ANALOG ELECTRONICS

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – III

Subject Code	14XXX32	IA Marks	20
Number of Lecture Hours/Week	04	Exam Marks	80
Total Number of Lecture Hours	50	Exam Hours	03

CREDITS – 04

Course objectives: This course will enable students to:

- Recall and Explain various BJT parameters, connections and configurations.
- Explain and Demonstrate BJT Amplifier, Hybrid Equivalent and Hybrid π Models.
- Recall and Explain construction and characteristics of JFETs and MOSFETs.
- Explain various types of FET biasing, and Demonstrate use of FET amplifiers.
- Demonstrate and Construct Frequency response of BJT and FET amplifiers at various frequencies.
- Define, Demonstrate and Analyze Power amplifier circuits in different modes of operation.
- Demonstrate and Apply Feedback and Oscillator circuits using FET.

Modules	Teaching Hours	Revised Bloom's Taxonomy (RBT) Level
Module -1 **BJT AC Analysis** BJT modeling, r_e transistor model: Common Emitter Configuration, Voltage-Divider Bias, CE Emitter-Bias Configuration (Excluding Pspice Analysis), Emitter Follower Configuration, Determining Current Gain, Effect of R_L and R_S, Cascaded Systems, RC- Coupled BJT Amplifier, Cascode Connection, Darlington Connection. The Hybrid Equivalent Model, Approximate Hybrid Equivalent Circuit-Fixed Bias Configuration, Voltage Divider Configuration, Complete Hybrid Equivalent Model, Hybrid π Model. Relevant problems.	**10 Hours**	**L1, L2**
Module -2		
Field – Effect Transistors Introduction, Construction and Characteristics of JFETs, Transfer Characteristics- Derivation, Applying Schokley's Equation, Depletion Type MOSFET: Basic Construction, Basic Operation and Characteristics, P-Channel Depletion Type MOSFET and Symbols, Enhancement Type MOSFET-Basic Construction, Basic Operation and Characteristics, P-Channel Enhancement Type MOSFET and Symbols, CMOS. Relevant problems. **FET Biasing** Introduction, Fixed-Bias Configuration, Self-Bias Configuration, Voltage-Divider Biasing. Relevant problems.	**10 Hours**	**L1, L2**
Module -3		

FET Amplifiers Introduction, JFET Small Signal Model, JFET AC equivalent Circuit, Fixed- Bias Configuration, Self-Bias Configuration (Excluding Pspice Analysis), Voltage-Divider Configuration, Source Follower Configuration. Relevant problems. **BJT and JFET Frequency Response** General Frequency Considerations, Low Frequency Response- BJT Amplifier (Excluding Pspice Analysis) Low Frequency Response- FET Amplifier (Excluding Pspice Analysis), Miller Effect Capacitance, High Frequency Response- BJT Amplifier, High Frequency Response- FET Amplifier (Excluding Pspice Analysis), Multistage Frequency Effects. Relevant problems.	**10 Hours**	**L1, L2, L3**
Module -4		
Power Amplifiers Introduction: Definitions and Amplifier Types, Series Fed Class A Amplifier, Operation of Amplifier Stage, Transformer Coupled Class A Amplifier, Class B Amplifier Operation, Class B Amplifier Circuits: Transformer Coupled Push-Pull Circuits, Complementary –Symmetry Circuits, Amplifier Distortion, Class C and Class D Amplifier. Relevant Problems.	**10 Hours**	**L1, L2, L3, L4**
Module -5		
Feedback and Oscillator Circuits Feedback Concepts, Feedback Connection Types, Oscillator operation, Phase Shift Oscillator: FET Phase Shift Oscillator, Transistor Phase Shift Oscillator, Wien Bridge Oscillator, Tuned oscillator Circuit: FET and Transistor Colpitts Oscillator, FET and Transistor Hartley Oscillator, Crystal oscillator, Unijunction Oscillator. Relevant Problems.	**10 Hours**	**L2, L3**

Course outcomes:

After studying this course, students will be able to:

- Acquire knowledge of
  - Working principles, characteristics and basic applications of BJT and FET.
  - Single stage, cascaded and feedback amplifier configurations.
  - Frequency response characteristics of BJT and FET.
  - Power amplifier classifications such as Class A, Class B, etc.
- Analyse the performance of
  - r_e transistor model, π model.
  - FET amplifier in CS configuration.
  - Power Amplifiers and Oscillator circuits.
- Interpretation of performance characteristics of transistors amplifiers, frequency Response and Oscillators.
- Apply the knowledge gained in the design of transistorized circuits, amplifiers and Oscillators.

Graduate Attributes (as per NBA):

- Engineering Knowledge.
- Problem Analysis.
- Design / development of solutions (partly).
- Interpretation of data.

Question paper pattern:

- The question paper will have ten questions.

- Each full question consists of 16 marks.
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.

The students will have to answer 5 full questions, selecting one full question from each module.

Text Books:

1. Robert L. Boylestad and Louis Nashelsky, "Electronics devices and Circuit theory", Pearson, 11th Edition, 2015, ISBN:9789332542600.

Reference Books:

1. I. J. Nagrath, "Electronics: Analog and Digital", PHI.
2. David A. Bell, "Electronic Devices and Circuits", Oxford University Press.

DIGITAL ELECTRONICS
[As per Choice Based Credit System (CBCS) scheme]
SEMESTER – III

Subject Code	14XXX33	IA Marks	20
Number of Lecture Hours/Week	04	Exam Marks	80
Total Number of Lecture Hours	50	Exam Hours	03

CREDITS – 04

Course objectives: This course will enable students to:

- Describe, Illustrate and Analyze Combinational Logic circuits, Simplification of Algebraic Equations using Karnaugh Maps and Quine McClusky Techniques.
- Define and Describe Decoders, Encoders, Digital multiplexers, Adders and Subtractors, Binary comparators, Latches and Master-Slave Flip-Flops.
- Describe, Demonstrate, Analyze and Design of Mealy and Moore Models, Synchronous Sequential Circuits, State diagrams and Registers and Counters.

Modules	Teaching Hours	Revised Bloom's Taxonomy (RBT) Level
Module -1 **Combinational Logic Design** Boolean Laws and Theorems, Sum-of-product and Product-of-sum Form, Karnaugh Map, Karnaugh Map with 'Don't Care' Conditions, Five Variable Karnaugh Map, Quine-McCluskey Minimisation Procedure: Reduction Techniques, Map Entered Variable Method. Relevant Problems.	**10 Hours**	**L2, L3, L4**
Module -2		
Logic Circuit Design: Arithmetic Operation Combinational Circuit, Binary Adder, Binary Substractor, Binary Parallel Adder, The Look-Ahead-Carry Binary Adders, Binary Multipliers, Binary Dividers, Comparator. Relevant Problems. **Logic Circuit Design: Data Processing** Introduction, Decoders: One-to-Two Line Decoder, Two-to-Four Line Decoder, Three-to-Eight Line Decoder, Encoders: Four-to-Two Line Encoder, Four-to-Two Line Priority Encoders, Multiplexers: Two-to-One Multiplexer, Four-to-One Multiplexer, Eight-to-One Multiplexer, Cascading of Multiplexers: Construction of Four-to-One Multiplexer, Eight-to-One Multiplexer using Two-to-One Multiplexer, Cascading of Multiplexers using Enable, Demultiplexers: One-to-Two Line Demultiplexer, One-to-Four Line Demultiplexer, Casacading of Demultiplexers: Construction of One-to-Four Line Demultiplexers using One-to-Two Line Demultiplexers, Cascading of Demultiplexers using Enable. Relevant Problems.	**10 Hours**	**L1, L2**
Module -3		

Flip-Flops Introduction, Basic Bistable Element, SR Latch: SR Latch using NOR Gates, Gated SR Latch using NOR Gates, SR Latch using NAND Gates, Gated SR Latch using NAND Gate, Characteristic of SR Latch, State Transition Diagram of SR Latch, Excitation Table of SR Latch, Triggering of Latches, D-Flip-Flop, JK Flip-Flop, T Flip-Flop, Race Around Condition, Master Slave Flip-Flop, Edge-Triggered Flip-Flop, Conversion of Flip-Flops: SR Flip-Flop to JK Flip-Flop. Relevant Problems.	**10 Hours**	**L1, L2**
Module -4		
Design of Sequential Circuits Introduction, Notations, Moore and Mealy Sequential Circuits, Analysis of Asynchronous Sequential Circuits: Fundamental Mode Asynchronous Sequential Circuit without Latches, Pulse Mode Asynchronous Sequential Circuit with Latches. Relevant Problems.	**10 Hours**	**L2, L3, L6**
Module -5		
Registers Introduction, Registers: Four Bit Latch, Shift Register, Serial In Serial Out Shift Register: Left-Shift Serial-In Serial-Out Register with D Flip-Flop, Serial-In Parallel-Out Shift Register, Parallel-In Serial-Out Shift Register: PISO Left-Shift Register, Ring Counter, Johnson Counter. Relevant Problems. **Counters** Introduction, Synchronous Counter, Modulus-4 Synchronus Up Counter, Modulus-4 Synchronus Down Counter, Modulus-4 Synchronus Up/Down Counter, Modulus-8 Synchronus Up Counter, Modulus-8 Synchronus Down Counter, Modulus-8 Synchronus Up/ Down Counter. Relevant Problems.	**10 Hours**	**L2, L3, L6**

Course outcomes:

After studying this course, students will be able to:

- Acquire knowledge of
  - Combinational Logic.
  - Simplification Techniques using Karnaugh Maps, Quine McClusky Technique.
  - Operation of Decoders, Encoders, Multiplexers, Adders and Subtractors.
  - Working of Latches, Flip-Flops,
  - Designing Registers, Counters.
  - Mealy, Moore Models and State Diagrams
- Analyse the performance of
  - Simplification Techniques using Karnaugh Maps, Quine McClusky Technique.
  - Synchronous Sequential Circuits.
- Interpretation of performance characteristics of Mealy and Moore Models.
- Apply the knowledge gained in the design of Counters, Registers and etc.

