ET _____	Analog Electronics Circuits
Credits:4 (3-1-0)	
Pre-requisites:	Physics
Course Objective:	The course aims to: • To introduce the fundamental aspects of Electronics and Circuits. • To understand the fundamental concepts of DC and AC Biasing. • Enable the students to design and analysis of circuits using BJTs, FETs, and Op-Amps. • To enhance the ability to analyze and design of basic transistor amplifier and power amplifier circuits. • Enable the students to analyze oscillator, active filters circuits. • Enable the students to use simulation software for circuit analysis.
Course Outcome:	On completion of the course, a student should be able to: • Understand the fundamental concepts of electronics components, circuits and measuring instruments • Design and analysis of various electronic circuits using BJTs, FETs, and Op-Amps • Understand the fundamental concepts amplifier, oscillator and filter circuits
Syllabus	
Module I **[8] Hours**	Biasing of BJTs: Load lines (AC and DC), Operating Points, Fixed Bias and Self Bias, DC Bias with Voltage Feedback, Bias Stabilization, Design Operation. Biasing of FETs and MOSFETs: Principle and Physical Operation of MOSFETs. Fixed Bias Configuration and Self Bias Configuration, Voltage Divider Bias and Design.
Module II **[12] Hours**	Small Signal Analysis of BJTs: r_e equivalent model, Graphical and mathematical determination of h-parameters, Small Signal Analysis of CE, CC, CB Amplifier with and without R_E. Effect of R_S and R_L on CE Amplifier, Emitter Follower, Analysis of Cascade, Darlington Connection. Small Signal Analysis of FETs: Small-Signal Equivalent-Circuit Model, Small Signal Analysis of CS, CD, CG Amplifier with and without RS. Effect of RSIG and RL on CS Amplifier, Analysis of Source Follower and Cascaded System using FETs.
Module III **[10] Hours**	High Frequency Response of FETs and BJTs: Low and High Frequency Response of BJTs and FETs, Frequency Response of CS Amplifier, Frequency Response of CE Amplifier, Multistage Frequency Effects, Miller Effect Capacitance, Square Wave Testing. Power Amplifier: Classifications, Class-A and Class-B Amplifier Circuits, Transfer Characteristics, Power Dissipation and Conversion Efficiency of Power Amplifiers.
Module IV **[10] Hours**	Feedback and Oscillators: Feedback Concepts, Four Basic Feedback Topologies, Practical Feedback Circuits, Basic Principle of Sinusoidal Oscillator, Introduction to Advanced Oscillators: LC Oscillators, VCO. Operational Amplifier: Introduction, OpAmp Applications: Instrumentation amplifier, Voltage limiters, 741-Op-Amp. Active filters: frequency responses, Filter design: Low Pass Filter, High Pass Filter, Band-pass Filter and Band-reject Filter.
Suggested Books:	1. Electronic Devices and Circuit Theory (Ninth Edition), Robert L. Boylestad and Louis Nashelsky, Pearson Education 2. Integrated Electronics: Analog Digital Circuits and Systems, Jacob Millman, Christos Halkias. McGraw-Hill, Inc., New York, NY, USA 1972 3. Microelectronic Circuits (Fifth Edition), Adel S. Sedra and Kenneth C. Smith.

	4. Electronic Devices (Seventh Edition), Thomas L. Floyd, Pearson Education 5. OP-Amps and Linear Integrated Circuits- Ramakant A. Gayakwad (PHI Publication).
Evaluation*:	1. Quiz: 15% 2. Mid Term/ Course Project: 30% 3. End Term Exam: 50% 4. Teacher's Assessment: 5%

Mishra

ET ______	Analog Electronic Circuits Laboratory
	Credit:1.5 (0-0-3)
Pre-requisites:	Basic Electronics Circuit, Math I, Math-II
Course Objective:	The course presents basics of electronic devices and circuits including: Transistors BJT, FET, Biasing, analysis and applications that aims to: • Equip the students with the basic concepts in Analog Electronics. • Introduce different design circuits to work with particular application. • Make them capable of developing some hardware mini projects. • Finally let them understood proper usage of electronic devices.
Course Outcome:	On completion of the AEC-LAB-course, a student should be able to: • Design and implement simple and major electronic design problems on breadboard. • Demonstrate the differences between traditional devices and circuits. • Capable of connecting various passive elements in the circuit and modeling. • Can design and develop some mini and major projects using different electronic devices and few applications of electronics.
	Syllabus
Number of experiments to be carried out = 8	1. Design, construction and testing of BJT biasing circuit. 2. Design, construction and testing of JFET biasing circuit. 3. Design, construction and testing of BJT common-emitter circuit- AC & DC performance, AC voltage gain, input and output impedance with bypassed and un-bypassed emitter resister. 4. Design, construction and testing of emitter follower circuit-AC and DC performance, voltage gain, input and output impedance. 5. Frequency response of a common-emitter amplifier at low frequency, high frequency and mid frequency range. 6. Design, construction and testing of JFET C-S Amplifier (DC and AC analysis). 7. Study of square wave testing of an Amplifier. 8. Design, construction and testing of RC phase shift oscillator using Op-Amp. 9. Study of class A & B power amplifier. 10. Design a Band Pass Filter using OpAmp Some of the project List: 1. Design a Colpitts Radio frequency Oscillator Circuit using BJT. 2. Design a variable power supply from 1.5 volt to 12 volts. 3. Design a function generator. 4. Design Op-Amp as a Schmitt Trigger circuit. 4. Air purifier. 5. Automatic gain control/automatic voltage controller. 6. Design of PLL. 7. Design of self-tuned filter. 8. Design of low dropout regulator etc.
Suggested Books	1. Electronic Devices and Circuit Theory (Ninth Edition), Robert L. Boylestad and Louis Nashelsky, Pearson Education
Evaluation*:	1. Attendance, Daily Performance, Record: 40% 2. Lab Test, Viva: 40% 3. Course Project: 20%

