable circuits.
4. To analyze the performance of digital to analog converters.
5. To apply the concept of voltage measurement in DMT.
### Data Communication Networks

<table>
<thead>
<tr>
<th>Unit</th>
<th>Topics</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Introduction to Networks &amp; Data Communications: Goals and Applications of Networks, The Internet, Protocols &amp; Standards, Layered Tasks, OSI Reference Model, TCP/IP, Addressing, Line Coding Review.</td>
</tr>
</tbody>
</table>

### Text Books:

### Reference Books:

### Course Outcomes: At the end of this course students will demonstrate the ability to:

1. Identify the issues and challenges in the architecture of a network.
2. Analyze the services and features of various protocol layers in data layer.
3. Demonstrate the knowledge of multiple access to design a access technique for a particular application.
4. Realize protocols at different layers of a network hierarchy.
5. Recognize security issues in a network and various application of application layer.
KEC-064 ANALOG SIGNAL PROCESSING | 3L : 0T : 0P | 3 Credits

<table>
<thead>
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<tr>
<td>I</td>
<td>Introduction to domains and the analogue/digital trade off, Introduction to current conveyor, current feedback amplifier. Analog signal filtering: introduction to bilinear transfer functions and active realizations. Second-order filter realization, filter design parameters (Q and ( \omega_0 )), frequency response, Three op-amp biquad, effect of finite gain of op-amp over filters, Sallen-Key biquad.</td>
<td>8</td>
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<td>II</td>
<td>Ideal low-pass filter, Buttreworth and Chebyshev magnitude response, pole locations, low-pass filter specifications, comparison of Maximally flat and Equal ripple responses.</td>
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<td>III</td>
<td>Delay equalization: equalization procedures, equalization with first-order and second order modules, strategies for equalization design. Definition of Bode sensitivity.</td>
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<td>IV</td>
<td>The General Impedance Convertor (GIC), optimal design of the GIC, realization of simple ladders, Gorski-Popiel’s Embedding Technique, Bruton’s FDNR technique, Creating negative components.</td>
<td>8</td>
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<tr>
<td>V</td>
<td>Elementary transconductor building blocks, resistors, integrators, amplifiers, summers, Gyrorator, First and second order filters, Higher order filters</td>
<td>8</td>
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</tbody>
</table>

Text Book:


Course Outcomes: At the end of this course students will demonstrate the ability to:

1. Describe and apply fundamentals of signal processing in analog domain and its associated concepts like OTA and current conveyor.
2. Introduction of filter and its designing parameters
3. Solve problems and design higher order filters like Butterworth and Chebyshev.
4. Understand and explain the reasons for delay in filter designing and its procedure to equalize.
5. Understand the principles of the inductor simulation like general impedance convertor (GIC), optimal design of the GIC, Gorski-Popiel’s Embedding Technique, Bruton’s FDNR technique which are used for placing equivalent inductor on integrated circuits.
KEC-065  RANDOM VARIABLES & STOCHASTIC PROCESS  3L:0T:0P  3 Credits

<table>
<thead>
<tr>
<th>Unit</th>
<th>Topics</th>
<th>Lectures</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td><strong>Probability</strong>: Introduction to set theory, experiments and sample spaces, joint probability, conditional probability, concept of total Probability, Bayes’ Theorem, and independent events, Bernoulli’s trials, combined experiments.</td>
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<tr>
<td>II</td>
<td><strong>Random Variables</strong>: Introduction, types of random variables, cumulative distribution function and probability density functions, Standard distributions: Gaussian, exponential, Rayleigh, uniform, Bernoulli, binominal, Poisson, discrete uniform and conditional distributions. Functions of one random variable: distribution, mean, variance, moments and characteristics functions.</td>
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<tr>
<td>III</td>
<td><strong>Multiple Random Variables</strong>: Joint distributions, joint density function and properties, marginal distribution and density functions, conditional distribution and density Functions, statistical independence, functions of two random variables, joint moments, Multiple random variables: multiple functions of multiple random variables, jointly Gaussian random variables, sums of random variable, Central limit theorem.</td>
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<tr>
<td>IV</td>
<td><strong>Stochastic Processes</strong>: Definitions, Random process concept, Statistics of stochastic processes: Mean, Autocorrelation, Covariance Functions and its properties, Strict and Wide sense stationary, random processes, Time Averages and Ergodicity, Mean-Ergodic Processes.</td>
<td>8</td>
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<tr>
<td>V</td>
<td><strong>Stochastic Processes in Frequency Domain</strong>: Power spectrum of stochastic processes, Properties of power spectral density, Relationship between Power Spectrum and Autocorrelation Function, the Cross-Power Density Spectrum and Properties, Relationship between Cross-Power Spectrum and Cross-Correlation Function, Transmission over LTI systems, Gaussian and White processes.</td>
<td>8</td>
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</tbody>
</table>

**Text Books:**

**Reference Books:**
1. Devore – Probability and statistics for engineering and sciences, Cengage learning 2011

**Course Outcomes: At the end of this course students will demonstrate the ability to:**

1. Students will be able to explain the basic learning of Probability.
2. Students will be able to demonstrate the concept of Random Variables.
3. Students will be able to analyze Multiple Random Variables.
4. Students will be able to interpret the basics of Stochastic Processes.
5. Students will be able to express Stochastic Processes in Frequency domain.
SUGGESTIVE LIST OF EXPERIMENTS:

Part A: Based on ARM Process:
1. To develop and verify the interfacing ADC and DAC with LPC 2148 Arm Micro Controller.
2. Interfacing of LED and PWM with Micro Controller (ARM-) using embedded C program.
3. Interfacing of serial port with Am processor using embedded C-program.
4. Interfacing of key board and LCD with Arm processor using embedded C-Program.
5. To develop and verify Embedded C program mailbox using ARM.
6. To implement zigbee protocol with ARM program.
7. Implement the lighting and winking LEDs of the ARM I/O port via programming.
8. ARM programming in C language using KEIL IDE.
9. Demonstrate the TIMING concept of real time application using RTOS on ARM microcontroller kit.
10. Demonstrate the Multi-Tasking concept of real time application using RTOs on ARM microcontroller.
11. Demonstrate the RS 232 serial communication using RTOS on ARM microcontroller kit.
12. ISR (Interrupt Service Routine) programming in ARM based system with I/O port.

Part B: Based on MSP 430
1. Write a program for temperature & to display on intelligent LCD display.
2. Write a program to generate a Ram waveform using DAC with micro controller.
3. Write a program to Interface GPIO port in C using MSP430 (blinking LEDs, push buttons)
4. Write a program Interface potentiometer with GPIO.
5. Write a program of PWM based Speed Controller of Motor controlled by potentiometer connected to GPIO.
6. Write a program of PWM generation using Timer on MSP430 GPIO.
7. Write a program to Interface an accelerometer.
8. Write a program using USB (Sending data back and forth across a bulk transfer-mode USB connection.)

Part C: Virtual Lab Platform
https://www.soe.uoguelph.ca/webfiles/engg4420/EmbeddedSystemsAndLabsForARM-V1.1.pdf
https://profile.iiita.ac.in/bibhas.ghoshal/IEMB_2018/Lectures/ES_basics.pdf
https://nptel.ac.in/courses/108/102/108102045/

Practical Outcome The Student able to:
1. To understand the building blocks of embedded system.
2. To learn the concept of interfacing with different devices.
3. To relate the concept of memory map and memory interface.
4. To discover the characteristics of real time system and to validate the process using know input-output parameters.
5. To understand the basis work of microcontroller and learn the working.
6. Demonstrate knowledge of programs environment and executing variety of programs.
KIC-652 | CONTROL SYSTEMS LAB | 0L:0T:2P | 1 Credit

SUGGESTIVE LIST OF EXPERIMENTS:

1. Introduction to MATLAB Control System Toolbox.
2. Determine transpose, inverse values of given matrix.
3. Plot the pole-zero configuration in s-plane for the given transfer function.
4. Determine the transfer function for given closed loop system in block diagram representation.
5. Create the state space model of a linear continuous system.
6. Determine the State Space representations of the given transfer function.
7. Determine the time response of the given system subjected to any arbitrary input.
8. Plot unit step response of given transfer function and find delay time, rise time, peak time, peak overshoot and settling time.
9. Determine the steady state errors of a given transfer function.
10. Plot root locus of given transfer function, locate closed loop poles for different values of k.
11. Plot bode plot of given transfer function. Also determine gain and phase margins.
12. Plot Nyquist plot for given transfer function. Also determine the relative stability by measuring gain and phase margin.

Course Outcomes: At the end of this course students will demonstrate the ability to:

1. Classify different tools in MATLAB along with the basic matrix operations used in MATLAB.
2. Evaluate the poles and zeros on s-plane along with transfer function of a given system.
3. Construct state space model of a linear continuous system.
4. Evaluate the various specifications of time domain response of a given system.
5. Appraise the steady state error of a given transfer function.
6. Examine the relative stability of a given transfer function using various methods such as root locus, Bode plot and Nyquist plot.
KIC-653 | INDUSTRIAL INSTRUMENTATION LAB | 0L:0T:2P | 1 Credit

**SUGGESTIVE LIST OF EXPERIMENTS:**

1. Instrumentation Amplifier: Design for specific gain and verification of CMRR.
2. Realization of PCM signal using ADC and reconstruction using DAC using 4-bit/8bit systems. Observe the Quantization noise in each case.
3. Study of low noise and low frequency amplifier for biomedical application.
4. Design of temperature transmitter using RTD.
5. Design of cold junction compensation circuit.
7. Design of pressure transmitter.
8. Performance evaluation of pressure gauges using Dead weight tester.
10. Measurement of flow using orifice, electromagnetic and positive displacement flowmeters.
11. Study of PID controllers in flow measurement.
13. Experiment using PLC Trainer Kits
14. Simulate and analyze the frequency domain measurement of electrical signals using spectrum analyzer.
15. Range finding and object detection using detection sensor.
16. Measurement using various sensors and analyzing the output using Virtual Instrumentation Lab-VIEW software.

**Course Outcomes: At the end of this course students will demonstrate the ability:**

1. To design instrumentation amplifier.
2. To execute PCM technique and demonstrate the concept.
3. To design equipments related to temperature measurement.
4. To analyze the performance of various pressure gauges.
5. To conceptualize the principle of flow meters using various flow measurement instruments.