

ELECTRONICS AND COMMUNICATION ENGINEERING

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UNIVERSITY, UTTAR PRADESH, LUCKNOW



EVALUATION SCHEME & SYLLABUS

FOR

B. TECH. THIRD YEAR

ELECTRONICS ENGINEERING  
ELECTRONICS AND COMMUNICATION ENGINEERING  
ELECTRONICS AND TELECOMMUNICATION ENGINEERING

AS PER

AICTE MODEL CURRICULUM

[Effective from the Session: 2020-21]

# ELECTRONICS AND COMMUNICATION ENGINEERING

## B.Tech. V Semester

### Electronics and Communication Engineering

S. No.	Course Code	Course Title	Periods			Evaluation Scheme				End Semester		Total	Credits
			L	T	P	CT	TA	Total	PS	TE	PE		
1	KEC-501	Integrated Circuits	3	1	0	30	20	50		100		150	4
2	KEC-502	Microprocessor & Microcontroller	3	1	0	30	20	50		100		150	4
3	KEC-503	Digital Signal Processing	3	1	0	30	20	50		100		150	4
4	KEC-051-054	Department Elective-I	3	0	0	30	20	50		100		150	3
5	KEC-055-058	Department Elective-II	3	0	0	30	20	50		100		150	3
6	KEC-551	Integrated Circuits Lab	0	0	2				25		25	50	1
7	KEC-552	Microprocessor & Microcontroller Lab	0	0	2				25		25	50	1
8	KEC-553	Digital Signal Processing Lab	0	0	2				25		25	50	1
9	KEC-554	Mini Project/Internship **	0	0	2				50			50	1
10	KNC501/KNC502	Constitution of India, Law and Engineering / Indian Tradition, Culture and Society	2	0	0	15	10	25		50			NC
11		MOOCs (Essential for Hons. Degree)											
		<b>Total</b>										<b>950</b>	<b>22</b>

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

#### Course Code

#### Course Title

#### Department Elective-I

KEC-051	Computer Architecture and Organization
KEC-052	Industrial Electronics
KEC-053	VLSI Technology
KEC-054	Advance Digital Design using Verilog

#### Department Elective-II

KEC-055	Electronics Switching
KEC-056	Advance Semiconductor Device
KEC-057	<b>Electronic Instrumentation and Measurements</b>
KEC-058	Optical Communication

# ELECTRONICS AND COMMUNICATION ENGINEERING

## B.Tech. VI Semester Electronics and Communication Engineering

S. No.	Course Code	Course Title	Periods			Evaluation Scheme				End Semester		Total	Credits
			L	T	P	CT	TA	Total	PS	TE	PE		
1	KEC-601	Digital Communication	3	1	0	30	20	50		100		150	4
2	KEC-602	Control System	3	1	0	30	20	50		100		150	4
3	KEC-603	Electromagnetic Field Theory and Antenna	3	1	0	30	20	50		100		150	4
4	KEC-061- KEC-064	Department Elective-III	3	0	0	30	20	50		100		150	3
5		Open Elective-I	3	0	0	30	20	50		100		150	3
6	KEC-651	Digital Communication Lab	0	0	2				25		25	50	1
7	KEC-652	Control System Lab	0	0	2				25		25	50	1
8	KEC-653	Elective Lab	0	0	2				25		25	50	1
9	KNC601/ KNC602	Constitution of India, Law and Engineering / Indian Tradition, Culture and Society	2	0	0	15	10	25		50			NC
10		MOOCs (Essential for Hons. Degree)											
		<b>Total</b>										<b>900</b>	<b>21</b>

Course Code	Course Title
	<b>Department Elective-III</b>
KEC-061	Microcontroller & Embedded System
KEC-062	Satellite Communication
KEC-063	Data Communication Networks
KEC-064	Analog Signal Processing

Course Code	Elective Lab
KEC-653A	Measurement & Instrumentation Lab
KEC-653B	CAD for Electronics Lab
KEC-653C	Microcontroller & Embedded System Lab

**B.Tech 3<sup>rd</sup> Year  
V Semester  
Syllabus**

# ELECTRONICS AND COMMUNICATION ENGINEERING

<b>KEC-501</b>	<b>INTEGRATED CIRCUITS</b>	<b>3L:1T:0P</b>	<b>4 Credits</b>
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Unit	Topics	Lectures
I	<b>The 741 IC Op-Amp:</b> 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.	8
II	<b>Linear Applications of IC Op-Amps:</b> Op-Amp based V-I and I-V converters, instrumentation amplifier, generalized impedance converter, simulation of inductors. <b>Active Analog filters:</b> 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.	8
III	<b>Frequency Compensation &amp; Nonlinearity:</b> Frequency Compensation, Compensation of two stage Op-Amps, Slewing in two stage Op-Amp. Nonlinearity of Differential Circuits, Effect of Negative feedback on Nonlinearity. <b>Non-Linear Applications of IC Op-Amps:</b> Basic Log–Anti Log amplifiers using diode and BJT, temperature compensated Log-Anti Log amplifiers using diode, peak detectors, sample and hold circuits. Op-amp as a comparator and zero crossing detector, astable multivibrator & monostable multivibrator. Generation of triangular waveforms, analog multipliers and their applications.	4  8
IV	<b>Digital Integrated Circuit Design:</b> An overview, CMOS logic gate circuits basic structure, CMOS realization of inverters, AND, OR, NAND and NOR gates. <b>Latches and Flip flops:</b> 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.	6
V	<b>Integrated Circuit Timer:</b> 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. <b>Phase Locked Loop (PLL):</b> Basic principle of PLL, block diagram, working, Ex-OR gates and multipliers as phase detectors, applications of PLL.	6

### Text Book:

1. Microelectronic Circuits, Sedra and Smith, 7th Edition, Oxford, 2017.
2. Behzad Razavi, Design of Analog CMOS Integrated Circuits, McGraw Hill
3. Gayakwad, "Op-Amps and Linear Integrated Circuits, 4th Edition, Pearson Education.
4. Sergio Franco, Design of Operational Amplifier and Analog Integrated Circuit, McGraw Hill
5. David A. Bell, "Operational Amplifiers and Linear IC's", Pearson Education,

### Reference Books:

1. Franco, Analog Circuit Design: Discrete & Integrated, McGraw Hill, 1st Edition.
2. D. Roy Choudhary and Shail B. Jain, "Linear Integrated Circuits", New Age Publication
3. International Publications TB1 L.K. Maheshwari, Analog Electronics, PHI,2005
4. Salivahnan, Electronics Devices and Circuits, McGraw Hill , 3rd Edition, 2015
5. Millman and Halkias: Integrated Electronics, McGraw Hill, 2nd Edition, 2010.
6. TB2 L.K. Maheshwari and M.M.S. Anand, Laboratory Experiments & PSPICE Simulation in Analog Electronics Experiments, PHI, 2005.