<table>
<tr><td>ET ______</td><td>Introductory Simulation Lab for MATLAB & LABVIEW</td></tr>
<tr><td colspan="2">Credit:1 (0-0-2)</td></tr>
<tr><td>Pre-requisites:</td><td>Basic Electronics Circuit, Programming concepts</td></tr>
<tr><td>Course Objective:</td><td>The course presents basics of MATLAB and LABVIEW programming that aims to:
• Equip the students with the basic programming concepts.
• Introduce various inbuilt functions available in MATLAB for problem solving.
• Learn the basic building blocks available in LABVIEW.</td></tr>
<tr><td>Course Outcome:</td><td>On completion of the course, a student should be able to:
• Write programs for small/medium scale problems including small analog and digital circuits.
• Use efficiently the concept of array and multidimensional matrices for data manipulation.
• Develop graphical user interface (GUI) using MATLAB.
• Design small circuits using MATLAB and LABVIEW.</td></tr>
<tr><td colspan="2"><u>Syllabus</u></td></tr>
<tr><td>Number of experiments to be carried out = 10</td><td>Software Tools to be used: MATLAB, LABVIEW

1. MATLAB Basics: Initialization of variables, array, multidimensional array, storing multidimensional array in memory, accessing multidimensional arrays with one dimension, scalar, array and matrix operations.

2. Plotting: Multiple plots, Line colour, line style, marker, legend, logarithmic scales, controlling x- and y- axis plotting limits, multiple plots on same axis, multiple figures, subplots, polar plots, annotating and saving plots, 2D plots, 3D plots.

3. Branches: if, switch, try/catch, Loop: while, for, break, continue, Nesting loops

4. User defined functions, variable passing, optional arguments, sharing data using global memory, subfunctions, private functions, nested functions.

5. Implementation of mathematical functions using MATLAB

6. Simulating simple electrical circuits using MATLAB

7. Creating and displaying Graphical user Interface (GUI), object properties, GUI components, dialog boxes, menu.

8. Introduction to SIMULINK basics, Functional Blocks to create Models, Development of Simple Application Model using Simulink

9. LABVIEW Basics: Introduction to LABVIEW windows and Blocks, Generation of different type of Signals, Addition and Multiplication of Signals, Plotting of Signals

10. Spectral Analysis: Amplitude and Power Spectrum

11. Introduction to Data Acquisition Systems using LABVIEW</td></tr>
</table>

	12. Execution of MATLAB Script using LABVIEW
Suggested Book:	1. MATLAB programming for Engineers by Stephen J. Chapman, 3rd Edition, Cengage Learning
Evaluation*:	1. Attendance, Daily Performance, Record: 40% 2. Lab Test, Viva: 40% 3. Course Project: 20%