Graduate Attributes (as per NBA):

- Engineering Knowledge.
- Problem Analysis.
- Design / development of solutions (partly).
- Interpretation of data.

Question paper pattern:

- The question paper will have ten questions.
- Each full question consists of 16 marks.
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.

The students will have to answer 5 full questions, selecting one full question from each module.

Text Books:

1. D. P. Kothari and J. S Dhillon, "Digital Circuits and Design", Pearson, 2016, ISBN:9789332543539.

Reference Books:

1. Donald D. Givone, "Digital Principles and Design", McGraw Hill.
2. Charles H Roth, Jr., "Fundamentals of logic design", Cengage Learning.

ELECTRONIC INSTRUMENTATION

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – III

Subject Code	14XXX33	IA Marks	20
Number of Lecture Hours/Week	04	Exam Marks	80
Total Number of Lecture Hours	50	Exam Hours	03

CREDITS – 04

Course objectives: This course will enable students to:

- Define and Describe accuracy and precision, types of errors, statistical and probability analysis.
- Describe basic functional concepts of various analog and digital measuring instruments.
- Describe basic concepts of microprocessor based instruments.
- Describe and Discuss functioning and types of oscilloscopes and signal generators, AC and DC bridges.
- Recognize and Describe significance and working of different types of transducers.

Modules	Teaching Hours	Revised Bloom's Taxonomy (RBT) Level
Module -1 **Measurement and Error:** Definitions, Accuracy and Precision, Significant Figures, Types of Error, Statistical Analysis, Probability of Errors, Limiting Errors. Relevant problems. **Ammeters:** DC Ammeter, Multirange Ammeter, The Ayrton Shunt or Universal Shunt, Requirements of Shunt, Extending of Ammeter Ranges, RF Ammeter (Thermocouple), Limitations of Thermocouple, Effect of Frequency on Calibration, Measurements of Very Large Currents by Thermocouples. Relevant problems. **(Text 2)** **Voltmeters and Multimeters:** Introduction, Basic Meter as a DC Voltmeter, DC Voltmeter, Multirange Voltmeter, Extending Voltmeter Ranges, Loading, Transistor Voltmeter, Differential Voltmeter, Average Responding Voltmeter, Peak responding Voltmeter, True RMS Voltmeter, Considerations in Choosing an Analog Voltmeter, Multimeter. Relevant problems. **(Text 2)**	**10 Hours**	**L1, L2**
Module -2		
Digital Voltmeters: Introduction, RAMP technique, Dual Slope Integrating Type DVM, Integrating Type DVM, Most Commonly used principles of ADC, Successive Approximations, Continuous Balance DVM, $3\frac{1}{2}$-Digit, Resolution and Sensitivity of Digital Meters, General Specifications of DVM, Microprocessor based Ramp type DVM. Relevant Problems. **(Text 2)**	**10 Hours**	**L1, L2**

Digital Instruments: Introduction, Digital Multimeters, Digital Frequency Meter, Digital Measurement of Time, Universal Counter, Decade Counter, Electronic Counter, Digital Tachometer, Digital pH Meter, Digital Phase Meter, Digital Capacitance Meter, Microprocessor based Instruments. Relevant Problems. **(Text 2)**		
Module -3		
Oscilloscopes: Introduction, Basic principles, CRT features, Block diagram of Oscilloscope, Simple CRO, Vertical Amplifier, Horizontal Deflecting System, Sweep or Time Base Generator, Storage Oscilloscope, Digital Readout Oscilloscope, Measurement of Frequency by Lissajous Method, Probes for CRO, Digital Storage Oscilloscope. **(Text 2)** **Signal Generators:** Introduction, Fixed and Variable AF Oscillator, Standard Signal Generator, Laboratory Type Signal Generator, AF sine and Square Wave Generator, Function Generator, Square and Pulse Generator, Sweep Generator. **(Text 2)**	**10 Hours**	**L1, L2**
Module -4		
Measuring Instruments: Output Power Meters, Field Strength Meter, Stroboscope, Phase Meter, Vector Impedance Meter, Q Meter, Megger, Analog pH Meter, Telemetry. Relevant Problems. **(Text 2)** **Bridges:** Introduction, Wheatstone's bridge, Kelvin's Bridge; AC bridges, Capacitance Comparison Bridge, Inductance Comparison Bridge, Maxwell's bridge, Wein's bridge, Wagner's earth connection, Relevant Problems. **(Text 2)**	**10 Hours**	**L1, L2**
Module -5		
Transducers: Introduction, Electrical transducers, Selecting a transducer, Resistive transducer, Resistive position transducer, Strain gauges, Resistance thermometer, Thermistor, Inductive transducer, Differential output transducers, LVDT, Piezoelectric transducer, Photoelectric transducer, Photovoltaic transducer, Semiconductor photo diode and transistor, Temperature transducers-RTD. Relevant Problems. **(Text 2)**	**10 Hours**	**L1, L2**
Course outcomes: After studying this course, students will be able to: • Acquire knowledge of o Difference between accuracy and precision o Functioning of various types of analog and digital measuring instruments. o Different types of quantization, resolution and sensitivity in digital instruments such as frequency meters, tachometers, pH meters etc. o Microprocessor based instrumentation o Functioning of various types of Oscilloscopes and signal generators. o Different types of transducers in various applications.		

- Analyse the performance of
  - AC and DC bridges.
- Interpretation of performance characteristics of analog and digital measuring instruments.
- Understand the importance of life-long learning in the field of electronic instrumentation.

Graduate Attributes (as per NBA)

- Engineering Knowledge.
- Problem Analysis (partly).
- Life-long learning.

Question paper pattern:

- The question paper will have ten questions.
- Each full question consists of 16 marks.
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module.

Text Books:

1. A. D. Helfrick and W.D. Cooper, "Modern Electronic Instrumentation and Measuring Techniques", Pearson, 1st Edition, 2015, ISBN:9789332556065.
2. H. S. Kalsi, "Electronic Instrumentation", McGraw Hill, 3rd Edition, 2012, ISBN:9780070702066.

Reference Books:

1. A. K. Sawhney, "Electronics and Electrical Measurements", Dhanpat Rai & Sons.
2. David A. Bell, "Electronic Instrumentation and Measurements", Oxford University Press.

MICROPROCESSORS AND MICROCONTROLLERS

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – III

Subject Code	14XXX35	IA Marks	20
Number of Lecture Hours/Week	04	Exam Marks	80
Total Number of Lecture Hours	50	Exam Hours	03

CREDITS – 04

Course objectives: This course enables students to:

- Recall and Describe basics of Digital Computer, Microprocessors, Microcomputers and Microcontrollers.
- Discuss fundamentals of 8086 microprocessor architecture, pin diagram, etc.
- Discuss and Describe architecture of 8051 microcontroller, memory and I/O organization and addressing modes.
- Recall and Describe 8051 Instruction set, Timers and counters, serial communication.
- Demonstrate and Develop 8051 interfacing and applications.

Modules	Teaching Hours	Revised Bloom's Taxonomy (RBT) Level
Module -1 **Microprocessor Introduction:** Digital Computer, Microprocessors, Microcomputers and Microcontrollers **(section 0.3, 1.1 of Text 1)**. **8086 Microprocessor**: Architecture – General Purpose Registers, Pointers, Segment Registers, Advantages of Segment Registers, PSW, Pin diagram in Minimum Mode **(Text 2)**.	**10 Hours**	**L1, L2**
Module -2		
8051 Microcontroller: Architecture, Registers, Pin diagram, I/O ports functions, Memory organization, External Memory (ROM & RAM) interfacing, Addressing Modes **(Text 1)**.	**10 Hours**	**L1, L2**
Module -3		
8051 Instruction Set: Data Transfer instructions, Arithmetic instructions, Logical instructions, Branch instructions, Bit manipulation instructions, Stack and Subroutine instructions, Assembler directives, Assembly language program examples **(Text 1)**.	**10 Hours**	**L1, L2**
Module -4		
8051 Timers and Counters – Operation and Assembly language programming **(Text 1)**. **8051 Serial Communication**- Basics of Serial Data Communication, RS-232 standard, 9 pin RS232 signals, Assembly language programming for 8051 serial data transmission and reception, 8051 Interrupts and 8051 Assembly language Interrupts programming **(Text 1)**.	**10 Hours**	**L1, L2**

Module -5		
8051 Interfacing and Applications: Interfacing 8051 to simple switches and LEDs, LCD, ADC-0804 and Stepper motor and 8051 Assembly language Interfacing programming **(Text 1)**.	**10 Hours**	**L3, L4**

Course outcomes:

After studying this course, students will be able to:

- Acquire knowledge of
  - Architecture of 16 bit 8086 microprocessor.
  - Architecture, registers of 8051 microcontroller.
  - Instruction set of 8051 microcontroller.
  - Functioning of 8051 timers, counters and serial I/O.
  - 8051 interfacing and its applications.
- Apply the knowledge gained in the design of microprocessor and microcontroller based systems.
- Acquire competency in using tools such as assembler/ compiler.

Graduate Attributes (as per NBA)

- Engineering Knowledge.
- Design/ development of solutions.

Modern tool usage.

Question paper pattern:

- The question paper will have ten questions.
- Each full question consists of 16 marks.
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module.

Text Books:

1. Muhammad Ali Mazidi and Janice Gillespie Mazidi and Rollin D. McKinlay, "The 8051 Microcontroller and Embedded Systems – using assembly and C", Pearson, 2nd Edition, 2006, ISBN:9788131710265.
2. Yu-cheng Liu and Glenn A. Gibson, "Microcomputer Systems - The 8086/8088 Family Architecture, Programming and Design", Pearson, 2nd Edition 2015, ISBN:9789332550087.