### 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.

# ELECTRONICS AND COMMUNICATION ENGINEERING

<b>KEC-502</b>	<b>MICROPROCESSOR &amp; MICROCONTROLLER</b>	<b>3L:1T:0P</b>	<b>4 Credits</b>
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Unit	Topics	Lectures
I	<b>Introduction to Microprocessor:</b> Microprocessor architecture and its operations, Memory, Input & 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.	8
II	<b>Basic Programming concepts:</b> , 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.	8
III	<b>16-bit Microprocessors (8086):</b> Architecture, Pin Description, Physical address, segmentation, memory organization, Addressing modes. <b>Peripheral Devices:</b> 8237 DMA Controller, 8255 programmable peripheral interface, 8253/8254 programmable timer/counter, 8259 programmable interrupt controller, 8251 USART and RS232C.	8
IV	<b>8051 Microcontroller Basics:</b> 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.	8
V	<b>Assembly programming and instruction of 8051:</b> 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, Comparison of Microprocessor, Microcontroller, PIC and ARM processors and their application areas. <b>Interfacing:</b> LCD & Keyboard Interfacing, ADC, DAC & Sensor Interfacing, External Memory Interface, Stepper Motor and Waveform generation.	8

### Text Books:

1. Ramesh Gaonkar, "Microprocessor Architecture, Programming, and Applications with the 8085", 6th Edition, Penram International Publication (India) Pvt. Ltd., 2013
2. Mazidi Ali Muhammad, Mazidi Gillispie Janice, and McKinlay Rolin D., "The 8051 Microcontroller and Embedded Systems using Assembly and C", Pearson, 2nd Edition, 2006
3. Senthil Kumar Saravanan, Jeevanathan, Microprocessor and Microcontrollers, Oxford, 2010
4. D. V. Hall : Microprocessors Interfacing, , McGraw 3rd Edition
5. Fundamental of Microprocessor and Microcontrollers, B. RAM, Dhanpat Rai Publication
6. Soumitra Kumar Mandal, Microprocessor and Microcontrollers Architecture Programming and Interfacing using 8085, 8086 and 8051, McGraw Hill

### Reference Books:

1. Kenneth L. Short, "Microprocessors and programmed Logic", 2nd Ed, Pearson Education Inc., 2003
2. Barry B. Brey, "The Intel Microprocessors, 8086/8088, 80186/80188, 80286, 80386, 80486, Pentium, PentiumPro Processor, PentiumII, PentiumIII, Pentium IV, Architecture, Programming & Interfacing", Eighth Edition, Pearson Prentice Hall, 2009.
3. Shah Satish, "8051 Microcontrollers MCS 51 Family and its variants", Oxford, 2010

### 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

# ELECTRONICS AND COMMUNICATION ENGINEERING

<b>KEC-503</b>	<b>DIGITAL SIGNAL PROCESSING</b>	<b>3L:1T:0P</b>	<b>4 Credits</b>
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Unit	Topics	Lectures
I	<p><b>Introduction to Digital Signal Processing:</b> Basic elements of digital signal processing, advantages and disadvantages of digital signal processing, Technology used for DSP.</p> <p><b>Realization of Digital Systems:</b> Introduction- basic building blocks to represent a digital system, recursive and non-recursive systems, basic structures of a digital system: Canonic and Non-Canonic structures.</p> <p><b>IIR Filter Realization:</b> Direct form, cascade realization, parallel form realization, Ladder structures- continued fraction expansion of <math>H(z)</math>, example of continued fraction, realization of a ladder structure, design examples.</p> <p><b>FIR Filter Realization:</b> Direct, Cascade, FIR Linear Phase Realization and design examples.</p>	8
II	<p><b>Infinite Impulse Response Digital (IIR) Filter Design:</b> Introduction to Filters, Impulse Invariant Transformation, Bi-Linear Transformation, All- Pole Analog Filters: Butterworth and Chebyshev, Design of Digital Butterworth and Chebyshev Filters, Frequency Transformations.</p>	6
III	<p><b>Finite Impulse Response Filter (FIR) Design:</b> Windowing and the Rectangular Window, Gibb's phenomenon, Other Commonly Used Windows (Hamming, Hanning, Bartlett, Blackmann, Kaiser), Examples of Filter Designs Using Windows.</p> <p><b>Finite Word length effects in digital filters:</b> Coefficient quantization error, Quantization noise – truncation and rounding, Limit cycle oscillations-dead band effects.</p>	4  2
IV	<p><b>Discrete Fourier Transform:</b> 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.</p> <p><b>Fast Fourier Transform:</b> Radix-2 algorithm, decimation-in-time, decimation-in-frequency algorithms, signal flow graphs, Butterflies, computations in one place, bit reversal, examples for DIT &amp; DIF FFT Butterfly computations with examples.</p>	6  6
V	<p><b>Multirate Digital Signal Processing (MDSP):</b> Introduction, Decimation, Interpolation, Sampling rate conversion: Single and Multistage, applications of MDSP- Subband Coding of Speech signals, Quadrature mirror filters, Advantages of MDSP.</p> <p><b>Adaptive Filter:</b> Introduction &amp; Example of adaptive Filter, The window LMS Algorithm, Recursive Least Square Algorithm. The Forward-Backward Lattice and Gradient Adaptive Lattice Method.</p> <p><b>Digital Signal Processors:</b> Introduction, Architecture, Features, Addressing Formats, Functional modes. Introduction to Commercial Digital Signal Processors</p>	4  4  2

**Text Books:**

1. John G Prokias, Dimitris G Manolakis, Digital Signal Processing, Pearson , 4<sup>th</sup> Edition, 2007
2. S. Salivahanan, Digital Signal Processing, McGraw Hill, 4<sup>th</sup> Edition 2017.
3. Johnny R. Johnson, Digital Signal Processing, PHI Learning Pvt Ltd., 2009.

**Reference Books:**

1. Oppenheim & Schafer, Digital Signal Processing. Pearson Education 2015
2. S.K. Mitra, 'Digital Signal Processing–A Computer Based Approach, McGraw Hill, 4<sup>th</sup> Edition.

**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.

KEC-551	INTEGRATED CIRCUITS LAB	0L:0T:2P	1 Credit
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## SUGGESTIVE LIST OF EXPERIMENTS:

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

### Virtual Lab Link:

- <http://vlabs.iitkgp.ernet.in/be/exp17/index.html>
- <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:

- Design different non-linear applications of operational amplifiers such as log, antilog amplifiers and voltage comparators.
- Explain and design different linear applications of operational amplifiers such as filters.
- Demonstrate the function of waveforms generator using op-Amp.
- Construct multivibrator and oscillator circuits using IC555 and IC566 and perform measurements of frequency and time.
- Design and practically demonstrate the applications based on IC555 and IC566.



KEC-552	MICROPROCESSOR & MICROCONTROLLER LAB	0L:0T:2P	1 Credit
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## 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.
15. Interfacing of Stepper motor to 8051.
16. Interfacing of ADC to 8051.

**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>

**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.

KEC-553	DIGITAL SIGNAL PROCESSING LAB	0L:0T:2P	1 Credit
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## SUGGESTIVE LIST OF EXPERIMENTS:

1. Introduction to MATLAB and or Open Source Software, Scilab (Using Spoken Tutorial MOOCs). Hardware (Using TI / Analog devices / Motorola / Equivalent DSP processors).
2. Write a Program for the generation of basic signals such as unit impulse, unit step, ramp, exponential, sinusoidal and cosine.
3. Implement IIR Butterworth analog Low Pass for a 4 KHz cut off frequency.
4. Verify Blackman and Hamming windowing techniques.
5. Evaluate 4-point DFT of and IDFT of  $x(n) = 1, 0 \leq n \leq 3; 0$  elsewhere.
6. Verify Linear convolution of two sequences using FFT
7. Verify Circular Convolution of two sequences using FFT.
8. To verify FFT as sample interpolator.
9. To implement Tone Generation.
10. To implement floating point arithmetic.
  
11. To study Open code composer studio and DSP Processors and architecture of TMS320C6713 DSP processor. Perform all Experiment 1 to 10
12. To implement IIR and FIR filter using DSP TMS320C6713 Processor.
  
13. **VIRTUAL Lab by NME-ICT available at: (*Through Virtual Lab*)**
  - 13.1 Study of Discrete Fourier Transform (DFT) and its inverse.
  - 13.2 Study of FIR filter design using window method: Lowpass and highpass filter.
  - 13.3 Study of FIR filter design using window method: Bandpass and Bandstop filter.
  - 13.4 Study of Infinite Impulse Response (IIR) filter.