RB

ET _____	Microprocessor and Microcontroller (CSE, IT, CE)
Credits:3 (3-0-0)	
Pre-requisites:	Digital Electronics
Course Objective:	The course aims to: • Let the student know first what is microprocessor (MP) and microcontroller (MC). • How to do data handling with MP and MC using assembly level programming • To know the architecture of MP and MC. • To learn the design aspects of I/O and Memory Interfacing circuits. • To interface MP and MC with peripheral chips. • To design a microcontroller based system
Course Outcome:	On completion of the course, a student should be able to: • Analyze and justify different generations of microprocessors and microcontrollers. • Understand and execute programs based on MP and MC • Capable of interfacing various modules with both MP and MC using proper interfacing medium. • Design both Memory Interfacing and I/O interfacing circuits • Design and implement 8051 microcontroller based systems.
Syllabus	
Module I **[10] Hours**	**Microprocessor Architecture:** 8085 Microprocessor Architecture, Pins & Signals, Register Organization, Addressing modes. **Assembly Language Programming of 8085:** Instruction set of 8085, programming.
Module II **[10] Hours**	**Interfacing:** Programmable peripheral interface 8255, ADC, DAC, Relay and Stepper Motor interfacing. **Special Purpose Programmable Peripheral Devices and Their Interfacing:** Programmable Interrupt Controller 8259A, Programmable Communication Interface 8251 USART, Programmable Interval Timer 8253/54 and Introduction to DMA Controller: DMA Transfers and Operations. **Introduction to 8086 Microprocessor:** Architecture, Register Organization, Physical Memory Organizations
Module III **[10] Hours**	**8051 Microcontroller and Programming:** Overview of the microcontrollers, Intel's 8051 Architecture, PSW Register, Register Banks and Stack, Pin diagram, Addressing Modes, Instructions and Assembly Programming, Assembler Directives, Time Delay for Various 8051 chips. **Interfacing 8051:** Programming 8051 Timers, Serial Port Programming, Interrupts Programming, ADC, DAC and Sensor Interfacing, External Memory Interface, Stepper Motor and Waveform generation. **Other Microcontroller Boards:** Introduction to Aurdino Uno Microcontroller board / Raspberry Pi board
Suggested Books:	1. R.S. Gaonkar, "Microprocessor architecture, programming & application with 8085", Penram International Publishing. (India) Pvt. Ltd. 2. Douglas V.Hall, "Microprocessors and Interfacing: Programming and Hardware", TMH . 3. M. Rafiqzzaman, "Microprocessor – Theory & Applications. (Intel & Motorola)", PHI 4. Mazidi & Mazidi, "The 8051 Microcontroller & Embedded Systems",

	Pearson / PHI publication 5. Kenneth J. Ayala, "The 8051 Microcontroller", Cengage Learning Publisher
Evaluation*:	1. Quiz: 15% 2. Mid Term/ Course Project: 30% 3. End Term Exam: 50% 4. Teacher's Assessment: 5%

ET _____	Microprocessor and Microcontroller Lab
	Credit:1 (0-0-2)
Pre-requisites:	Analog Electronics Circuit, Digital Electronics and Programming concepts
Course Objective:	The course presents basics of Assembly language programming including: Basics of Mnemonics, operands, Addressing, labels and Assembler Directives that aims to: • Equip the students with the basic programming concepts in ALP. • Introduce different interfacing modules to work with particular application. • Make them capable of developing some hardware mini projects. • Finally let them understood Processor programming.
Course Outcome:	On completion of the MPMC-LAB-course, a student should be able to: • Design and execute simple and major mathematical problems on MC. • Demonstrate the differences between traditional calculators with MC. • Capable of connecting various interfacing modules like DAC, ADC, PPI, etc., with MC. • Can design and develop some mini and major projects using different sensors and few applications of electronics.
	Syllabus
Number of experiments to be carried out = 10	**8085:** 1. Programs on implementing basic 8, 16-Bit arithmetic operations using 8085 MP 2. Programs on implementing basic 8, 16-Bit logic operations using 8085 MP. 3. Programs on implementing special functions and operations using 8085 MP. 4. Programs on implementing specific math application using 8085 MP. **8051:** 5. Programs on implementing basic 8, 16-Bit arithmetic operations using 8051 MC 6. Programs on implementing basic 8, 16-Bit logic operations using 8051 MC. 7. Programs on implementing special functions and operations using 8051 MC. 8. Programs on implementing bit operations using 8051 MC. **8051/8085 Interfacings:** 9. Interfacing ADC with 8051 MC/8085 MP 10. Interfacing DAC with 8051 MC /8085 MP 11. Interfacing PPI with 8051 MC /8085 MP for multiple applications. 12. Interfacing Stepper motor with 8051 MC /8085 MP 13. Interfacing any live sensor with 8051 MC/8085 MP **Mini-Projects:** 1. Real time implementation of any application with sensors using Microcontrollers. 2. Real time design of any controlling application using Microcontrollers. 3. Real time design of any security application using Microcontrollers. 4. Any electronics related project on real-time. 5. Not limited to the above, all new ideas and implementations are ever invited.
Suggested Book	1. 8085 Microprocessor - Ramesh Gaonkar 2. The 8051 Microcontroller. ARCHITECTURE, PROGRAMMING, and APPLICATIONS. Kenneth J. Ayala 3. The Intel Microprocessors:8085/ 8086/8088, 80186/80188, 80286, 80386, 80486, Pentium, Pentium pro Processor, Pentium II, Pentium III, Pentium 4, and Core2 ... -

PTO

	Architecture, Programming, and Interfacing by Barry B.Brey 4. Microprocessors and Interfacing: Programming and Hardware by Douglas V Hall
Evaluation*	**1. Regularity, Daily Performance, Record: 40%** **2. Lab Test, Viva: 40%** **3. Course Project: 20%** * **Minor modifications are allowed if require.**