Reference Books:

1. Douglas Hall, "Microprocessors and Interfacing – Programming & Hardware", McGraw Hill.
2. Kenneth J. Ayala, "The 8051 Microcontroller Architecture, Programming & Applications", Thomson Learning.
3. Krishna Kant, "Microprocessors and Microcontrollers: Architecture, Programming, and System Design", PHI.

OOPs with C++ (Elective)

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – III

Subject Code	14XXX361	IA Marks	20
Number of Lecture Hours/Week	03	Exam Marks	80
Total Number of Lecture Hours	40	Exam Hours	03

CREDITS – 03

Course objectives: This course enables students to:

- Describe the fundamental concepts of object-oriented Programming (OOP) and basics of C++ programming.
- Define and Describe Arrays, structure, union and pointers.
- Define and Describe Classes, objects, constructors, destructors, inheritance and polymorphism, Template and exception handling.

Modules	Teaching Hours	Revised Bloom's Taxonomy (RBT) Level
Module -1 Fundamentals of OOPs , Basics of C++	**08 Hours**	**L1, L2**
Module -2		
Functions, Arrays, Structure, Union , Bit fields	**08 Hours**	**L1, L2**
Module -3		
Pointers, Classes and objects,	**08 Hours**	**L1, L2**
Module -4		
Constructors and Destructors, Inheritance,	**08 Hours**	**L1, L2**
Module -5		
Polymorphism, Template and exception handling	**08 Hours**	**L1, L2**

Course outcomes:

After studying this course, students will be able to:

- Acquire knowledge of
  - C++ basics and fundamental concepts of OOPs.
  - OOPs features such as classes, objects, inheritance and polymorphism.
  - Arrays, structures, union, bit fields and pointers.
  - Template and exception handling.
- Apply the knowledge gained in the
  - Understanding of Java and other object oriented programming languages.
  - Development of wide range of object oriented software packages.
- Acquire competency in using OOPs in different platforms.
- Understand the importance of life-long learning in the field of OOPs.

Graduate Attributes (as per NBA)

- Engineering Knowledge.
- Problem Analysis.
- Design/Development of solutions.
- Modern Tool Usage.
- Life-long learning.

Question paper pattern:

- The question paper will have ten questions.
- Each full question consists of 16 marks.
- There will be 2 full questions (with a maximum of four sub questions) from each module.

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

Text Books:

1. Rakesh Shukla, "Object Oriented Programming in C++", Wiley India, 2013, ISBN: 9788126516582.
2. Herbert Schildt, "The Complete Reference C++", McGraw Hill, 4th Edition, 2003, ISBN:978007053532465.

Reference Books:

1. Stanley B.Lippmann and Josee Lajore, "C++ Primer", Pearson.
2. K. R. Venugopal, Rajkumar Buyya, and T. Ravi Shankar, "Mastering C++", McGraw Hill.

OPERATING SYSTEMS (Elective)

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – III

Subject Code	14XXX362	IA Marks	20
Number of Lecture Hours/Week	03	Exam Marks	80
Total Number of Lecture Hours	40	Exam Hours	03

CREDITS – 03

Course objectives: This course enables students to:

- Define and Describe operating systems, Computer System architecture, Operating System structure, Operating System operations and services.
- Explain Process concept, Process scheduling, Operations on processes, Inter-process communication, Multi-Threaded Programming and Process management as a whole.
- Define and Discuss the Critical section problem, Peterson's solution, Synchronization hardware, Semaphores, Process synchronization and deadlocks in general.
- Define and Describe swapping, contiguous memory allocation, paging; tructure of page table, Segmentation Memory management of an Operating System.

Modules	Teaching Hours	Revised Bloom's Taxonomy (RBT) Level
Module -1 **Introduction to Operating Systems, System structures:** What operating systems do; Computer System organization; Computer System architecture; Operating System structure; Operating System operations; Process management; Memory management; Storage management; Protection and security; Distributed system; Special-purpose systems; Computing environments. Operating System Services; User - Operating System interface; System calls; Types of system calls; System programs; Operating System design and implementation; Operating System structure; Virtual machines; Operating System generation; System boot.	**08 Hours**	**L1, L2**
Module -2		
Process Management: Process concept; Process scheduling; Operations on processes; Inter-process communication. Multi-Threaded Programming: Overview; Multithreading models; Thread Libraries; Threading issues. Process Scheduling: Basic concepts; Scheduling criteria; Scheduling algorithms; Multiple-Processor scheduling; Thread scheduling.	**08 Hours**	**L1, L2**
Module -3		
Process Synchronization: Synchronization: The Critical section problem; Peterson's solution; Synchronization hardware; Semaphores; Classical problems of	**08 Hours**	**L1, L2**

synchronization; Monitors.		
Module -4		
Deadlocks: Deadlocks: System model; Deadlock characterization; Methods for handling deadlocks; Deadlock prevention; Deadlock avoidance; Deadlock detection and recovery from deadlock.	**08 Hours**	**L1, L2**
Module -5		
Memory Management: Memory Management Strategies: Background; Swapping; Contiguous memory allocation; Paging; Structure of page table; Segmentation; Virtual Memory Management: Background.	**08 Hours**	**L1, L2**

Course outcomes:

After studying this course, students will be able to:

- Acquire knowledge of Operating system
  - Structure, operations and services.
  - Process and memory management.
  - Process scheduling, process synchronization and deadlock.
  - Virtual memory management.
- Apply the knowledge gained in the design of operating systems.
- Acquire competency in understanding different Operating Systems.
- Understand the importance of life-long learning in the field of Operating Systems.

Graduate Attributes (as per NBA)

- Engineering Knowledge.
- Design/Development of solutions.
- Life-long learning.

Question paper pattern:

- The question paper will have ten questions.
- Each full Question consists of 16 marks.
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module.

Text Books:

1. Abraham Silberschatz, Peter Baer Galvin and Greg Gagne, "Operating System Principle", Wiley India, 8th Edition, 2009, ISBN:9788126520510.

Reference Books:

1. D.M Dhamdhere, "Operating systems - A concept based Approach", McGraw Hill.
2. P.C.P. Bhatt, "Introduction to Operating Systems: Concepts and Practice", PHI.
3. Harvey M Deital, "Operating systems", Pearson.

COMPUTER ORGANISATION (Elective)

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – III

Subject Code	14XXX363	IA Marks	20
Number of Lecture Hours/Week	03	Exam Marks	80
Total Number of Lecture Hours	40	Exam Hours	03

CREDITS – 03

Course objectives: This course enables students to:

- Recall and Describe basic structure of computers, machine instructions and programs.
- Recall and Describe different addressing modes, output operations, Stacks and Queues, Subroutines and Additional Instructions, IEEE standard for Floating point Numbers.
- Write and Describe accessing I/O Devices, Interrupts, Direct Memory Access, Busses, Interface Circuits, and Standard I/O Devices.
- Describe Semiconductor RAM Memories, Read Only Memories, Cache Memories, Performance Considerations and Virtual Memories.
- Recall and Describe execution of a Complete Instruction, Multiple Bus Organization, Microprogrammed Control and Hardwired Control.

Modules	Teaching Hours	Revised Bloom's Taxonomy (RBT) Level
Module -1 **Basic Structure of Computers:** Computer Types, Functional Units, Basic Operational Concepts, Bus Structures, Software, Performance – Processor Clock, Basic Performance Equation. **Machine Instructions and Programs:** Numbers, Arithmetic Operations and Characters, Memory Location and Addresses, Memory Operations, Instructions and Instruction Sequencing.	**08 Hours**	**L1, L2**
Module -2		
Machine Instructions and Programs (Continued): Addressing Modes, Assembly Language, Basic Input and Output Operations, Stacks and Queues, Subroutines, Additional Instructions. IEEE standard for Floating point Numbers (6.7.1 of Chapter 6)	**08 Hours**	**L1, L2**
Module -3		
Input/output Organization: Accessing I/O Devices, Interrupts, Direct Memory Access, Busses, Interface Circuits, Standard I/O Devices.	**08 Hours**	**L1, L2**
Module -4		
Memory System: Some Basic Concepts, Semiconductor RAM Memories, Read Only Memories, Cache Memories, Performance Considerations, Virtual Memories.	**08 Hours**	**L1, L2**
Module -5		

Basic Processing Unit: Some Fundamental Concepts, Execution of a Complete Instruction, Multiple Bus Organization, Microprogrammed Control, Hardwired Control.	**08 Hours**	**L1, L2**

Course outcomes:

After studying this course, students will be able to:

- Acquire knowledge of
  - The basic structure of computers & machine instructions and programs.
  - Addressing Modes, Assembly Language,
  - Stacks, Queues and Subroutines.
  - Input/output Organization such as accessing I/O Devices, Interrupts.
  - Memory system basic Concepts, Semiconductor RAM Memories, Static memories, Asynchronous DRAMS, Read Only Memories, Cache Memories and Virtual Memories.
  - Some Fundamental Concepts of Basic Processing Unit, Execution of a Complete Instruction, Multiple Bus Organization, Hardwired Control and Microprogrammed Control.
- Apply the knowledge gained in the design of Computer.
- Acquire competency in understanding computer organisation.
- Understand the importance of life-long learning in the field of computer organisation.

Graduate Attributes (as per NBA)

- Engineering Knowledge.
- Problem Analysis.
- Life-long learning.

Question paper pattern:

- The question paper will have ten questions.
- Each full question consists of 16 marks.
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module.

Text Books:

1. Carl Hamacher, Zvonko Vranesic, Safwat Zaky, “Computer Organization”, McGraw Hill, 5th Edition, 2015, ISBN:9781259005275.

Reference Books:

1. David A. Patterson, John L. Hennessy, “Computer Organization and Design – The Hardware / Software Interface ARM”, Elsevier.
2. William Stallings, “Computer Organization & Architecture”, Pearson.
3. Vincent P. Heuring & Harry F. Jordan, “Computer Systems Design and Architecture”, Pearson.