**Virtual Lab Link:** <http://vlabs.iitkgp.ernet.in/dsp/index.html#>  
<http://vlabs.iitkgp.ernet.in/dsp/>

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

### Spoken Tutorial (MOOCs):

Spoken Tutorial MOOCs, ' Course on Scilab', IIT Bombay (<http://spoken-tutorial.org/>)

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

1. Create and visualize various discrete/digital signals using MATLAB/Scilab.
2. Implement and test the basic operations of Signal processing.
3. Examine and analyse the spectral parameters of window functions.
4. Design IIR and FIR filters for band pass, band stop, low pass and high pass filters.
5. Design the signal processing algorithms using MATLAB/Scilab.

# ELECTRONICS AND COMMUNICATION ENGINEERING

<b>KEC-051</b>	<b>COMPUTER ARCHITECTURE AND ORGANIZATION</b>	<b>3L:0T:0P</b>	<b>3 Credits</b>
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<b>Unit</b>	<b>Topics</b>	<b>Lectures</b>
I	<b>Introduction to Design Methodology:</b> 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.	8
II	<b>Processor Basics:</b> CPU Organization- Fundamentals, Additional features. Data Representation - Basic formats, Fixed point numbers, Floating point numbers. Instruction Sets- Formats, Types and programming considerations.	8
III	<b>Datapath Design:</b> Fixed point arithmetic - Addition and Subtraction, Multiplication and Division, Arithmetic Logic Unit-Combinational ALUs and Sequential ALUs. Floating point arithmetic.	8
IV	<b>Control Design:</b> basic concepts- introduction, hardwired control, Microprogrammed control- Introduction, multiplier control unit, CPU control unit, Pipeline Control- Instruction Pipelines, Pipeline performance and Superscalar Processing. Data Hazards, Control Hazards, Advanced Concepts in pipeline Processing	8
V	<b>Memory organization:</b> Multi level memories, Address translation, Memory allocation, Caches - Main features, Address Mapping, Structure versus Performance, <b>System Organization:</b> Communication methods- Basic Concepts, Bus Control. IO and System- Control Programmed IO, IO Processor and Operating System. Parallel Processing & Fault Tolerance. Introduction to HDL Programming (VHDL & Verilog)	8

## Text Book:

1. John P Hayes "Computer Architecture and Organization", 3<sup>rd</sup> Edition McGraw Hill Publication. (2017)
2. M Morris Mano, "Computer System Architecture", 3<sup>rd</sup> Edition, Pearson. (2017)

## Reference Books:

1. Carl Hamacher, Zvonko Vranesic and Safwat Zaky, "Computer Organization and Embedded Systems", McGraw Hill Publication. (2009)
2. Samir Palnitkar, Verilog HDL: A Guide to Digital Design and Synthesis, Pearson Education Asia, 2nd Edition
3. David A. Patterson and John L. Hennessy, Computer Organization & Design, Elsevier, 5th Edition, 2017

## 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.

# ELECTRONICS AND COMMUNICATION ENGINEERING

<b>KEC-052</b>	<b>INDUSTRIAL ELECTRONICS</b>	<b>3L:0T:0P</b>	<b>3 Credits</b>
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Unit	Topics	Lectures
I	<b>Introduction to Power Switching Devices:</b> Description of working & constructional features, Switching Characteristics, ratings and Applications of Power Transistor, Power MOSFET, SCR, DIAC, TRIAC, IGBT and MCT.	8
II	<b>SCR Performance and Applications:</b> Protection of SCR, SCR Triggering and Commutation Circuits/Methods, Series and Parallel operation of SCR, two transistor model of SCR, Describe Construction & Working of Opto- Isolators, Opto-TRIAC, Opto-SCR.	8
III	<b>Power Converter Performance &amp; Applications:</b> Introduction to Basic Power Converters Architecture - Single Phase, their performance under different types of Loads, Average/RMS output Voltage & Current, Freewheeling Diode, Feedback Diode, State Relay using Opto SCR, SMPS and UPS functioning through Block Diagrams.	8
IV	<b>Timers &amp; Delay Elements, High Frequency Power Heating, Sensor and Actuators:</b> RC Base Constant Timers, Timer Circuits using SCR, IC-555, Programmable Timer and their Industrial Applications, Induction Heating and Dielectric Heating System and Their Applications, Sensors, Transducers, and Transmitters for Measurement, Control & Monitoring : Thermoresistive Transducer, Photoconductive Transducers, Pressure Transducers, Flow Transducers, Level Sensors, Speed Sensing, Vibration Transducers, Variable-Frequency Drives, Stepper Motors and Servomotor Drives.	8
V	<b>Automation and Control:</b> Data Communications for Industrial Electronics, Telemetry, SCADA & Automation, AC & DC Drives, Voltage & Power Factor Control through Solid State Devices, Soft Switching, Industrial Robots.	8

**Text Books:**

1. M.H. Rashid, "Power Electronics: Circuits, Devices & Applications", Pearson, 4rd Edition, 2013.
2. P.C.Sen, "Power Electronics", McGraw Hill, 2<sup>nd</sup> Ed, 2017
3. V.R. Moorthy, "Power Electronics: Devices, Circuits and Industrial Applications" Oxford University Press, 2007.
4. P.S. Bhimbra, "Power Electronics", Khanna Publishers.

**Reference Books:**

1. B. Paul, Industrial Electronic and Control, Prentice Hall of India Private Limited (2004).
2. Ned Mohan, T.M. Undeland and W.P. Robbins, "Power Electronics: Converters, Applications and Design", Wiley India Ltd, 2008.
3. Thomas E. Kissell, Industrial Electronics: Applications for Programmable Controllers, Instrumentation and Process Control, and Electrical Machines and Motor Controls, 3rd edition, 2003, Prentice Hall.
4. Chakrabarti & Rai, "Fundamentals of Power Electronics & Drives" Dhanpat Rai & Sons.
5. S.N.Singh, "A Text Book of Power Electronics" Dhanpat Rai & Sons.
6. G.K. Dubey, Power Semiconductor Controlled Drives, Prentice Hall inc. (1989).

**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 COMMUNICATION ENGINEERING

<b>KEC-053</b>	<b>VLSI TECHNOLOGY</b>	<b>3L:0T:0P</b>	<b>3 Credits</b>
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Unit	Topics	Lectures
I	<b>Introduction To IC Technology:</b> SSI, MSI, LSI, VLSI Integrated Circuits. Crystal Growth and Wafer Preparation: Electronic Grade Silicon, Czochralski Crystal Growth, Silicon Shaping, Processing Considerations. Wafer Cleaning Technology - Basic Concepts, Wet cleaning, Dry cleaning	8
II	<b>Epitaxy:</b> Vapor-Phase Epitaxy, Molecular Beam Epitaxy, Silicon on Insulators, Epitaxial Evaluation. <b>Oxidation:</b> Growth Kinetics, Thin Oxides, Oxidation Techniques and Systems, Oxides Properties.	8
III	<b>Lithography:</b> Optical Lithography, Electron beam lithography, Photo masks, Wet Chemical Etching. <b>Dielectric and Polysilicon Film Deposition:</b> Deposition Processes of Polysilicon, Silicon Dioxide, Silicon Nitride.	8
IV	<b>Diffusion:</b> Models of diffusion in solids, Fick's 1-Dimensional diffusion equation, Diffusion of Impurities in Silicon and Silicon Dioxide, Diffusion Equations, Diffusion Profiles, Diffusion Furnace, Solid, Liquid and Gaseous Sources, <b>Ion-Implantation:</b> Ion-Implantation Technique, Range Theory, Implantation Equipment.	8
V	<b>Metallization:</b> Metallization Application, Metallization Choices, Physical Vapor Deposition, Vacuum Deposition, Sputtering Apparatus. <b>Packaging of VLSI devices:</b> Package Types, Packaging Design Consideration, VLSI Assembly Technologies, Package Fabrication Technologies, CMOS fabrication steps.	8

### Text Books:

1. S. M. Sze, "VLSI Technology", McGraw Hill Publication, 2<sup>nd</sup> Edition 2017
2. S.K. Ghandhi, "VLSI Fabrication Principles", Willy-India Pvt. Ltd, 2008
3. J. D. Plummer, M. D. Deal and Peter B. Griffin, "Silicon VLSI Technology: Fundamentals, Practice and Modeling", Pearson Education, 2009
4. Stephen A. Campbell, "Fabrication Engineering at the Micro and Nano scale", Oxford University Press, 2013
5. R. S. Muller and T. I. Kamins, Device Electronics for Integrated Circuits, 3rd Edition, Willy, New York.
6. Paolo Antognetti and Giuseppe Massobrio, Semiconductor Device Modelling with SPICE, McGraw Hill.