Tutuchu

ET _____	Signals and Systems
Credits:3 (3-0-0)	
Pre-requisites:	Math I, Math II
Course Objective:	• Understanding the fundamental characteristics of signals and systems. • Coverage of continuous and discrete-time signals and systems, their properties and representations and methods that are necessary for the analysis of discrete-time signals and systems. • In-depth understanding of Z-transformation, DFT, DTFT and its applications. • Detailed algorithm of FFT, its problem solving and application areas.
Course Outcome:	On completion of the course, a student should be: • Characterize and analyze the properties of DT signals and systems. • Analyze Discrete Time systems in Time domain using convolution. • Apply knowledge of mathematics on signals and its operations. • Identify the characteristics, formulate, and solve numerical on signals and systems. • Understand and solve complex research problems in signal operations and inter-disciplinary areas.
Syllabus	
Module I **[10] Hours**	Basics of Continuous time (CT) and Discrete time (DT) signals. Discrete Time Signals: (Elementary examples, classification: periodic and a periodic Signals energy and Power signals, Even and Odd Signals). Discrete Time System: Block diagram representation of discrete time systems, classification of discrete time systems –static and dynamic, time variant and time – invariant, linear and non-linear, casual and anti-casual, stable and unstable. Analysis and response (convolution sum) of discrete - time linear LTI system, Recursive and Non-recursive discrete time system. Constant coefficient differences equations and their solutions, impulse response of LTI system, structures of LTI systems Recursive and Non-recursive realization of FIR system. Correlation of discrete time Signals.
Module II **[12] Hours**	The Z-transform and one-sided Z-transform, properties of Z-transform, inverse of the Z-transform, Solution of difference equations. **The Discrete Time Fourier Transform: Its Properties and Applications:** Frequency Domain Sampling: The Discrete time Fourier Transform; Properties of the DTFT. Discrete Fourier Transform: The DFT and IDFT, the DFT as a linear transformation Relationship of DFT with Z-transform, Properties of DFT: periodicity, linearity, scaling, and time reversal of a sequence. Circular convolution, circular correlation, circular correction by convolution, method linear convolution by overlap save methods and by overlap add method, Circular convolution and correlation by DFT method, Overlap add and save filtering by DFT method.
Module III **[8] Hours**	Fast Fourier Transform: Operation counts by direct copulation of DFT, Radix – 2 FFT algorithm- Decimation –in-time (DIT) and Decimation – in frequency (DIF) algorithm, Efficient computation DFT of Two real sequences, Efficient Computation of DFT of a 2 N-point real sequences.
Suggested Books:	1. Digital Signal Processing – Principles, Algorithms and Applications by J. G. Proakis and D. G. Manolakis, 4th Edition, Pearson. 2. Signals and Systems by A. Nagoor Kani, Tata McGraw Hill.

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	3. Alan V Oppenheim, Alan S Wilsky and Hamid Nawab S, "Signals & Systems", Prentice Hall, New Delhi, 2005. 4. Simon Haykin and Barry Van Veen, "Signals & Systems", John Wiley and Sons Inc., New Delhi, 2008 5. Ashok Ambardar, "Introduction to Analog and Digital Signal Processing", PWS Publishing Company, Newyork, 2002. 6. Sanjit .K. Mitra "Digital Signal Processing A Computer based approach" 'Tata McGraw Hill Edition ,New Delhi,2001 7. Rodger E Zaimer and William H Tranter, "Signals & Systems – Continuous and Discrete", McMillan Publishing Company, Bangalore ,2005. 8. Emmanuel C.Ifeachor "Digital Signal Processing A Practical Approach", Pearson Education Limited, England, 2002 9. Principles of Signal Processing and Linear Systems, by B.P. Lathi, Oxford. 10. Principles of Linear Systems and Signals, by B.P. Lathi, Oxford.
Evaluation*:	1. Quiz: 15% 2. Mid Term/ Course Project: 30% 3. End Term Exam: 50% 4. Teacher's Assessment: 5%

SMohanty
2-8-2022.

Dr. Subrata Kumar Mohanty
ETC Department.