DESIGN AND ANALYSIS OF ALGORITHMS (Elective)

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – III

Subject Code	14XXX364	IA Marks	20
Number of Lecture Hours/Week	03	Exam Marks	80
Total Number of Lecture Hours	40	Exam Hours	03

CREDITS – 03

Course objectives: This course enables students to:

- Describe and Analyze non-recursive and recursive algorithms.
- Recall and Describe binary search, merge Sort and quick sort.
- Explain asymptotic performance of algorithms.
- Describe and Analyze greedy method and dynamic programming.
- Explain decrease-and-conquer approaches and space-time tradeoffs.

Modules	Teaching Hours	Revised Bloom's Taxonomy (RBT) Level
Module-1 **Introduction:** Notion of Algorithm, Review of Asymptotic Notations, Mathematical Analysis of Non-Recursive and Recursive Algorithms **Brute Force Approaches:** Introduction, Selection Sort and Bubble Sort, Sequential Search and Brute Force String Matching.	**08 Hours**	**L1, L2, L4**
Module -2		
Divide and Conquer: General Method, Defective Chess Board, Binary Search, Merge Sort, Quick Sort and its performance.	**08 Hours**	**L1, L2**
Module -3		
The Greedy Method: The General Method, Knapsack Problem, Job Sequencing with Deadlines, Minimum-Cost Spanning Trees: Prim's Algorithm, Kruskal's Algorithm; Single Source Shortest Paths.	**08 Hours**	**L1, L2**
Module -4		
Dynamic Programming: The General Method, Warshall's Algorithm, Floyd's Algorithm for the All-Pairs Shortest Paths Problem, Single-Source Shortest Paths: General Weights, 0/1 Knapsack, The Traveling Salesperson problem.	**08 Hours**	**L1, L2, L3**
Module -5		
Decrease-and-Conquer Approaches: Introduction, Insertion Sort, Depth First Search and Breadth First Search, Topological Sorting, **Space-Time Tradeoffs:** Introduction, Sorting by Counting, Input Enhancement in String Matching.	**08 Hours**	**L1, L2, L3**

Course outcomes:

After studying this course, students will be able to:

- Acquire knowledge of

- Algorithms using inductive proofs and invariants.
- Worst-case running times of algorithms using asymptotic analysis.
- Dynamic-programming paradigm.
- Greedy algorithms and its sustainability.
- Major graph algorithms and analyses.

- Apply the knowledge gained in the design of Algorithm.
- Acquire competency in using different Algorithms.
- Understand the importance of research in the field of Algorithms.

Graduate Attributes (as per NBA)

- Engineering Knowledge.
- Problem Analysis.
- Design/Development of solutions.
- Life-long learning.

Question paper pattern:

- The question paper will have ten questions.
- Each full Question consists of 16 marks.
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module.

Text Books:

1. Anany Levitin, "Introduction to the Design & Analysis of Algorithms", Pearson, 2nd Edition, 2007, ISBN:9780321358288 (Listed topics only from the Chapters 1, 2, 3, 5, 7 and 8).
2. Ellis Horowitz, Sartaj Sahni, Sanguthevar Rajasekaran, "Fundamentals of Computer Algorithms", Universities Press, 2nd Edition, 2007, ISBN: 9788173716126 (Listed topics only from the Chapters 3, 4, 5).

Reference Books:

1. Thomas H. Cormen, Charles E. Leiserson, Ronal L. Rivest, Clifford Stein, "Introduction to Algorithms", PHI.
2. R. C. T. Lee, S. S. Tseng, R. C. Chang & Y. T. T Sai, "Introduction to the Design and Analysis of Algorithms A Strategic Approach", McGraw Hill.

ANALOG ELECTRONICS LABORATORY

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – III

Laboratory Code	14XXL37	IA Marks	20
Number of Lecture Hours/Week	01Hr Tutorial (Instructions) + 02 Hours Laboratory	Exam Marks	80
		Exam Hours	03

CREDITS – 02

Course objectives: This laboratory course enables students to get practical experience in design, assembly and evaluation/testing of

- Rectifiers and Voltage Regulators.
- BJT characteristics and Amplifiers.
- JFET Characteristics and Amplifiers.
- MOSFET Characteristics.
- Power Amplifiers.
- RC-Phase shift, Hartley, Colpitt's and Crystal Oscillators.

Laboratory Experiments: **NOTE: The experiments are to be carried using discrete components only.**	**Revised Bloom's Taxonomy (RBT) Level**
1. To design and set up the following rectifiers with and without filters: (a) Full Wave Rectifier (b) Bridge Rectifier To determine ripple factor and conversion efficiency.	**L5, L6**
2. To plot load regulation characteristics using zener diode and calculate the percentage load regulation.	**L2, L3, L4**
3. To plot the input and output characteristics of a NPN transistor in common emitter configuration and calculate the dynamic input resistance, dynamic output resistance and common emitter current gain.	**L2, L3, L4**
4. To design and set up the common emitter amplifier under voltage divider bias with and without feedback and determine the gain-bandwidth product from its frequency response.	**L5, L6**
5. To design and setup common collector amplifier (Emitter Follower) using voltage divider bias and to determine gain-bandwidth product from its frequency response.	**L5, L6**
6. To plot the input and output characteristics of a JFET and calculate its parameters, namely; drain dynamic resistance, mutual conductance and amplification factor.	**L2, L3, L4**
7. To design, setup and plot the frequency response of Common Source JFET amplifier, and obtain the bandwidth.	**L5, L6**
8. To plot the input and output characteristics of n-channel MOSFET and calculate its parameters, namely; drain dynamic resistance, mutual conductance and amplification factor.	**L2, L3, L4**

9. To set up and study the working of complementary symmetry class B push pull power amplifier and calculate the efficiency.	**L2, L3, L4**
10. To design and setup the RC-Phase shift Oscillator using BJT, and calculate the frequency of output waveform.	**L5, L6**
11. To design and setup the following tuned oscillator circuits using BJT, and determine the frequency of oscillation. (a) Hartley Oscillator (b) Colpitts Oscillator	**L5, L6**
12. To design and setup the crystal oscillator and determine the frequency of oscillation.	**L5, L6**

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

- Design and Test rectifiers and voltage regulators.
- Compute the parameters from the characteristics of BJT, JFET and MOSFET devices.
- Design, Test and Evaluate BJT amplifiers in CE and CC configurations.
- Design and Test JFET amplifiers.
- Design and Test a power amplifier.
- Design and Test various types of oscillators.

Graduate Attributes (as per NBA)

- Engineering Knowledge.
- Problem Analysis.
- Design/Development of solutions.

Conduct of Practical Examination:

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

Reference Book:

1. K. A. Navas, "Electronics Lab Manual", Volume I, PHI, 5th Edition, 2015, ISBN:9788120351424

DIGITAL ELECTRONICS and INTERFACING LABORATORY

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER - III

Laboratory Code	14XXL38	IA Marks	20
Number of Lecture Hours/Week	01Hr Tutorial (Instructions) + 02 Hours Laboratory	Exam Marks	50
		Exam Hours	03

CREDITS – 02

Course objectives: This laboratory course enables students to get practical experience:

- in design, realisation and verification of
  - Demorgan's Theorem.
  - Full/Parallel Adders and Subtractors.
  - Multiplexer using logic gates
  - Demux and Decoder
  - Flip-Flops, Shift registers and Counters
- in interfacing microcontroller to
  - Toggle Switch and LEDs
  - LCD
  - Stepper Motor
  - Light dependant resistor (LDR) , a relay and buzzer.

Laboratory Experiments: **NOTE:** Use discrete components to test and verify the logic gates. Multisim may be used for designing the gates along with the above.	**Revised Bloom's Taxonomy (RBT) Level**
1. To verify (a) Demorgan's Theorem for 2 variables (b) The sum-of product and product-of-sum expressions using universal gates.	**L1, L2, L3**
2. To design and implement (a) Full Adder using basic logic gates. (b) Full subtractor using basic logic gates.	**L5, L6**
3. To design and implement 4-bit Parallel Adder/ subtractor using IC 7483.	**L5, L6**
4. To realize (a) 4:1 Multiplexer using gates (b) 3-variable function using IC 74151(8:1 MUX) (c) 1:8 Demux and 3:8 Decoder using IC74138	**L2, L3**
5. To realise the following flip-flops using NAND Gates. (a) Clocked SR Flip-Flop (b) JK Flip-Flop	**L2, L3**
6. To realize the following shift registers using IC7474 (a) SISO (b) SIPO (c)PISO (d) PIPO	**L2, L3**
7. To realize the Ring Counter and Johnson Counter using IC7476	**L2, L3**
8. To realize the Mod-N Counter using IC7490	**L2, L3**
9. To Interface 8051 to a toggle Switch and 8 LEDs to light up LEDs alternatively when the Switch is ON (in Assembly	**L4, L5, L6**

language).	
10. To Interface 8051 to LCD to display a message (in C Language).	**L4, L5, L6**
11. To Interface 8051 to Stepper Motor to rotate the motor for a given number of steps (C language programming).	**L4, L5, L6**
12. Interface a Light dependant resistor (LDR), a relay and buzzer to make a light operated switch (in Assembly language).	**L4, L5, L6**

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

- Demonstrate the truth table of various logic gates.
- Design, Test and Evaluate various combinational circuits such as adders, subtractors, multipliers, comparators, parity generators, multiplexers and de-Multiplexers.
- Construct flips-flops, counters and shift registers.
- Develop and Test interfacing of 8051 Microcontroller to various devices.

Graduate Attributes (as per NBA)

- Engineering Knowledge.
- Problem Analysis.
- Design/Development of solutions.