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

1. Interpret the basics of crystal growth, wafer preparation and wafer cleaning.
2. Evaluate the process of Epitaxy and oxidation.
3. Differentiate the lithography, etching and deposition process.
4. Analyze the process of diffusion and ion implantation
5. Express the basic process involved in metallization and packaging.

# ELECTRONICS AND COMMUNICATION ENGINEERING

<b>KEC 054</b>	<b>ADVANCED DIGITAL DESIGN USING VERILOG</b>	<b>3L:0T:0P</b>	<b>3 Credits</b>
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<b>Unit</b>	<b>Topic</b>	<b>Lectures</b>
I	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.	8
II	Combinational Circuit Design, Multiplexers, Decoders, Encoders, Code Comparators, Adders, Subtractors, Multipliers, Introduction to Verilog, Behavioral and Structural specification of logic circuits, Boolean function implementation using Verilog, Timing Analysis, Hazard Detection and Elimination	8
III	Synchronous Sequential Circuits Design, Mapping Algorithm, Synchronous State Machines, ASM Charts, Asynchronous Sequential Circuit Design, Races, Multi-level minimization and optimization.	8
IV	Factoring, Decomposition, BDD, Ordered BDD, LPDD, Fault Detection and Analysis in combinational and sequential systems, Path Sensitization method, Boolean Difference Method, Initial State Method.	8
V	Study of programmable logic families, PLD, CPLD, FPGA, ASIC, PLA, Architectures, Design of Combinational and sequential circuits using CPLD and FPGA, Design Examples.	8

## Text Books:

1. Michael D. Ciletti, "Advanced Digital Design with the Verilog HDL, 2<sup>nd</sup> Edition", Pearson Education, 2017
2. Richard F. Tinker, "Engineering Digital Design", Academic Press.
3. Stephen Brown and Zvonko Vranesiv, "Fundamental of Digital Logic with Verilog Design", McGraw Hill.
4. Neil H.E. Weste, "CMOS VLSI Design: A Circuits and Systems Perspective, 4<sup>th</sup> Edition", Pearson Education, 2015
5. Navabi Zainalabedin, Verilog Digital System Design, 2<sup>nd</sup> Edition, McGraw Hill,
6. Morris Mano, Digital Design, 6<sup>th</sup> Edition, , 6<sup>th</sup> Edition, Pearson Publication

## Reference Books:

1. John Williams, "Digital VLSI Design with Verilog", Springer Publication..
2. Samuel C. Lee, "Digital Circuit and Logic Design", PHI India Ltd.
3. Parag K. Lala, "Digital System Design Using PLDs", PHI India Ltd.
4. Alexander Miczo, "Digital Logic Testing and Simulation", 2<sup>nd</sup> Edition Wiley
5. R.Jacob.Baker, Harry.W.Li, David.Boyce, "CMOS Circuit Design Layout and Simulation.

**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.

# ELECTRONICS AND COMMUNICATION ENGINEERING

<b>KEC-055</b>	<b>ELECTRONIC SWITCHING</b>	<b>3L:0T:0P</b>	<b>3 Credits</b>
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<b>Unit</b>	<b>Topics</b>	<b>Lectures</b>
I	<b>Evolution of switching systems:</b> Introduction, Message switching, Circuits switching, Functions of a switching system, Register translator-senders, Distribution frames, Crossbar switch, A general trucking, Electronic switching, Reed- electronic system, Digital switching systems.	8
II	<b>Digital Switching:</b> Switching functions, Space Division Switching, Time Division Switching, Two-Dimensional Switching, Digital Cross-Connect Systems, Digital Switching in an Analog Environment.	8
III	<b>Telecom Engineering:</b> Network Traffic Load and Parameters, Grade of Service and Blocking Probability, Modeling Switching Systems, Incoming Traffic and Service Time Characterization, Blocking models and Loss Estimates, Delay Systems	8
IV	<b>Control of switching systems:</b> Introduction, Call-processing functions, Common control, Reliability, availability and security; Stored-program control. <b>Signaling:</b> Introduction, Customer line signaling, Audio-frequency junctions and trunk circuits, FDM carrier systems, PCM signaling, Inter-register signalling, Common-channel signaling principles, CCITT signaling system no. 6 and 7, Digital customer line signaling.	8
V	<b>Packet Switching:</b> Packet Switching, Statistical Multiplexing, Routing Control (dynamic routing, virtual circuit routing and fixed-path routing), Flow Control, X.25, Frame Relay, TCP/IP ATM Cells, ATM Service Categories, ATM Switching (ATM Memory Switch, Space-Memory Switch, Memory-Space Switch, Memory-Space Memory switch, Banyan Network Switch, Close Networks).	8

## Text Book:

1. T. Viswanathan and M. Bhatnagar, Telecommunication Switching Systems and Networks, 2nd Ed., Prentice-Hall, 2018
2. J.E. Flood, "Telecommunication Switching, Traffic and Networks", Pearson Education 2016.
3. John C. Bellamy, "Digital Telephony", John Wiley, 3rd Edition, 2006
4. Roger L. Freeman, Telecommunication System Engineering, 4th Edition, John Wiley & Sons, Inc., 2004.

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

1. Describe the fundamentals of circuit switching and distinguish complex telephone systems.
2. Differentiate the fundamentals of Space division switching and time division switching.
3. Design, develop and evaluate the telecom traffic to meet defined specifications and needs.
4. Identify the control of switching networks and signalling concepts.
5. Classify the engineering concepts of packet switching and routing which will help to design various switch architectures for future research work.

# ELECTRONICS AND COMMUNICATION ENGINEERING

<b>KEC-056</b>	<b>ADVANCE SEMICONDUCTOR DEVICES</b>	<b>3L:0T:0P</b>	<b>3 Credits</b>
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Unit	Topics	Lectures
I	<b>Physics and Properties of Semiconductors:</b> Introduction, Crystal Structure, Energy Bands and Energy Gap, Carrier Concentration at Thermal Equilibrium, Carrier-Transport Phenomena. Phonon, Optical, and Thermal Properties, Heterojunctions and Nanostructures, Basic Equations and Examples. <i>p-n</i> Junctions, Introduction, Depletion Region, Current-Voltage Characteristics, Junction Breakdown, Transient Behavior and Noise, Terminal Functions, Heterojunctions. Metal-Semiconductor Contacts, Metal-Insulator - Semiconductor Capacitors.	8
II	<b>Bipolar Transistors:</b> Static Characteristics, Microwave Characteristics, Related Device Structures, Heterojunction Bipolar Transistor. <b>MOSFETs:</b> Basic Device Characteristics, Nonuniform Doping and Buried-Channel Device, Device Scaling and Short-Channel Effects, MOSFET Structures, Circuit Applications, Nonvolatile Memory Devices, Single-Electron Transistor. JFETs, MESFETs, and MODFETs	8
III	<b>Tunnel Devices:</b> Tunnel Diode, Related Tunnel Devices, Resonant-Tunneling Diode. <b>IMPATT Diodes:</b> Static Characteristics, Dynamic Characteristics, Power and Efficiency, Noise Behavior, Device Design and Performance, BARITT Diode, TUNNETT Diode.	8
IV	Transferred-Electron and Real-Space-Transfer Devices Thyristors and Power Devices <b>Photonic Devices and Sensors:</b> Radioactive Transitions, Light-Emitting Diode (LED), Laser Physics, Laser Operating Characteristics, Specialty Lasers.	8
V	<b>Photodetectors and Solar Cells:</b> Photoconductor, Photodiodes, Avalanche Photodiode, Phototransistor, Charge-Coupled Device (CCD), Metal-semiconductor-Metal Photodetector, Quantum-Well Infrared Photodetector, Solar Cell. Sensors: Thermal Sensors, Mechanical Sensors, Magnetic Sensors, Chemical Sensors.	8