ET _____	DIGITAL ELECTRONICS CIRCUITS
Credits:3 (3-0-0)	
Pre-requisites:	Number System and Logic Gates
Course Objective:	• To introduce number systems and codes • To introduce basic postulates of Boolean algebra and shows the correlation between Boolean expressions. • To introduce the methods for simplifying Boolean expressions • To outline the formal procedures for the analysis and design of combinational circuits and sequential circuits • To introduce the concept of memories, programmable logic devices and digital ICs.
Course Outcome:	On completion of this course, • The students can design combinational and sequential digital logic circuits. • Also, they will have knowledge on Programmable Logic devices and memory design.
Syllabus	
Module I **[10] Hours**	Number System: Binary Numbers, Data Representation, Binary, Octal, Hexadecimal and Decimal Number System and their Conversion, Complements, Signed Binary Numbers, Binary Codes, Error detecting codes. Boolean Algebra and Logic Gates: Basic Definitions, Basic Theorems and properties of Boolean Algebra, Boolean Functions, Canonical and Standard Forms, Other logic Operations, Digital Logic Gates, Digital Logic Families. Gate Level Minimization: The K-Map Method, Four and Five Variable Map, Product of Sums Simplification, Don't-Care Conditions, NAND and NOR Implementation, Other two-level Implementation, Exclusive-OR Function. Combinational Logic Design: Combinational Circuits, Binary Adder-Subtractor, BCD adder, Binary Multiplier, Comparator, Decoder, Encoder, Multiplexers and De-multiplexers.
Module II **[12] Hours**	Sequential Logic: Concepts of Sequential Circuits, Latches, Flip-flops, Analysis and synthesis of Clocked Sequential Circuits, State Reduction. Sequential Circuits and Memory Elements: Registers, Shift Registers, Ripple Counters, Synchronous Counters, Other Counters, Finite State Machine, Sequence Detector Circuits, Introduction to RAM and ROMs, Memory Decoding, PLA, PAL.
Module III **[8] Hours**	Concepts in VHDL/ VERILOG: Basic Concepts, Using a Hardware Description Language, Defining Module in VHDL, Structural and Combinational Modelling, Binary Words, Libraries, Learning VHDL/ VERILOG. Logic Families: RTL, DTL, TTL, ECL. CMOS Logic Circuits: Voltages as Logic Variables, Logic Delay Times: Output Switching Times, Propagation Delay, Fan-In and Fan-out, Extension to other Logic Gate. C-MOS Electronics, MOSFETS, The NOT Function in C-MOS:

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	Complementary Pairs and the C-MOS Invertors, Logic Formation Using MOSFETS: the NAND and NOR Gate, C-MOS Logic Connection.
Suggested Books:	1. Digital Design, 3rd Edition, Moris M. Mano, Pearson Education. 2. A First Course in Digital System Design: An Integrated Approach, India Edition, John P. Uyemura, PWS Publishing Company, a division of Thomson Learning Inc. 3. Digital Principles and Applications, 6th Edition, Donald P. Leach, Albert Paul Malvino and Goutam Saha, Tata McGraw Hill Publishing Company Ltd., New Delhi. 4. Digital Fundamentals, 5th Edition, T.L. Floyd and R.P. Jain, Pearson Education, New Delhi. 5. Digital Electronics, Principles and Integrated Circuit, Anil K. Jain, Wiley India Edition. 6. Digital Systems – Principles and Applications, 10th Edition, Ronald J. Tocci, Neal S. Widemer and Gregory L. Moss, Pearson Education. 7. Digital Design, Robert K. Dueck, CENGAGE Learning.
Evaluation*:	1. Quiz: 15% 2. Mid Term/ Course Project: 30% 3. End Term Exam: 50% 4. Teacher's Assessment: 5%

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ET _____	**Digital Electronics Circuits Lab**
Credit:1 (0-0-2)	
Course Objective:	The laboratory introduces students • to practical digital circuit design • to contributes significantly to provide them with engineering skills. • to analyze and understand the theoretical parts in the practical aspects of it.
Course Outcome:	On completion of the course, a student should be able to: • Students will able to analyze and design digital combinational circuits like decoders, encoders, multiplexers, and de-multiplexers including arithmetic circuits (half adder, full adder, multiplier). • Able to analyze sequential digital circuits like flip-flops, registers, counters. • Students will be able to represent numerical values in various number systems and perform number conversions between different number systems.
Syllabus	
Number of experiments to be carried out = 10	**Write here the specific instruction(s) required to carry out the lab experiments** 1. Implementation of logic gates using Universal gates. 2. Gate-level minimization: Design, Implementation and testing of Boolean functions. 3. Combinational Circuits: Design, assemble and test: adders and subtractors. 4. Design, assemble and test of code converters: gray code to binary, binary to gray, and BCD to 7 segment display. 5. Design with multiplexers, de-multiplexers, and Decoders. 6. Flip-Flop: Assemble, test and investigate operation of SR, D & J-K flip-flops. 7. Shift Registers: Design and investigate the operation of all types of shift registers with parallel load. 8. Counters: Design, assemble and test various ripple and synchronous counters - decimal counter, Binary counter with parallel load. 9. Binary Multiplier: Design and implement a circuit that multiplies 4-bit unsigned numbers to produce a 8-bit product. 10. VHDL/Verilog simulation and implementation of Combinational Circuits: Experiments listed at Sl. No. 3 and 5. 11. VHDL/Verilog simulation and implementation of Sequential Circuits: Experiments listed at Sl. No. 6 to 8.
Suggested Book:	1. Digital Design, 3rd Edition, Moris M. Mano, Pearson Education.
Evaluation*:	1. Attendance, Daily Performance, Record: 40% 2. Lab Test, Viva: 40% 3. Course Project: 20%