Conduct of Practical Examination:

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

Reference Book (For 1 to 6 experiments):

1. K. A. Navas, "Electronics Lab Manual", Volume I, PHI, 5th Edition, 2015, ISBN:9788120351424.

LINEAR INTEGRATED CIRCUITS

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – IV

Subject Code	14XXX42	IA Marks	20
Number of Lecture Hours/Week	04	Exam Marks	80
Total Number of Lecture Hours	50	Exam Hours	03

CREDITS – 04

Course objectives: This course will enable students to:

- Define and Describe basic concepts of Op-AMPs, characteristics and specifications.
- Develop and Apply Op-AMP applications to signal conditioning for amplifiers, filters and oscillators.
- Develop and Apply Op-AMP applications for comparators and data conversions.
- Develop, Apply and Analyze the use of Op-AMPs for advanced applications such as PLL, VCOs, V-I Converters, I-V Converters, AGC, AVC, Analog multipliers.

Modules	Teaching Hours	Revised Bloom's Taxonomy (RBT) Level
Module -1		
Introduction to Operational Amplifiers and Characteristics Introduction, Block diagram, characteristics and equivalent circuits of an ideal op-amp, various types of Operational Amplifiers and their applications, Power supply configurations for OP-AMP applications, inverting and non-inverting amplifier configurations. Relevant Problems. **The Practical op-amp** Introduction, Input offset voltage, offset current, thermal drift, Effect of variation in Power supply voltage, common-mode rejection ratio, Slew rate and its Effect, PSRR and gain – bandwidth product, frequency limitations and compensations, transient response, Interpretation of OP-AMP LM741 & TL082 datasheet. Relevant Problems.	**10 Hours**	**L1, L2**
Module -2		
Amplifiers and Oscillators Summing amplifier, Integrators and differentiators, Instrumentation amplifier, Differential input and differential output amplifier, Voltage-series feedback amplifier, Voltage-shunt feedback amplifier, Log/ Antilog amplifier, isolation amplifiers, Triangular/rectangular wave generator, phase-shift oscillators bridge oscillator, analog multiplier (MPY634) VCO. Relevant Problems.	**10 Hours**	**L3, L4**
Module -3		
Active Filters Characteristics of filters, Classification of filters, magnitude and frequency response, Butterworth 1st and 2nd low pass, high pass and band pass filters, Chebyshev filter characteristics, Band reject filters, Notch filter, All pass filters and self tuned filters. Relevant Problems.	**10 Hours**	**L3, L4**
Module -4		

Comparators and Converters Comparator, Zero Crossing Detector, Monostable and Astable Multivibrator, Schmitt Trigger, Voltage limiters, Clipper and clampers, Absolute value output circuit, Peak detector, Sample and hold Circuit, Precision rectifiers, Voltage-to-current converter, Current-to-voltage converter. Relevant Problems.	**10 Hours**	**L2, L3**
Module -5		
Advanced Applications Applications as Frequency Divider, PLL, AGC, AVC using op-AMP and analog multipliers, Amplitude modulation using analog multiplier, Frequency Shift Keying, simple OP-AMP Voltage regulator, Fixed and Adjustable Voltage Regulators, Dual Power supply, Basic Switching Regulator and characteristics of standard regulator ICs – TPS40200, TPS40210. Relevant Problems.	**10 Hours**	**L3, L4, L5**

Course outcomes:

After studying this course, students will be able to:

- Acquire knowledge of
  - Operational amplifiers and characteristics as well as various types of op-amps.
  - Functioning of PLL, VCO, V-I, I-V converters, AGC, AVC and analog multipliers.
  - Active Filters, Comparators and Convertors.
- Analyse the performance of
  - Op-amps and Various Applications.
  - Instrumentation Amplifiers, Isolation Amplifiers, Wave Generators and Oscillators.
- Interpretation of Performance Characteristics of Practical Op-amps.
- Apply the knowledge gained in the design of practical circuits for amplifiers, filters oscillators and electronic systems.

Graduate Attributes (as per NBA)

- Engineering Knowledge
- Problem Analysis
- Design / development of solutions (partly)

Question paper pattern:

- The question paper will have ten questions.
- Each full Question consisting of 16 marks.
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module.

Text Books:

1. Ramakant A Gayakwad, "Op-Amps and Linear Integrated Circuits," Pearson, 4th Ed, 2015.

Reference Books:

1. B Somanathan Nair, "Linear Integrated Circuits: Analysis, Design & Applications," Wiley India, 1st Edition, 2015.

2. Data Sheet: http://www.ti.com/lit/ds/symlink/tl082.pdf.

4. Application Note: http://www.ti.com/lit/an/sloa020a/sloa020a.pdf.

5. MPY634 Data Sheet: http://www.ti.com/lit/ds/symlink/mpy634.pdf.

6. Application Note: http://www.ti.com/lit/an/sbfa006/sbfa006.pdf.
7. ASLK Pro Manual: ASLK Manual.

NETWORK ANALYSIS AND CONTROL SYSTEMS

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – III

Subject Code	14XXX45	IA Marks	20
Number of Lecture Hours/Week	04	Exam Marks	80
Total Number of Lecture Hours	50	Exam Hours	03

CREDITS – 04

Course objectives: This course will enable students to:

- Describe, Apply and Analyze basic network concepts emphasizing Series and Parallel Combination of Passive Components, Source Transformation and Shifting.
- Describe, Apply and Analyze use of mesh and nodal techniques for Formulating the Transfer Function of Networks.
- Apply and Analyze various network theorems in solving the problems related to Electrical Circuits.
- Describe and Analyze two-port networks and methods of analysing the Electrical Networks.
- Describe Open and Closed Loop Control Systems, Analysis of Control Systems Using Block Diagram Reduction and Signal Flow Graph Techniques.
- Determine the time domain response of first and second order systems to Various types of Inputs.
- Define and Describe stability in control systems, Analysis of stability using Routh-Hurwitz Criterion and Evaluate stability of systems using Root-Locus technique.

Modules	**Teaching Hours**	**Revised Bloom's Taxonomy (RBT) Level**
Module -1		
Basic Network Concepts Series and Parallel combination of Resistors, Inductances and Capacitors. Star-Delta Transformation. Source Transformation and Source Shifting. Relevant Problems. **Mesh and Node Analysis** Kirchhoff's Laws. Mesh Analysis and Super mesh Analysis. Node Analysis and Super node Analysis. Relevant Problems.	**10 Hours**	**L2, L3, L4**
Module -2		
Network Theorems and Two Port Networks Superposition Theorem, Thevenin's Theorem, Norton's Theorem, Maximum Power Transfer Theorem. Relationship of Two-Port Variables, Open Circuit Impedance Parameters, Short Circuit Admittance Parameters, Transmission Parameters, Hybrid Parameters, Relationships between the parameter sets. Relevant Problems.	**10 Hours**	**L2, L3, L4**
Module -3		

Introduction to Control Systems Introduction, Definitions, Open Loop Control Systems, Closed Loop (Feedback) Control Systems, Automatic Tank Level Control System, Position Control System, Merits and Demerits of Feedback. Transfer Function Concept, Properties of Transfer Function, Unity Feedback Systems. Relevant Problems. **Mathematical Modeling of Systems** Translation Systems, Rotational Systems, Electrical Analog of Mechanical Systems. Relevant Problems. Block Diagram Reduction, Signal Flow Graph, Masson's Gain Formula. Relevant Problems.	**10 Hours**	**L1, L2, L3**
Module -4		
Transient Response Analysis Introduction, Typical Test Input Signals, First Order Systems: Unit-Step, Unit-Ramp, Unit-Impulse Response of First Order Systems. Relevant Problems. Second-Order Position Control System, Unit-Step Response of Second-Order Systems, Performance Indices (No Derivation), Steady State Error: Unit Step Input, Unit Ramp Input, Unit Parabolic Input, Steady State Error in terms of Closed Loop Transfer Function for Unit Step and Unit Ramp Input. Relevant Problems.	**10 Hours**	**L2, L3, L4**
Module -5		
Routh Stability Introduction, Stability, Necessary Conditions for Stability, Routh Array, Special Cases, Application of Routh-Hurwitz Stability Criterion, Relative Stability. Relevant Problems. **Root-Locus Technique** Root-Loci for Second Order System, Basic Conditions of Root-Loci, Rules for the Construction of Root-Loci. Relevant Problems.	**10 Hours**	**L1, L2, L3**

Course outcomes:

After studying this course, students will be able to:

- Acquire knowledge of
  - Series and Parallel combination of Passive Components, Source Transformation and Source Shifting.
  - Network Theorems and Electrical laws to reduce circuit complexities and to arrive at feasible solutions.
  - Various Two-Port Parameters and their Relationship for finding Network Solutions.
  - Basic Concepts of Control Systems, Stability Concepts of Linear Systems.
- Analyse the Performance of
  - Various Types of Networks Using different concepts and principles.
  - Behavior of control systems with respect to simplification and determining stability of complex systems
- Interpretation of Performance Characteristics of Networks and control systems.
- Apply the knowledge gained in the analysis and design of electrical and electronic

circuits.

Graduating Attributes (as per NBA)

- Engineering Knowledge
- Problem Analysis
- Design / development of solutions (partly)
- Investigations

Question paper pattern:

- The question paper will have ten questions.
- Each full Question consisting of 16 marks
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module.

Text Books:

1. M. E. Van Valkenburg, "Network Analysis", Pearson, 3rd Edition, 2015**.** ISBN: 9789332550131.
2. Ravish R. Singh, "Network Analysis and Synthesis", McGraw Hill, 2013. ISBN: 9781259062957.
3. D. Roy Choudhury, "Modern Control Engineering", PHI, 2015. ISBN: 9788120321960.

Reference Books:

1. D. Roy Choudhury, "Networks and Systems", New Age International.
2. B. C. Kuo, "Automatic Control Systems", Wiley India.