**Text Book:**

1. S. M. Sze, Kwok K. NG, "Physics of Semiconductor Devices", 3<sup>rd</sup> Edition, Wiley Publication, 2015
2. Ben G. Streetman & S K Banerjee, Solid State Electronic Devices, Pearson 7<sup>th</sup> Edition, 2015
3. Jacob Millman, Christos C. Halkias, Satyabrata Jit, Electronic Devices and Circuits. Publisher: McGraw Hill, 4<sup>th</sup> Edition 2015.
4. Pierret, Robert F., Semiconductor device fundamentals. 2<sup>nd</sup> Edition, Pearson Education India, 2015.
5. Stephen A. Campbell, "Fabrication Engineering at the Micro and Nano scale", Oxford University Press, 2013
6. R. S. Muller and T. I. Kamins, Device Electronics for Integrated Circuits, 3rd Edition, Wiley, New York.

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

1. Explain the behavior of BJT and MOSFET in DC biasing and as CE amplifier circuit.
2. Describe the Tunnel diode and IMPATT diode.
3. Explain the basics of Light-Emitting Diode (LED) and evaluate the performance of Photoconductor and photodiode.
4. Distinguish the performance of Photoconductor, photodiode, Phototransistor, Charge-Coupled Device
5. Analyze the functioning of Metal-Semiconductor-Metal Photodetector.



# ELECTRONICS AND COMMUNICATION ENGINEERING

<b>KEC-057</b>	<b>ELECTRONIC INSTRUMENTATION AND MEASUREMENTS</b>	<b>3L:0T:0P</b>	<b>3 CREDITS</b>
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<b>Unit</b>	<b>Topics</b>	<b>Lectures</b>
I	<b>Electrical Measurements:</b> Measurement system, Characteristics of instruments, Methods of measurement, Errors in Measurement & Measurement standards, Measurement error combination. <b>Review of indicating and integrating instruments:</b> PMMC instrument, Galvanometer, DC ammeter, DC voltmeter, Series ohm meter.	8
II	<b>Electronic Instruments:</b> Transistor voltmeter circuits, AC electronic voltmeter, current measurement with electronic instruments, probes. <b>Digital voltmeter systems:</b> Digital multimeter, digital frequency meter <b>Instrument calibration:</b> Comparison method, digital multimeter as standard instrument, Calibration instrument.	8
III	<b>Measuring Methods:</b> Voltmeter and Ammeter methods, Wheatstone bridge, Measurement of low, medium and high resistances, Insulation resistance measurement, <b>AC bridges</b> for measurement of inductance and capacitance.	8
IV	<b>Electronic Measurements:</b> Electronic instruments: Wattmeter & Energy meter. Time, Frequency and phase angle measurements using CRO; Storage oscilloscope, Spectrum & Wave analyzer, Digital counter & Frequency meter, Q meter	8
V	<b>Instrumentation:</b> Transducers, classification & selection of transducers, strain gauges, Thermistors, Thermocouples, LVDT, Inductive & capacitive transducers, Piezoelectric and Hall-effect transducers, Measurement of motion, force, pressure, temperature, flow and liquid level.	8

## Text Book:

1. David A Bell, "Electronic Instrumentation and Measurements", Pearson Education.
2. H.S. Kalsi, "Electronic Instrumentation", 6th Edition McGraw Hill,
3. A K Sawhney, "Electrical & Electronic Measurement & Instrument", Dhanpat Rai & Sons, India (2015).
4. BC Nakra & K. Chaudhary, "Instrumentation, Measurement and Analysis," McGraw Hill, 2nd Edition (2009).
5. E. O. Doebelin, "Measurements systems: Applications and Design", 6th Edition, McGraw Hill 2017.
6. WD Cooper, "Electronic Instrument & Measurement Technique", Prentice Hall International (2001).
7. A. K. Ghosh, Introduction to Measurements and Instrumentation –, 2nd Edition, PHI, 2007

## 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.

# ELECTRONICS AND COMMUNICATION ENGINEERING

<b>KEC-058</b>	<b>OPTICAL COMMUNICATION</b>	<b>3L:0T:0P</b>	<b>3 Credits</b>
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Unit	Topics	Lectures
I	<p><b>Introduction to Optical Communication:</b> Optical Spectral Band with Operating Windows, General Communication System, Optical Communication System with its advantages.</p> <p><b>Optical Fiber Waveguides:</b> Ray Theory of Transmission with TIR, Acceptance Angle, Numerical Aperture and Skew Rays, Electromagnetic Mode Theory for Optical Propagation, Modes in a Planar Guide, Phase and Group Velocity, Phase Shift with Total Internal Reflection, Evanescent Field, Goos-Haenchen Shift, Cylindrical Fiber Modes, Mode Coupling, Step Index fibers Vs Graded Index fibers, Single Mode Fibers- Cut off wavelength, MFD &amp; Spot Size.</p>	08
II	<p><b>Signal Loss in Optical Fibers:</b> Attenuation, Material Absorption Losses (Intrinsic and Extrinsic absorption), types of Linear and Non-Linear Scattering Losses, Fiber Bending Losses, Kerr Effect.</p> <p><b>Dispersion:</b> 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 Single Mode Fiber, Dispersion Modified Single Mode Fibers, Polarization &amp; Fiber Birefringence.</p>	08
III	<p><b>Optical Sources: LEDs-</b>Introduction to LEDs &amp; Materials used for fabrication, LED Power and Efficiency, LED Structures, LED Characteristics, Modulation Bandwidth.</p> <p><b>Laser Diodes-</b>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.</p>	08
IV	<p><b>Power Launching in Fiber:</b> Source to Fiber Power Launching and Coupling Techniques, Power Launching Vs Wavelength, Equilibrium Numerical Aperture.</p> <p><b>Photo Detectors:</b> Introduction, Physical Principles of Photodiodes: The PIN Photo Detector, 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.</p>	08
V	<p><b>Digital Receiver Performance:</b> Probability of Error / BER, Receiver Sensitivity &amp; The Quantum Limit, Error Control Techniques, Eye Diagram Pattern Features, Coherent Detection: Homodyne Detection and Heterodyne Detection, Digital links: Point to Point Links, Power Penalties, Multichannel &amp; Multiplexing Transmission Techniques, basic concept of Free Space Optics (FSO) based Communication System.</p>	08

**Text Book:**

1. John M. Senior, "Optical Fiber Communications", Pearson, 3rd Edition, 2010.
2. Gerd Keiser, "Optical Fiber Communications", McGraw Hill, 5th Edition, 2013.
3. Govind P. Agrawal, "Fiber Optic Communication Systems", John Wiley, 3<sup>rd</sup> Edition, 2004.
4. Joseph C. Palais, "Fiber Optic Communication", Pearson Education, 4<sup>th</sup> Edition, 2004