Singh

ET ______	**Digital Signal Processing**
	Credits: 3 (3-0-0)
Pre-requisites:	Basic Electronics, Mathematics
Course Objective:	The course aims to: • Comprehensive, theory based understanding of signals and system fundamentals applicable to the engineering discipline. • In-depth understanding of Z-transformation, DFT and its applications. • Detailed algorithm of FFT, its problem solving and application areas. • Design of digital filters and its implementation.
Course Outcome:	On completion of the course, a student should be: • Able to apply knowledge of mathematics on signals and its processing. • Able to design digital filters and analyze with distinct signals. • Able to identify the characteristics, formulate, and solve numerical on signals and systems. • Able to understand and solve complex research problems in signal processing and inter-disciplinary areas.
	Syllabus
Module I **[10] Hours**	*Discrete Time Signals*: Elementary examples, classification – periodic and non-periodic signals, energy and power signals, even and odd signals. *Discrete Time Systems*: Block diagram representation of discrete time systems, classification of discrete time systems – static and dynamic, time variant and time – invariant, linear and non-linear, causal and anti-causal, stable and unstable. *Analysis of Discrete Time Systems*: Response (convolution sum) of discrete-time linear LTI systems, recursive and non-recursive discrete time system. Constant coefficient difference equations and their solutions, impulse response of LTI system, structures of LTI systems, recursive and non-recursive realization of FIR system, correlation of discrete time signals.
Module II **[8] Hours**	*Z-transform*: Two-sided and one-sided Z-transforms, properties of Z-transform, inverse Z-transform, Solution of difference equations using Z-transform. *Discrete Fourier Transform*: Definition of DFT and IDFT, DFT as a linear transformation, properties of DFT, relationship of DFT with DTFT & Z-transform, circular convolution, circular correlation, circular convolution by linear convolution method, computation of linear convolution using overlap add/save method, computation of circular convolution and correlation using DFT.
Module III **[12] Hours**	*Fast Fourier Transform*: Computational complexity of DFT, radix-2 FFT algorithms: decimation-in-time and decimation-in-frequency, efficient computation of DFT of two real sequences, efficient computation of DFT of a 2N-pt real sequence. *Design of Digital Filters*: Causality and its implication, design of linear phase FIR filters using different windowing techniques, design of IIR filters using impulse invariance and bilinear transformation methods.

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Suggested Books:	1. *Digital Signal Processing – Principles, Algorithms and Applications*, J. G. Proakis and D. G. Manolakis, 4th Edition, Pearson. 2. *Digital Signal Processing: A Computer-Based Approach*, Sanjit K. Mitra, TMH. 3. *Digital Signal Processing*, S. Salivahan, A. Vallavraj and C. Gnanapriya, TMH. 4. *Digital Signal Processing*, Manson H. Hayes (Schaum's Outlines), TMH. 5. *Digital Signal Processing: A Modern Introduction*, Ashok Ambardar, Cengage Learning. 6. *Modern Digital Signal Processing*, Roberto Cristi, Cengage Learning. 7. *Digital Signal Processing: Fundamentals and Applications*, Li Tan, Academic Press, Elsevier. 8. *Digital Signal Processing: A MATLAB-Based Approach*, Vinay K. Ingle and John G. Proakis, Cengage Learning. 9. *Fundamentals of Digital Signal Processing using MATLAB*, Robert J. Schilling and Sandra L. Harris, Cengage Learning.
Evaluation*:	1. Quiz: 15% 2. Mid Term/ Course Project: 30% 3. End Term Exam: 50% 4. Teacher's Assessment: 5%

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<table>
<tr><td>ET ______</td><td>Digital Signal Processing Lab</td></tr>
<tr><td colspan="2">Credits: 1 (0-0-2)</td></tr>
<tr><td>Pre-requisites:</td><td>Basic Electronics, Mathematics, DSP theory course</td></tr>
<tr><td>Course Objective:</td><td>The course presents the basics of signals and systems fundamentals applicable to the engineering discipline. that aims to:
• Introduce different techniques pertaining to problem solving skills in signal processing.
• Aim the students with the necessary constructs of MATLAB programming.
• Analysis and synthesis of systems using MATLAB tool.</td></tr>
<tr><td>Course Outcome:</td><td>On completion of the course, a student should be able to:
• Prepare and design for small/medium scale problems related to signal processing.
• Demonstrate the differences between traditional and DSP processors.
• Design different type of digital filters.
• Understand the concepts of signal processing tool box.
• Acquire the physical signals and its processing for extracting information.</td></tr>
<tr><td colspan="2"><u>Syllabus</u></td></tr>
<tr><td>Number of experiments to be carried out = Any 10</td><td>Tools: MATLAB / DSP Processor