MICROCONTROLLERS FOR EMBEDDED SYSTEMS

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – IV

Subject Code	14XXX44	IA Marks	20
Number of Lecture Hours/Week	04	Exam Marks	80
Total Number of Lecture Hours	50	Exam Hours	03

CREDITS – 04

Course objectives: This course will enable students to:

- Recall and Describe the basic architecture of 16-bit microcontrollers.
- Describe the hardware-interfacing concepts and Apply to connect digital as well as analog sensors while ensuring low power considerations.
- Apply the protocols used by microcontroller to Develop to communicate with external sensors and actuators in real world.
- Describe IoT and architecture, and Develop a Wi-Fi Connectivity in a Smart Electric Meter.

Modules	Teaching Hours	Revised Bloom's Taxonomy (RBT) Level
Module -1		
Fundamentals of microcontrollers for Embedded Systems Embedded system overview, applications, features and architecture considerations - ROM, RAM, timers, data and address bus, I/O interfacing concepts, and memory mapped I/O. CISC Vs RISC design philosophy, Von-Neumann Vs Harvard architecture. MSP430x5x 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; MSP430 specifics. Variants of the MSP430 family viz. MSP430x2x, MSP430x4x, MSP430x5x and their targeted applications, Sample embedded system on MSP430 microcontroller.	**10 Hours**	**L1, L2**
Module -2		
Peripherals and programming for Microcontroller Memory Mapped Peripherals, programming System registers, I/O pin multiplexing, pull up/down registers, GPIO control. Interrupts and interrupt programming. Watchdog timer. System clocks. Low Power aspects of MSP430: low power modes, Active vs Standby current consumption, FRAM vs Flash for low power & reliability. **Case Study**: MSP430 based embedded system application bringing up the salient features of GPIO, Watchdog timer, low power, FRAM Energy and power consumption estimation for embedded board	**10 Hours**	**L2, L3, L4**
Module -3		
Timer & Real Time Clock (RTC), PWM control, timing generation and measurements. Analog interfacing and	**10 Hours**	**L2, L3**

data acquisition: ADC and Comparator in MSP430, data transfer using DMA. Power considerations: Programming for optimal power consumption while using peripherals, Using MSP430 peripheral intelligence in power management Case Study: MSP430 based embedded system application using ADC & PWM demonstrating peripheral intelligence. "Remote Controller of Air Conditioner Using MSP430.		
Module -4		
Serial communication basics, Synchronous/Asynchronous interfaces (like UART, USB, SPI, and I2C). UART protocol, I2C protocol, SPI protocol. Implementing devices. Case Study: MSP430 based embedded system application using the interface protocols for communication with external devices: "A Low-Power Battery less Wireless Temperature and Humidity Sensor with Passive Low Frequency RFID.	**10 Hours**	**L2, L3**
Module -5		
IoT 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. Case Study: MSP430 based Embedded Networking Application: "Implementing Wi-Fi Connectivity in a Smart Electric Meter.	**10 Hours**	**L3, L4, L6**

Course outcomes:

After studying this course, students will be able to:

- Learn 16-bit architecture and its programming.
- Acquire the ability to design software using C for embedded systems applications.
- Understand and program various digital and analog Sensor Interfaces specific to Microcontroller.
- Design and understand various use cases and projects in the domain of Embedded Systems, Internet of Things, and will be able to implement the same.

Graduate Attributes (as per NBA)

- Engineering Knowledge
- Problem Analysis
- Design / development of solutions (partly)
- Modern Tool Usage
- Project Management and Finance (partly).

Question paper pattern:

- The question paper will have ten questions.
- Each full question consisting of 16 marks.
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module.

Text Books:

1. John H. Davis, “MSP430 Microcontroller Basics”, Elsevier, 2012.

Reference Books:

1.http://processors.wiki.ti.com/index.php/MSP430_LaunchPad_Low_Power_Mode

2.http://processors.wiki.ti.com/index.php/MSP430_16Bit_UltraLow_Power_MCU_Training

ENGINEERING ELECTROMAGNETICS

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – IV

Subject Code	14XXX44	IA Marks	20
Number of Lecture Hours/Week	04	Exam Marks	80
Total Number of Lecture Hours	50	Exam Hours	03

CREDITS – 04

Course objectives: This course will enable students to:

- Define and Describe Coluomb's law and electric field intensity.
- Define and Explain electric flux density, Gauss's law and divergence.
- Describe energy and potential along with concepts of current and conductors.
- Describe Poisson's and Laplace's Equations, and Uniqueness Theorem.
- Define and Describe basic concepts of Magnetostatics by studying the various laws, Stoke's Theorem and scalar and vector magnetic flux density.
- Explain Magnetic Forces, Materials and Inductance.
- Describe the concepts of time varying fields and Develop Maxwell's equations in Point and Integral Forms.
- Describe and Compare different Types of Wave Propagation.

Modules	Teaching Hours	Revised Bloom's Taxonomy (RBT) Level
Module -1 **a. Coluomb's Law and Electric Field Intensity** Experimental law of Coulomb, Electric field intensity, Field due to continuous volume charge distribution, Field of a line charge. Relevant Problems. **b. Electric flux density, Gauss's law and divergence** Electric flux density, Gauss' law, Divergence. Maxwell's First equation (Electrostactics), Vector Operator ▼ and divergence theorem. Relevant Problems.	**10 Hours**	**L1, L2**
Module -2		
Energy and potential Energy expended in moving a point charge in an electric field, The line integral, Definition of potential difference and potential, The potential field of point charge, Energy density in the electrostatic field. Relevant Problems. **Conductors, dielectrics and capacitance** Current and current density, Continuity of current, Metallic conductors, Conductor properties and boundary conditions, boundary conditions for perfect Dielectrics, Capacitance and examples. Relevant Problems.	**10 Hours**	**L1, L2**
Module -3		
Poisson's and Laplace's Equations Derivation of Poisson's and Laplace's Equations, Uniqueness theorem, Examples of the solution of	**10 Hours**	**L1, L2**

Laplace's equation, Examples of the solution of Poisson's equation, Relevant Problems. **The Steady Magnetic Field** Biot-Savart Law, Ampere's circuital law, Curl, Stokes' theorem, Magnetic flux and magnetic flux density, Scalar and Vector Magnetic Potentials. Relevant Problems.		
Module -4		
Magnetic Forces Force on a moving charge, differential current elements, Force between differential current elements. Force and Torque on a closed circuit. Relevant Problems. **Magnetic Materials and Inductance** Magnetisation and permeability, Magnetic boundary conditions, Magnetic circuit, Potential Energy and forces on magnetic materials, Inductance and mutual inductance. Relevant Problems.	**10 Hours**	
Module -5		
Time-varying fields and Maxwell's equations Farday's law, displacement current, Maxwell's equations in point form, Maxwell's equations in integral form, the retarded potential. Relevant Problems. **Uniform Plane Wave** Wave propagation in free space, Wave propagation in dielectrics, Poynting's theorem and wave power, Propagation in good conductors: Skin Effect. Relevant Problems.	**10 Hours**	**L1, L2, L5**

Course outcomes:

After studying this course, students will be able to:

- Acquire knowledge of
  - Basic Concepts of Electric Fields, Magnetic Fields and Electromagnetic Waves.
  - Basic Concepts to Solve Complex Problems in Electric Fields, Magnetic Fields and Electromagnetic Waves.
  - Time-varying fields and Maxwell's equations.
  - Wave propagation in free space and dielectrics.
- Analyse
  - Different Charge and Current Configurations to derive Electromagnetic Field Equations.
  - Poisson's and Laplace's Equations, Uniqueness theorem, and solution of Laplace's equation.
  - Time-varying fields, Maxwell's equations, wave propagation in free space and dielectrics.
- Interpretation of
  - Gradient, Divergence and Curl Operators.
  - Maxwell's Equations in differential and integral forms.
  - Wave propagation in free space and dielectrics.
- Apply the knowledge gained in the design of Electric and Electronic Circuits, Electrical Machines and Antenna's and Communication Systems.

Graduate Attributes (as per NBA)

- Engineering Knowledge

- Problem Analysis
- Design / development of solutions (partly)**.**

Question paper pattern:

- The question paper will have ten questions.
- Each full question consisting of 16 marks.
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module.

Text Books:

1. W.H. Hayt, J.A. Buck and M. Jaleel Akhtar, "Engineering Electromagnetics", 8th Edition, McGraw-Hill, 2015, 9789339203276.
2. Mathew N.O. Sadiku and S.V. Kulkarni, "Principles of Electromagnetics", 6th Edition, Oxford University Press, 2015, 9780199461851.

Reference Books:

1. John Krauss and Daniel A Fleisch, " Electromagnetics with applications", Mc Graw-Hill.
2. N. Narayana Rao, "Fundamentals of Electromagnetics for Engineering", Pearson.

VIRTUAL INSTRUMENTATION (Elective)

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – IV

Subject Code	14XXX461	IA Marks	20
Number of Lecture Hours/Week	04	Exam Marks	80
Total Number of Lecture Hours	40	Exam Hours	03

CREDITS – 03

Course objectives: This course will enable students to:

- Discriminate between traditional instrumentation and virtual instrumentation.
- Describe the concepts of virtual instrumentation.
- Demonstrate the use of LabView as a Virtual Instrument.
- Illustrate and Analyze data acquisition, processing and plotting of data.
- Describe and Use instrument control and motion control.