**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.

**B.Tech 3<sup>rd</sup> Year  
VI Semester  
Syllabus**

# ELECTRONICS AND COMMUNICATION ENGINEERING

<b>KEC-601</b>	<b>DIGITAL COMMUNICATION</b>	<b>3L:1T:0P</b>	<b>4 Credits</b>
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<b>Unit</b>	<b>Topics</b>	<b>Lectures</b>
I	<b>Deterministic and Random Signal:</b> Types of random variables, cumulative distribution function and probability density functions, Standard distributions: Gaussian, exponential, Rayleigh, uniform, Bernoulli, binomial, Poisson, discrete uniform and conditional distributions. Functions of one random variable: distribution, mean, variance, moments and characteristics functions.	8
II	<b>Digital Communication &amp; Modulation Basics:</b> Bandpass and Lowpass signal, Introduction to Digital communication systems, PSD of Line Coding schemes, Pulse shaping, Scrambling, Eye diagram, Gram-Schmidt orthogonalization scheme. <b>Digital Modulation:</b> Modulation and Demodulation of Digital modulation schemes-ASK, FSK, PSK, DPSK, QPSK and Constellation diagram. Introduction to M-ary communication.	8
III	<b>Digital Communication Through Band Limited Channels:</b> Characteristic and signal Design of band Limited Channels. Optimum Receiver for Channel with ISI and AWGN. Linear Equalization, Decision Equalization, Adaptive Equalization. Introduction of Multichannel and Multicarrier System.	8
IV	<b>Digital Receiver:</b> Optimum threshold detection, Concept of Matched Filters, BER analysis of BASK, BFSK, BPSK, <b>Spread spectrum Signal for Digital Communication:</b> Model of Spread Spectrum Digital Communication. Direct Sequence Spread Spectrum Signal (DS-SS), Frequency Hopped Spread Spectrum Signal (FH-SS).	8
V	<b>Information Theory:</b> Measure of information-information, entropy, mutual information, mutual entropy, Source encoding (Shannon-Fano, Huffman), Shannon's channel capacity theorem, Introduction to error correction and detection, Linear block codes, Cyclic codes (systematic, non-systematic), BCH, Reed Solomon code. Introduction of Trellis and Graph based codes, Convolution coding and decoding.	8

### **Text Books:**

1. John G. Proakis & Masoud Salehi, "Digital Communications", 5th Edition, McGraw Hill.
2. B.P. Lathi, "Modern Digital and Analog Communication Systems", 4th Edition, Oxford University Press.
3. H. Taub, D L Schilling, Gautam Saha, "Principles of Communication", 4th Edition, McGraw Hill.
4. Singh & Sapre, Analog & Digital Communication Systems, 3th Edition, McGraw Hill.
5. John G. Proakis, "Communication Systems Engineering 2<sup>nd</sup> Edition, Pearson Education, 2015

### **Reference Books:**

1. (Schaum's Outline Series) H P HSU & D Mitra, "Analog and Digital Communications", McGraw Hill 3rd Edition.
2. Bernard Sklar, Digital Communications, Pearson Education,
3. Simon Haykin, "Communication Systems", 5th Edition, Wiley India.

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

1. To formulate basic statistics involved in communication theory.
2. To demonstrate the concepts involved in digital communication.
3. To explain the concepts of digital modulation schemes.
4. To analyze the performance of digital communication systems.
5. To apply the concept of information theory in digital systems.

# ELECTRONICS AND COMMUNICATION ENGINEERING

<b>KEC-602</b>	<b>CONTROL SYSTEM</b>	<b>3L:1T:0P</b>	<b>4 Credits</b>
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Unit	Topics	Lectures
I	<b>Introduction to Control Systems:</b> 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.	8
II	<b>State-Variable Analysis:</b> 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.	8
III	<b>Time domain Analysis of Control Systems:</b> 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.	8
IV	<b>Stability of Linear Control Systems:</b> 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.	8
V	<b>Frequency Domain Analysis:</b> 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.	8

**Text Book:**

1. I. J. Nagrath & M. Gopal, "Control System Engineering", 6<sup>th</sup> Edition New Age International Publishers, 4<sup>th</sup> Edition 2018.
2. M. Gopla, "Control System Principles and Design", McGraw Hill 4<sup>th</sup> Edition
3. Ogata, "Modern Control Engineering, 5<sup>th</sup> Edition", Pearson Education, 2015
4. B.C. Kuo & Farid Golnaraghi, "Automatic Control Systems", 10<sup>th</sup> Edition, McGraw Hill
5. D. Roy Choudhary, "Modern Control Engineering", Prentice Hall of India.

**Reference Books:**

1. (Schaums Outlines Series) Joseph J. Distefano III, Allen R. Stubberud, Ivan J. Williams, "Control Systems", 3<sup>rd</sup> Edition, McGraw Hill, Special Indian Edition, 2010.
2. Salivahanan, "Control Systems Engineering", Pearson Education, 2015.
3. A. Anand Kumar, "Control Systems", Second Edition, PHI Learning private limited, 2014.
4. William A. Wolovich, "Automatic Control Systems", Oxford University Press, 2011.

**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 system.
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.

# ELECTRONICS AND COMMUNICATION ENGINEERING

<b>KEC-603</b>	<b>ELECTROMAGNETIC FIELD THEORY AND ANTENNA</b>	<b>3L:1T:0P</b>	<b>4 Credits</b>
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Unit	Topics	Lectures
I	<p><b>Vector Analysis:</b> Review of vector algebra, Review of cartesian, cylindrical and spherical coordinate systems, Introduction to <math>\nabla</math> <math>\Delta</math> (operator, Use of <math>\nabla</math> operator as gradient, divergence, curl).</p> <p><b>Electrostatic fields:</b> Introduction to coulomb's law, Gaussian law and its applications, Boundary conditions at electric interfaces, Method of images and its applications.</p> <p><b>Magnetostatics:</b> Introduction to ampere's law, Ampere's law and its applications, Magnetic vector potential, Magnetic forces, Boundary conditions at magnetic interfaces.</p>	8
II	<p><b>Waves and applications:</b> Maxwell's equation, Faraday's Law, transformer and motional electromotive forces, displacement current, Maxwell's equation in final form. Electromagnetic wave propagation: Wave propagation in lossy dielectrics, plane waves in lossless dielectrics, plane wave in free space, plane waves in good conductors, power and the pointing vector, reflection of a plain wave in a normal incidence</p>	8
III	<p><b>Transmission lines:</b> Introduction, Circuit representation of parallel plane transmission lines, Transmission lines with losses, Characteristic impedance, Propagation constant, Attenuation constant and phase constant, Reflection, Reflection coefficient, Expression for input impedance in terms of reflection coefficient, Standing wave ratio (SWR), Relation between SWR and reflection coefficient, Location of voltage maxima and minima, Impedance matching devices, Principle of impedance matching devices, Smith Chart.</p>	1
IV	<p><b>Antenna Introduction and Basics:</b> Introduction, Basic antenna parameters: Reflection and Radiation Mechanism: Patterns, Beam area (or Beam solid angle) <math>\Omega_A</math>, Radiation intensity, Beam efficiency, Directivity D and Gain G, Directivity and resolution, Antenna apertures, Effective height, The radio communication link, Fields from oscillating dipole, Single-to-noise ratio (SNR), Antenna temperature, Antenna impedance, Oscillating dipoles, Polarization.</p>	8
V	<p><b>Wave Propagation:</b> Ground wave Propagation: Plane earth reflection, Space wave and surface wave, Space wave propagation: Introduction, Field strength relation, Effects of imperfect earth, Effects of curvature of earth. Sky wave propagation: Introduction structural, details of the ionosphere, Wave propagation mechanism, Refraction and reflection of sky waves by ionosphere, Ray path, Critical frequency, MUF, LUF, OF, Virtual height and skip distance, Relation between MUF and the skip distance, Multi-Hop propagation, Wave characteristics.</p>	8

**Text Books:**

1. MNO Sadiku, "Elements of Electromagnetic", 7<sup>th</sup> Ed, Oxford University Press, 2018.
2. WH Hayt and JA Buck, "Engineering Electromagnetic", 7<sup>th</sup> Edition McGraw Hill, 2013
3. John D Kraus, Ronald J Marhefka and Ahmad S. Khan, "Antennas and Wave Propagation", 5<sup>th</sup> Edition, McGraw Hill, 2017.
4. Das, Antennas and Wave Propagation, McGraw Hill.
5. K.D.Prasad, Antennas and Wave Propagation, Satya Publication
6. (Schaums Outlines Series) Joseph J. Distefano III, Allen R. Stubberud, Ivan J. Williams, "Engineering Electromagnetic", 3<sup>rd</sup> Edition, McGraw Hill, Special Indian Edition, 2010.
7. C. A. Balanis, "Antenna Theory Analysis and Design", John Wiley, 2016

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

1. Identify different coordinate systems and their applications in electromagnetic field theory to establish a relation between any two systems using the vector calculus.
2. Explain the concept of static electric field, current and properties of conductors.
3. Express the basic concepts of ground, space, sky wave propagation mechanism.
4. Demonstrate the knowledge of antenna fundamentals and radiation mechanism of the antenna.
5. Analyze and design different types of basic antennas.