1. Introduction and hands-on session on MATLAB tool.
2. Introduction about DSP (DSK6713) processor/kit.
3. Generation and operations of DT signals.
4. Computation of linear convolution & correlation without using MATLAB inbuilt functions.
5. Computation of circular convolution & correlation without using MATLAB inbuilt functions.
6. Computation and plotting the power spectral density of DT signals.
7. Construction of z-plane zeros and poles, magnitude and phase response.
8. Computation of DFT & IDFT without using MATLAB inbuilt functions.
9. Computation of DFT & IDFT without using MATLAB inbuilt functions.
10. Design and implementation of FIR & IIR filters.
11. Frequency response of FIR filters - minimum phase and linear phase filters.
12. Convolution of long sequences using overlap-add and overlap-save methods.</td></tr>
<tr><td>Suggested Books:</td><td>1. Digital Signal Processing: A MATLAB-Based Approach by Vinay K. Ingle and John G. Proakis, Cengage Learning.
2. Fundamentals of Digital Signal Processing using MATLAB by Robert J. Schilling and Sandra L. Harris, Cengage Learning.</td></tr>
<tr><td>Evaluation*:</td><td>1. Attendance, Daily Performance, Record: 40%
2. Lab Test, Viva: 40%
3. Course Project: 20%</td></tr>
</table>

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ET _____	Principles of Communication Techniques
Credits:3 (3-0-0)	
Pre-requisites:	**Fourier Series & Fourier Transform.**
Course Objective:	This course provides a thorough introduction to the basic principles and various modulation techniques used in analog communication. The course introduces digital modulation & its applications, noise analysis in both analog & digital communication system. The course also introduces analytical techniques to evaluate the performance of communication systems.
Course Outcome:	On completion of the course, a student should be: 1. Students can analyze basic analog & digital communication systems. 2. Students can establish the connection and understand differences between AM and FM transmission along with digital modulation like PCM, DM etc. 3. Students can understand the concept of "noise" in a communication system 4. Students can understand the trade-offs (in terms of bandwidth, power, and complexity requirements) in both analog & digital communication system. 5. Students can design a basic communication system to solve a communication problem.
Syllabus	
Module I **[12] Hours**	**SIGNALS & SPECTRA:** An Overview of Electronic Communication Systems, Application of Fourier Series & Fourier Transform. **ANALOG MODULATION SYSTEMS:** Need for Frequency translation, Amplitude Modulation, Single Sideband Modulation, Other AM techniques and Frequency division multiplexing, Angle Modulation, Frequency Modulation, Phase Modulation, FM Modulators and Demodulators, Comparison of Power & Bandwidth in all modulation techniques.
Module II **[10] Hours**	**PULSE MODULATION:** Pulse Amplitude Modulation, Pulse Width Modulation and Pulse Position Modulation, Concept of Time division multiplexing, Samplings, Sampling theorem & its applications. **NOISE IN ANALOG COMMUNICATION:** Some Sources of Noise, AWGN, Power spectral density, Linear Filtering of Noise, Concept of SNR & Noise figure, Calculation of SNR in AM, Comparison of SNR with FM.
Module III **[8] Hours**	**DIGITAL MODULATION:** Quantization, Analog to Digital conversion, Digital representation of analog Signal, Quantization error, Companding, Pulse code Modulation (PCM), Differential PCM, Delta modulation (DM), ADM.

	NOISE IN DIGITAL COMMUNICATION: Noise in PCM & DM, Calculation of SNR in PCM & DM, Comparison of BW & Power requirement in basic Digital modulation systems.
Suggested Books:	**Essential Reading:** 1. H. Taub, D. L Schilling, G. Saha; *Principles of Communication System, 3rd Edition; 2008, Tata McGraw Hill, India;* ISBN: 0070648115. 2. Modern Digital and Analog Communication Systems, by B.P. Lathi, Oxford. 3. Simon Haykin: Communication System, 4^{th} Edition, Wiley **Supplementary Reading:** 1. Communication System Engineering,Second Edition by Masoud Salehi, John G. Proakis, ISBN: 0130950076 (paperback) 2. Analog Communication by Chandra Sekar, Oxford University Press.
Evaluation*:	1. Quiz: 15% 2. Mid Term/ Course Project: 30% 3. End Term Exam: 50% 4. Teacher's Assessment: 5%

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ET ____	Principles of Communication Techniques Lab
Credit:1	
Pre-requisites:	Basic Signal analysis.
Course Objective:	This Lab course presents basics of Analog & Digital Communication Systems including: Signal and Spectrum Analysis, AM/FM Transmitter and Receiver module, Frequency Division Multiplexing, PCM analysis etc. Lab classes aim to: 1. Explain the communication platform with the basic knowledge of AM/FM/PCM using both trainer kits and software platforms. 2. Explain the concept of time domain and frequency domain representation of signals. 3. Develop efficiency to represent analytical model using Graphical Design Platform like LABVIEW. 4. Emphasize on guided practical sessions
Course Outcome:	On completion of the Lab. course, a student should be able to: • Design analog transmitter and receiver • Demonstrate the differences between practical AM and FM transmission • Explain building blocks of modulator and demodulator • Understand the practical Analog & Digital modulator and demodulator circuits used for transmission. • Design transmitter and receiver section using software platform like MATLAB and LABVIEW.
Syllabus	
Number of experiments to be carried out 10	1. Sine wave, square wave, triangle wave, saw-tooth wave of frequency 1MHZ Measurement of power associated with different harmonics in signals. 2. Perform AM modulation and demodulation using Trainer Kits. Find out modulation index by observing atleast 3 AM waveforms. 3. Perform DSBSC, SSBSC modulations using Trainer Kits 4. Analyze & perform the process of frequency division multiplexing and de-multiplexing. 5. Perform FM modulation and Demodulation using Trainer Kits. 6. Perform Pulse modulations (PAM, PWM, PPM) using Trainer Kits. 7. Perform PCM modulation and Demodulation using Trainer Kits. 8. Perform DPCM/DM modulation and Demodulation using Trainer Kits 9. Using MATLAB generate a carrier and a modulating signal. Perform AM modulation and Demodulation using MATLAB. Repeat the simulation for more number of waveforms. 10. Perform FM modulation and Demodulation using MATLAB. 11. Perform AM modulation and Demodulation using LABVIEW software. 12. Perform FM modulation and Demodulation using LABVIEW software.