Modules	Teaching Hours	Revised Bloom's Taxonomy (RBT) Level
Module – 1		
Graphical System Design (GSD) and Modular programming: Introduction, GSD model, Design flow with GSD, Virtual Instrumentation, Virtual Instrument and traditional instrument, hardware and software in Virtual Instrumentation, Graphical programming and Textual programming. GSD using LabView: Introduction, Advantages of LabView, Software environment, Creating and saving a VI, Front panel toolbar, Block diagram toolbar, Palettes, Property dialog box, Front panel control and indicators, Block diagram, data types, data flow program. Introduction and Modular programming in LabView, Build a VI front panel and Block diagram, Icons, Building a connector pane, Displaying SUBVI's, Opening and editing SUBVI's.	**8 hrs**	**L2, L3**
Module -2		
Repetition and Loops, Arrays and Clusters : For loops, While loops, Shift registers, Control timing, Local variables , Global variables. Arrays in LabView, 1D array, 2D arrays, array initialization, array functions. Creating cluster control & Indicators, Cluster operations, Assembling Clusters, Conversion between Arrays & clusters, Error Handling , Error cluster.	**08 Hours**	**L2, L3**
Module -3		
Structures, Strings and File I/O: Case structure, Sequence structure , Timed structure, Formula Nodes, Event structure, Labview Mathscript Creating String controls and Indicators, String	**08 Hours**	**L1, L2**

Functions, Editing , Formatting and Parsing strings, Configuring String controls & Indicators Basics of File Input/Output, Choosing a File I/O Format , File I/O VI's		
Module -4		
Data Acquisition, Plotting Data: Introduction, Transducers, Signals, Signal conditioning, DAQ hardware configuration, DAQ hardware, Analog inputs, Analog outputs, Counters, Digital I/O, Selecting and Configuring a data acquisition device- Signal sources , Measurement systems, Types of data ,Waveform graphs ,Waveform charts , Waveform data , Digital waveform graphs, Customizing graphs and charts, Configuring a graph or chart	**08 Hours**	**L3, L4**
Module -5		
Instrument control, Motion Control: Introduction, GPIB communication, Hardware specifications, software architecture, instrument I/O assistant, VISA, instrument drivers, serial port communications. Components of a motion control system, Software for configuration, prototyping and development, Motion controller, Move types, Motor amplifiers and drives, Feedback devices and motion I/O. **Requirement : LabView Software from National Instruments**	**08 Hours**	**L2, L3**

Course outcomes:

After studying this course, students will be able to:

- Acquire knowledge of
  - graphical system design and modular programming
  - Repetition, Loops, Arrays and Clusters
  - Structures, Strings and File I/O
  - Data Acquisition, Plotting Data
  - Instrument control, Motion Control
- Understand and apply LabView software.
- Apply the knowledge gained in the design of practical virtual instrumentation systems.

Graduate Attributes (as per NBA)

- Engineering Knowledge
- Problem Analysis
- Modern Tool Usage

Question paper pattern:

- The question paper will have ten questions.
- Each full question consisting of 16 marks.
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module.

Text Books:

1. Jovitha Jerome, “Virtual Instrumentation using LabView”, PHI Learning, 2015, ISBN: 9788120340305.

Reference Books:

1. S.Sumathi, P.Surekha, “LabView based Advanced Instrumentation Systems”, Springer.
2. Gary Jhonson, “Labview Graphical Programming, Second Edition”, McGraw Hill.

ELECTRONICS ENGINEERING MATERIALS (Elective) [As per Choice Based Credit System (CBCS) scheme] SEMESTER – IV			
Subject Code	14XXX462	IA Marks	20
Number of Lecture Hours/Week	03	Exam Marks	80
Total Number of Lecture Hours	40	Exam Hours	03
CREDITS – 03			

Course objectives: This course will enable students to:

- Recall and Describe the scope of electrical and electronic materials, Requirement of Engineering materials, Operational requirements of electrical and electronic materials.
- Recall and Describe concepts of dielectric materials, classification of dielectric materials, Dielectric constant, Dielectric strength and Dielectric loss and, Polarization and its different facets.
- Recall and Describe solid insulating materials and their applications, and various insulating materials.
- Recall and Describe manufacturing method of a resistor, basic classification, construction details of different kinds of fixed resistors, specifications of resistors and thermistors.
- Recall and Describe characteristics and classification of capacitors, constructional details of fixed value capacitors, specifications of capacitors and identification of capacitors.
- Describe and Analyze types of PCBs, manufacturing process, layout and design of a PCB, manufacturing process of single-sided and double-sided PCBs.

Modules	**Teaching Hours**	**Revised Bloom's Taxonomy (RBT) Level**
Module – 1		
Introduction to Electrical and Electronic Materials: Importance of materials, Classification of electrical and electronic materials, Scope of electrical and electronic materials, Requirement of Engineering materials, Operational requirements of electrical and electronic materials, Classification of solids on the basis of energy gap, Products – working principle and materials, Types of engineering materials, Levels of material structure. Spintronics and Spintronic materials, Ferromagnetic semiconductors, Left handed materials. Relevant Problems.	**08 Hours**	**L1, L2**
Module -2		
Dielectric Materials: Properties and Behavior: Introduction to dielectric materials, classification of dielectric materials, Dielectric constant, Dielectric	**08 Hours**	**L1, L2**

strength and Dielectric loss. Polarization, Mechanisms of polarization, Comparison of different polarization process, Factors affecting polarization, Spontaneous polarization, Behavior of polarization under impulse and frequency switching, Decay and build-up of polarization under ac field, Complex dielectric constant. **Dielectric Materials: Types and Applications:** Solid Insulating Materials and their Applications, Polymeric Insulating Materials, Natural and Synthetic Rubber as Insulating Material, Paper as a Fibrous Insulating Material, Choices of Solid Insulating Material for Different Applications. Relevant Problems.		
Module -3		
Passive Components (Resistors): Passive and Active components, Introduction to Resistors, Manufacturing Method of a Resistor, Basic Classification of Resistor, Construction Details of Different Kinds of Fixed Resistors, Comparison Among Different Types of Fixed Resistors, Specifications Resistors, Variable Resistors, Non-Linear Resistors, Thermistors. Relevant Problems.	**08 Hours**	**L1, L2**
Module -4		
Passive Components (Capacitors): Capacitor: an Introduction, Characteristics of Capacitors, Classification of Capacitors, Forms and Materials of Common Types of Capacitors, Constructional details of Fixed Value Capacitors, Plastic Film Capacitors, Ceramic Dielectric Capacitors, Electrolytic Capacitors, Tantalum Electrolytic Capacitors, Air Capacitor, Polarized and Non-Polarized Capacitors, Variable Capacitors, Specifications of Capacitors, Identification of Capacitors. Relevant Problems.	**08 Hours**	**L1, L2**
Module -5		
Printed Circuit Board (PCB) Fabrication: Printed Circuit Board, Types of PCBs, Types of PCB Substrates, Manufacturing Process of Copper Cladded Laminate, Layout and Design of a PCB, Manufacturing Process of PCB, Manufacturing Process of Single-Sided PCBs, Manufacturing Process of Double-Sided PCBs. Relevant Problems.	**08 Hours**	**L1, L2, L3**
Course outcomes: After studying this course, students will be able to: • Acquire knowledge of o Electrical and electronic materials, Requirement of Engineering materials. o Concepts of dielectric materials, classification of dielectric materials, Polarization. o Solid Insulating Materials and their Applications and various Insulating Materials. o Manufacturing Method of a Resistor, Construction Details of Different Kinds of		

Fixed Resistors.
  - Characteristics and Classification of Capacitors, Construction and Specifications of Capacitors and Identification of Capacitors.
  - Types of PCBs, Manufacturing Process, Layout and Design of a PCB, Manufacturing Process of Single-Sided and Double-Sided PCBs.
- Apply the knowledge gained in the analysis and design of electrical and electronic circuits.

Graduating Attributes (as per NBA)

- Engineering Knowledge
- Design / development of solutions (partly)

Question paper pattern:

- The question paper will have ten questions.
- Each full Question consisting of 16 marks
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module.

Text Books:

1. K.M. Gupta and Nishu Gupta “Advanced Electrical and Electronics Materials”, Wiley, 2015. ISBN: 9788126555987.

Reference Books:

1. C. S. Indulkar and S. Thiruvengadam, “Electrical Engineering Materials,” S. Chand.

BUSINESS COMMUNICATION (Elective)

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – IV

Subject Code	14XXX463	IA Marks	20
Number of Lecture Hours/Week	03	Exam Marks	80
Total Number of Lecture Hours	40	Exam Hours	03

CREDITS – 03

Course objectives: This course will enable students to:

- Recall and Describe the principal concepts of communication, Communication process and its elements and universal elements in communication.
- Demonstrate and Apply the importance of oral communication, the key skills of oral communication, Develop use of oral communication skills to new communication technologies.
- Demonstrate, Apply and Develop different purposes of writing, the essential principles of effective written communication, and different formats of e-mails.
- Demonstrate, Apply and Develop the importance of presentation skills, how to design a presentation, The chief principles of delivering an effective presentation and to handle questions.
- Demonstrate, Apply and Develop writing an effective CV, the art of handling the interviews and to be an effective participant in group discussion.