# ELECTRONICS AND COMMUNICATION ENGINEERING

<b>KEC-061</b>	<b>MICROCONTROLLER &amp; EMBEDDED SYSTEMS</b>	<b>3L:0T:0P</b>	<b>3 Credits</b>
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Unit	Topics	Lectures
I	<p><b>Advanced concepts in 8051 architecture:</b> 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</p> <p><b>Introduction, AVR Family architecture</b>, Register File, The ALU. Memory access and Instruction execution. I/O memory. EEPROM. I/O ports. Timers. Interrupt Structure</p>	8
II	<p><b>MSP430x5x Microcontroller:</b> 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.</p>	8
III	<p><b>Peripheral Devices:</b> Watch dog timer, system clocks, Timer &amp; Real Time Clock (RTC), PWM control, timing generation and measurements. Analog interfacing and data acquisition ADC and Comparator in MSP430, data transfer using DMA.</p>	8
IV	<p><b>Serial communication</b> basics, Synchronous/Asynchronous interfaces (like UART, USB, SPI, and I2C). UART protocol, I2C protocol, SPI protocol. Implementing and programming UART, I2C, SPI interface using MSP430, Interfacing external devices.</p>	8
V	<p><b>Internet of Things (IoT):</b> overview and architecture, Overview of wireless sensor networks and design examples. Various wireless connectivity: NFC, ZigBee, Bluetooth, Bluetooth Low Energy, Wi-Fi. Adding Wi-Fi capability to the Microcontroller, Embedded Wi-Fi, User APIs for Wireless and Networking applications, Building IoT applications using CC3100 user API for connecting sensors.</p>	8

### Text Books:

1. Mazidi Ali Muhammad, Mazidi Gillispie Janice, and Mc Kinlay Rolin D "The 8051 Microcontroller and Embedded Systems using Assembly and C", Pearson Publication, 2006.
2. Raj Kamal, Embedded Systems, 2<sup>nd</sup> Edition McGraw Hill.
3. John H Davies, "MSP430 Microcontroller Basics" Newnes Publication, 2008
4. Internet of Things: Principles and paradigms. R. Buyya, and A.V Dastjerdi (Elsevier), 2016.

### Reference Books:

1. Raj Kamal, Microcontroller Architectures Programming Interfacing and System Design, Pearson Publication
2. Wolf, Wayne, Computers as Components – Principles of Embedded Computing System Design, Second Edition, Morgan-Kaufmann, 2008. TI MSP430x5xx and MSP430x6xx Family User's Guide, Revised 2018.

### 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. Evaluate the data transfer information through serial & parallel ports and implement its interfacing with MSP430.
5. Demonstrate the basics of IoT, WSN and its application sectors and design IoT based projects using MSP430 microcontroller.

# ELECTRONICS AND COMMUNICATION ENGINEERING

<b>KEC-062</b>	<b>SATELLITE COMMUNICATION</b>	<b>3L:0T:0P</b>	<b>3 Credits</b>
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<b>Unit</b>	<b>Topics</b>	<b>Lectures</b>
I	<b>Introduction to Satellite Communication:</b> History, Overview of Satellite Communication, Types of Satellite, Types of Orbit, Satellite services, Advantages & Applications of Satellite communication, Satellite Life phases, Space Debris, Introduction to Geo-synchronous and Geo-stationary satellites.	8
II	<b>Orbital Mechanics:</b> Orbital Mechanics, Kepler's Three laws of Planetary Motion, Developing the Equations of the orbit, Look Angle Determination, Earth Stations, Orbital Perturbations, Orbital effects in Communication system performance.	8
III	<b>Satellite Sub-systems:</b> Seven segments of Satellite communication, Attitude and Orbit control systems, Telemetry, Tracking and command control system, Power supply system. <b>Satellite Link Design:</b> Basic transmission theory, System noise temperature and G/T ratio, Design of down link and uplink, Design of satellite links for specified C/N.	8
IV	<b>Introduction to Various Satellite Systems:</b> VSAT, Direct broadcast satellite television and radio, Satellite navigation and the Global positioning systems, GPS position location principle, GPS receivers and codes, Satellite Signal Acquisition, GPS navigation Message, GPS Signal Levels, Timing Accuracy, GPS Receiver Operation.	8
V	<b>Launchers &amp; Advanced Technologies:</b> Mechanism of Satellite launching, Launch Vehicles, Advanced launching tech like Space X, Intelligent Testing, Control and Decision making for Space, Inter Satellite Link. <b>Indian Satellite Systems:</b> History and Overview of Indian Satellite System, Achievements, GSLV, PSLV, Advanced Technology Vehicle.	8

## Text Books:

1. B.Pratt, A.Bostian, "Satellite Communications", Wiley India, 2<sup>nd</sup> Edition, 2006.
2. D. Roddy, "Satellite Communications", McGraw-Hill, 4<sup>th</sup> Edition, 2001.
3. Tri T. Ha, Digital Satellite Communications, McGraw-Hill, 2<sup>nd</sup> Edition
4. D.C. Agrawal, Satellite Communication, Khanna Publishers; 7<sup>th</sup> Edition.

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

1. Define and list the benefits of satellite communication.
2. Demonstrate orbital mechanics principles of satellite communication systems and solve problems related to it.
3. Describe a satellite link and identify ways to improve the link performance.
4. Classify new technologies of satellite communication systems as per given specifications.
5. Examine advanced technologies of satellite launching and describe the Indian satellite system.



# ELECTRONICS AND COMMUNICATION ENGINEERING

<b>KEC-063</b>	<b>DATA COMMUNICATION NETWORKS</b>	<b>3L:0T:0P</b>	<b>3 Credits</b>
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Unit	Topics	Lectures
I	<b>Introduction to Networks &amp; Data Communications:</b> Goals and Applications of Networks, The Internet, Protocols & Standards, Layered Tasks, OSI reference Model, TCP / IP, Addressing, Signal forms and their characteristics. Line Coding, Pulse code modulation, Delta modulation, Transmission modes. Need of multiplexing, Classification of FDM, WDM, Synchronous TDM, Statistical TDM, Spread Spectrum, Transmission media	8
II	<b>Physical Layer:</b> Transmission Media- Guided and unguided, Network Topology Design, Structure of Switch, Switched network classification <b>Data Link Layer:</b> Error detection and Correction, Framing, Flow and Error Control Protocols, Noiseless Channel and Noisy Channel Protocol, HDLC, Point-to-Point Protocol	8
III	<b>Multiple Access:</b> RANDOH, CDMA, CSMA/CD, CSMA/CA, Controlled Access, Channelization <b>Wired LANs:</b> IEEE Standards, Standard Ethernet, Fast Ethernet, Gigabit Ethernet, Wireless LAN IEEE 802.11, Bluetooth IEEE 802.16. Architecture, SONET layers, SONET frames, STS multiplexing, SONET networks, Virtual tributaries	8
IV	<b>Network Layer:</b> Design Issues. Routing Algorithms. Congestion control Algorithms. Internetworking –TCP/IP, IP Packet, IPv4 and IPv6 Protocols, IPV4 Addresses, Connecting Devices, Virtual LAN IPV6 Addresses. Digitization of audio and video, and their compression, Voice Over IP.	8
V	<b>Transport Layer Protocol:</b> Process to process delivery, UDP, TCP, ATM, Cryptography, Network Security, Session Layer-Design issues. <b>Application Layer:</b> Remote login, Electronic Mail and File Transfer, HTTP, WWW, SMTP, <b>Cryptography-</b> Basics of cryptography and its application for Message Security and User Authentication <b>Network Security-</b> Security in different layers of Internet. Recent advancements in networking.	8