Suggested Books:	1. H. Taub, D. L Schilling, G. Saha; *Principles of Communication System, 3rd Edition; 2008, Tata McGraw Hill, India;* ISBN: 0070648115. 2. Modern Digital and Analog Communication Systems, by B.P. Lathi, Oxford
Evaluation*:	1. Performance of Experiment: 40% 2. Lab Test: 20% 3. Record: 10% Quiz: 10% 4. Quiz: 10% 5. Viva: 20%

3/8/22

<table>
<tr><td>ET _____</td><td>Electromagnetic Fields and Wave Propagation</td></tr>
<tr><td colspan="2">Credits:3 (3-0-0)</td></tr>
<tr><td>Pre-requisites:</td><td>Physics, Mathematics</td></tr>
<tr><td>Course Objective:</td><td>The course aims to:
Familiarize the students to the concepts and calculations pertaining to electric fields.
Familiarize the students to the concepts and calculations pertaining to magnetic fields.
Enable the students to analyze the electromagnetic wave propagation in free space and other dielectric media.
Enable the students to analyze the wave propagation in transmission lines.</td></tr>
<tr><td>Course Outcome:</td><td>On completion of the course, a student should be able to:
Understand the fundamentals of electric field, magnetic field and electromagnetic wave propagation in free space and other dielectric media
Explain the Maxwell's equations and their physical significance
Explain the basic principle behind reflection and refraction of plane wave in various media
Explain the electromagnetic wave propagation in transmission lines</td></tr>
<tr><td colspan="2"><u>Syllabus</u></td></tr>
<tr><td>Module I
[10] Hours</td><td>Static Electric Field: Introduction to Co-ordinate systems, Introduction to Line, Surface and Volume Integrals, Curl, Divergence and Gradient, Stokes theorem and Divergence theorem.
Coulomb's Law, Electric field due to discrete charges and continuous charge distribution, Boundary conditions, Electric scalar potential, Potential due to infinite uniformly charged line, Electric flux density, Gauss law and its applications.</td></tr>
<tr><td>Module II
[10] Hours</td><td>Static Magnetic Field: Biot-Savart Law, Magnetic field intensity, Ampere's circuital law and simple applications. Magnetic flux density, Lorentz force equation for a moving charge. Force on a wire carrying a current placed in a magnetic field, Torque on a loop carrying a current, Nature of magnetic materials, magnetization and permeability, magnetic boundary conditions.
Maxwell's Equations: Poisson's and Laplace's equation, Electrostatic energy and energy density, Continuity equation for current, Generalized Maxwell's equations in integral form and differential form, Maxwell's equation in phasor form.</td></tr>
<tr><td>Module III
[10] Hours</td><td>Electromagnetic Wave Propagation: Wave Equation, Uniform plane waves, Plane waves in free space and in a homogenous material. Wave equation in various media, Skin effect, Poynting theorem, Linear, Elliptical and Circular polarization, Reflection of plane wave from a conductor and perfect dielectric, Uniform plane wave propagation in an arbitrary direction, Reflection, and refraction of plane waves.
Transmission lines: The lumped-element circuit model for a two-wire transmission line and wave propagation, Reflection coefficient and VSWR of terminated two wire transmission lines.</td></tr>
<tr><td>Recommended Books:</td><td>Matthew N. O. Sadiku, Elements of Electromagnetics, Oxford University Press, UK, 2007.
Edward C. Jordan, Keith G. Balmain, Electromagnetic Waves and Radiating Systems, Pearson Education, India, 1995.
William H. Hayt, John A. Buck, Engineering Electromagnetics, McGraw Hill Education, New Delhi, 2011.</td></tr>
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Singh 02/08/22

	4. David M. Pozar, *Microwave Engineering*, John Willy & Sons, USA, 2011.
Evaluation:	1. Quiz: 15% 2. Mid Term: 30% 3. End Term Exam: 50% 4. Teacher's Assessment: 5%