**Text Books:**

1. Behrouz A. Forouzan, Introduction to Data Communications and Networking, 5th Edition, McGraw-Hill, 2017.
2. William Stallings, Data and Computer Communications, 8<sup>th</sup> Edition, Pearson Education.

**Reference Books:**

1. Kurose and Ross, Computer networking: A Top-Down Approach, 6th Edition, Pearson Education.
2. S. Tanenbaum, “Computer Networks”, 4th Edition, Pearson, Education 2013.

**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.

# ELECTRONICS AND COMMUNICATION ENGINEERING

EC-062	ANALOG SIGNAL PROCESSING	3L : 0T : 0P	3 Credits
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Unit	Topics	Lectures
I	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.	8
II	Ideal low-pass filter, Butterworth and Chebyshev magnitude response, pole locations, low-pass filter specifications, comparison of Maximally flat and Equal ripple responses.	8
III	Delay equalization: equalization procedures, equalization with first-order and second order modules, strategies for equalization design. Definition of Bode sensitivity.	8
IV	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.	8
V	Elementary transconductor building blocks, resistors, integrators, amplifiers, summers, Gyrator, First and second order filters, Higher order filters	8

## Text Book:

1. R. Schaumann and M.E. Valkenberg, "Design of Analog Circuits", Oxford University Press
2. J. Michael Jacob, "Applications and Design with Analog Integrated Circuits", 2<sup>nd</sup> Edition, Pearson.

## 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-651	DIGITAL COMMUNICATION LAB	0L:0T:2P	1 Credit
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## SUGGESTIVE LIST OF EXPERIMENTS:

### Part A

1. To study Eye diagram patterns of various digital pulses.
2. To study the inter symbol interference.
3. To study generation of Unipolar RZ & NRZ Line Coding.
4. To study generation of Polar RZ & NRZ Line Coding.
5. To study generation of Bipolar RZ & NRZ Line Coding.
6. Implementation and analysis of BASK modulation and demodulation
7. Implementation and analysis of BFSK modulation and demodulation
8. Implementation and analysis of BPSK modulation and demodulation. *(Through Virtual Lab)*
9. Implementation and analysis of QPSK modulation and demodulation. *(Through Virtual Lab)*
10. To simulate M-ary Phase shift keying technique using MATLAB.
11. To study generation and detection of DPSK using MATLAB.
12. Implementation and analysis of Delta modulation and demodulation.
13. Implementation and analysis of DSSS Modulation, Demodulation & BER measurement.
14. Implementation and analysis of FHSS Modulation, Demodulation & BER measurement.
15. To study encoding and decoding of Linear Block Codes
16. To study the working of Convolution encoder.

### Part B

1. To study simple dipole  $\lambda/2$  antenna and to calculate beam-width, front / back ratio, and gain of the antenna.
2. To study folded dipole antenna and to calculate beam-width, front / back ratio, and gain of the antenna.
3. To study  $\lambda/2$  phase array end-fire antenna and to calculate beam-width, front / back ratio, and gain of the antenna.
4. To study broadside array antenna and to calculate beam-width, front / back ratio, and gain of the antenna.

**Virtual Lab Link:** <https://vlab.amrita.edu/?sub=1&brch=201>

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

1. To formulate basic concepts of pulse shaping in digital communication.
2. To identify different line coding techniques and demonstrate the concepts.
3. To design equipments related to digital modulation and demodulation schemes.
4. To analyze the performance of various digital communication systems and evaluate the key parameters.
5. To conceptualize error detection & correction using different coding schemes in digital communication.

## 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.

KEC-653	CAD FOR ELECTRONICS LAB	0L:0T:2P	1 Credit
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## SUGGESTIVE LIST OF EXPERIMENTS:

### Part A

#### PSPICE Experiments:

- (a) Transient Analysis of BJT inverter using step input.  
(b) DC Analysis (VTC) of BJT inverter
- (a) Transient Analysis of NMOS inverter using step input.  
(b) Transient Analysis of NMOS inverter using pulse input.  
(c) DC Analysis (VTC) of NMOS inverter.
- (a) Analysis of CMOS inverter using step input.  
(b) Transient Analysis of CMOS inverter using step input with parameters.  
(c) Transient Analysis of CMOS inverter using pulse input.  
(d) Transient Analysis of CMOS inverter using pulse input with parameters.  
(e) DC Analysis (VTC) of CMOS inverter with and without parameters.
- Transient & DC Analysis of NAND Gate using CMOS inverter.
- Transient Analysis of NOR Gate inverter and implementation of XOR gate using NOR gate
- To design and perform transient analysis of D latch using CMOS inverter.
- To design and perform the transient analysis of SR latch circuit using CMOS inverter.
- To design and perform the transient analysis of CMOS transmission gate.
- Analysis of frequency response of Common Source amplifiers.
- Analysis of frequency response of Source Follower amplifiers

### Part B :

#### HDL (using VHDL program module & verilog Module)

##### VHDL PROGRAMS

- Design and Simulation of Full Adder using VHDL program module
- Design and Simulation of 4x1 MUX using VHDL program module
- Design and Simulation of BCD to Excess-3 code using VHDL program module
- Design and Simulation of 3 to 8 decoder using VHDL program module
- Design and Simulation of JK Flip-flop using VHDL program module
- Design and Simulation of CMOS Inverter using verilog Module

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

- Design and analyze the performance of different type of inverters.
- Design and analyze the performance of the basic logic gates using CMOS inverter circuit.
- Design and analyze the performance of the memory based digital circuits using CMOS inverter circuit.
- Analyze the performance of the different configuration of MOS amplifier circuits.

## SUGGESTIVE LIST OF EXPERIMENTS:

1. Measurement of phase difference and frequency using CRO (Lissajous Figure)
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. Characteristics of LDR, Photo Diode, and Phototransistor:
  - (i) Variable Illumination.
  - (ii) Linear Displacement
6. Characteristics of LVDT.
7. Study of the transistor tester and determination of the parameters of the given transistors
8. Experiment using PLC Trainer Kits

### Through Virtual Lab:

9. Measurement of low resistance Kelvin's double bridge.
10. To measure unknown capacitance of small capacitors by using Schering's bridge.
11. To measure unknown Inductance using Hay's bridge.
12. Measurement of capacitance by De Sauty Bridge.

**Virtual Lab Link:** <http://vlabs.iitkgp.ernet.in/asnm/#>

**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. Measure the unknown resistance, capacitance and inductance using LCR Bridge, Kelvin double bridge, Schering bridge, Hay's bridge, De sauty bridge.
2. Practically demonstrate the different types of transducers like J-type, K-type, PT-100 and RTD.
3. Interpret frequency and phase difference from Lissajous figure.
4. Interpret hybrid parameters of transistor and demonstrate different transducer like LDR and LVDT.
5. Demonstrate Experiment using PLC Trainer Kits