Modules	Teaching Hours	Revised Bloom's Taxonomy (RBT) Level
Module - 1		
The Nature and Process of Communication The role of communication. ▪ An instance of unclear communication Defining Communication, Classification of Communication, The purpose of Communication, The process of Communication, The elements of Communication, The major difficulties in communication, Barriers to communication, Condition for successful communication, The seven C's of communication, Universal elements in communication. ▪ How sentence structure affects meaning Communication and electronic media, communication social media. Summary. Case: Communication failures	**8 Hours**	**L2, L3**
Module -2		
Oral Communication What is oral communication?, Importance of oral communication ills, Choosing the form of communication, Principles of successful oral communication, Guidelines for effective oral	**8 Hours**	**L2, L3, L4**

communication, Barriers to effective oral communication. Three aspects of oral communication- Conversing, Listening and Body language. Intercultural oral communication ▪ Intercultural communication oral communication electronic media: Phones, Voice Mail, Conference call, cell phone, Video conferencing Summary. Case: Dealing with outsourcing backlash.		
Module -3		
Written Business Communication The art of writing, Skills required in written communication ▪ Informatory Writing The purpose of writing ▪ Persuasive writing ▪ Examples of clear and unclear writing Principles of effective writing ▪ Rewriting a letter Summary. Case: On writing well. ▪ Writing e-mails, A series of e-mails Summary. Case: A reply sent to an erring customer.	**08 Hours**	**L2, L3, L4**
Module -4		
Presentation Skills Introduction, What is a presentation: Essential characteristics of a good presentation, The difference between a presentation and a lecture, The difference between a presentation and written report, ▪ Preparing a presentation Identify the purpose of presentation, Analyse the audience and identify their needs, Design and organize the information, Decide on the medium of presentation and visual aids, Time the presentation, Become familiar with location of presentation. ▪ Delivering the presentation Rehearsal, Body language, Handling question and debate, Tips to fight to stage fright Summary Case: The presentation effect	**8 Hours**	**L2, L3, L4**
Module -5		
CV's, personal interviews and group discussion Applying for job, Writing a CV, The relationship between the resume and application letter, The resume of recent graduate, Guidelines for preparing a good CV Drafting an Application Letter, Interviews. Participating in a group discussion. Summary Case: An employment interview.	**8 Hours**	**L2, L3**

Course outcomes:

After studying this course, students will be able to:

- Apply reasoning by the contextual knowledge to assess legal and cultural issues and the consequent responsibilities relevant to the profession engineering practice
- Apply ethical principles and commit to professional ethics and responsibilities, and norms of the engineering practice.
- Function effectively as an individual and as a member or leader in divers technical teams
- Communicate effectively on complex engineering activities such as, being able to write effective reports and make effective presentation
- The need for, and the ability to engage in independent lifelong learning in specialized technologies.
- Engineering management principles and use them to manage projects in multidisciplinary environments.

Graduating Attributes (as per NBA)

- The Engineer and Society
- Ethics
- Individual and Teamwork
- Communication
- Lifelong learning
- Project Management and Finance

Question paper pattern:

- The question paper will have ten questions.
- Each full Question consisting of 16 marks
- There will be **2** full questions (with a **maximum** of **four** sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer **5** full questions, selecting one full question from each module.

Text Books:

1. P. D. Chaturvedi and Mukesh Chaturvedi, "Business Communication," Pearson, 2012, ISBN: 9788131765036.
2. Meenakshi Raman and Sangeeta Sharma, "Technical Communication", Oxford University Press, Third Edition, 2015, ISBN: 9780199457496.

Reference Books:

1. Hory Sankar Mukerjee, "Business Communication," Oxford University Press.
2. K.Alex, "Soft Skills", S.Chand.

MEMS AND MICROSYSTEMS (Elective)

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – IV

Subject Code	14XXX464	IA Marks	20
Number of Lecture Hours/Week	03	Exam Marks	80
Total Number of Lecture Hours	40	Exam Hours	03

CREDITS – 03

Course objectives: This course will enable students to:

- Recall and Describe the basics of MEMS and Microsystems.
- Use of microsystems in various fields.
- Recall and Describe working principles of Microsystems.
- Recall and Describe operating principles of Microsensors.
- Recall and Describe the importance of materials used in MEMS and Microsystems.
- Recall and Describe the fabrication processes of a Microsystem.
- Recall and Describe Microsystem packaging involving general considerations in packaging design, interfaces and technologies.

Modules	Teaching Hours	Revised Bloom's Taxonomy (RBT) Level
Module -1		
Overview of MEMS & Microsystems: MEMS & Microsystems, Typical MEMS and Micro system products, Evolution of Microfabrication, Microsystems and Microelectronics, the multidisciplinary nature of Microsystem design and Manufacture, Microsystems and Miniaturisation, Applications of Microsystems in automotive industry, Applications of Microsystems in other industries.	**08 Hours**	**L1, L2, L3**
Module -2		
Working Principles of Microsystems Introduction, Microsensors, Microactuation, MEMS with Microactuators, Microaccelerometers, Microfiuids	**08 Hours**	**L1, L2**
Module -3		
Materials for MEMS and Microsystems Introduction, Substrates and Wafers, Active Substrate Materials, Silicon as a Substrate Material, Silicon Compounds, Silicon Piezoresistors, Gallium Arsenide, Quartz, Piezoelectric Crystals, Polymers, Packaging Materials	**08 Hours**	**L1, L2**
Module -4		
Microsystem Fabrication Processes Introduction, Photolithography, Ion Implantation, Diffusion, Oxidation, Chemical Vapor Deposition, Physical Vapor Deposition- Sputtering, Depositon by Epitaxy, Etching, Summary of Microfabrication	**08 Hours**	**L1, L2**
Module -5		

Micro system packaging Introduction, Over view of mechanical packaging of micro electronics Microsystem packaging, Interfaces in Microsystem packaging, Essential Packaging technologies.	**08 Hours**	**L1, L2**

Course outcomes:

After studying this course, students will be able to:

- Acquire knowledge of
  - MEMS & Microsystems, the multidisciplinary nature of Microsystem design and Manufacture, Microsystems and Miniaturisation, Applications of Microsystems in automotive various industries.
  - Working principles of Microsystems that involve Microsensors, Microactuation, Microactuators, Microaccelerometers and Microfiuids.
  - Materials for MEMS and Microsystems.
  - Fabrication processes that involve Photolithography, Ion Implantation, Diffusion, Oxidation, Chemical Vapor Deposition, Physical Vapor Deposition-Sputtering, Deposition by Epitaxy, and Etching.
  - Over view of mechanical packaging of micro electronics Microsystem packaging, Interfaces in Microsystem packaging, Essential Packaging technologies
- Analyse the performance of
  - Various MEMS and Microsystem components, fabrication processes and applications.
- Apply the knowledge gained in the design of practical MEMS and Microsystems for various applications.

Graduate Attributes (as per NBA)

- Engineering Knowledge
- Problem Analysis
- Design / development of solutions (partly)

Question paper pattern:

- The question paper will have ten questions.
- Each full Question consisting of 16 marks
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module.

Text Books:

1. Tai-Ran Hsu, "MEMES & MICROSYSTEMS- Design and Manufacturing", McGraw Hill, 2014. ISBN: 0072393912.

Reference Books:

1. Chang Liu, "Foundations of MEMS", Pearson.
2. G. K. Anthasuresh, K J Vinoy, S Gopalkrishnan, K N Bhat and V K Atre, "Microand Smart Systems," Wiley India.

LINEAR INTEGRATED CIRCUITS (LIC) LABORATORY

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – IV

Laboratory Code	14XXL47	IA Marks	20
Number of Lecture Hours/Week	01Hr Tutorial (Instructions) + 02 Hours Laboratory	Exam Marks	80
		Exam Hours	03

CREDITS – 02

Course objectives: This laboratory course enables students to:

- Demonstrate, Analyze and Design Op-AMP negative feedback amplifier, instrumentation amplifier, astable multivibrator and integrator circuit.
- Demonstrate, Analyze and Design basic analog circuits like comparator, filters, and oscillators.
- Demonstrate, Analyze and Design Op-AMP for specific analog circuits.

Laboratory Experiments:	**Revised Bloom's Taxonomy (RBT) Level**
1. Study the characteristics of negative feedback amplifier **Aim:** Design the following amplifiers: a) A unity gain amplifier b) A non-inverting amplifier with a gain of 'A' c) An inverting amplifier with a gain of 'A' Apply a square wave of fixed amplitude and study the effect of slew rate on the three types of amplifiers. **Applications:** • Amplifying bioelectric potentials (ECG, EEG, EMG, EOG) and piezoelectric with high output impedance. • Amplifying sensor output signals (temperature sensors, humidity sensors, pressure sensors etc.) **Sample questions** o Explain the need for unity gain amplifier. o Advantages of op-amp based amplifiers as compare to BJT amplifiers. o Mention the applications for inverting and non-inverting amplifiers. o Give your inference on the frequency response of the amplifier. o Give the significance of gain-bandwidth product.	**L2, L3, L6**
2. Design of an instrumentation amplifier **Aim:** Design an instrumentation amplifier of a differential mode gain of 'A' using three amplifiers. **Applications:** • Used in measuring instruments designed for achieving high accuracy and high stability. • Used for amplifying low voltage, low frequency and higher output	**L2, L3, L6**

impedance signals. **Sample questions** o Explain the need for two stages in any instrumentation amplifier. o Why CMRR is high for instrumentation amplifiers? o Give some examples for low voltage, low frequency and higher output impedance signals. o How do the tolerances of resistors affect the gain of the instrumentation amplifier?	
3. Study the characteristics of regenerative feedback system with extension to design an astable multivibrator **Aim:** Design and test an astable multivibrator for a given frequency. **Applications** • It can be used in signal generators and generation of timing signals. • It can be used in code generators and trigger circuits. **Sample questions** o Discuss the difference between astable and bi-stable multivibrator. o Discuss the frequency limitation of astablemultivibrator. o Discuss the various applications of bi-stable multivibrator.	**L2, L3, L6**
4. Study the characteristics of integrator circuit **Aim:** Design and test the integrator for a given time constant. **Applications** • Used in function generators, PI/PID controllers. • Used in analog computers, analog-to-digital converters and wave-shaping circuits. • Used as a charge amplifier. **Sample questions** o Compare the output with that of ideal integrator. o How will you design a differentiator and mention its drawback. o Discuss the limitation of the output voltage of the integrator. o How will you obtain drift compensation in an inverting integrator?	**L2, L3, L6**
5. Design of Analog filters – I **Aim:** Design a second order butterworth band-pass filter for the given higher and lower cut-off frequencies. **Applications:** • Used in signal conditioning circuits for processing audio signals. • Used in measuring instruments. • Used in radio receivers. **Sample questions** o Discuss the effect of order of the filter on frequency response. o How will you vary Q factor of the frequency response. o Discuss the need for going to Sallen Key circuit. o Compare the performance of Butterworth filter with that of Chebyshev filter.	
6. Design of Analog filters – II **Aim:** Design and test a notch filter to eliminate the 50Hz power line frequency.	**L2, L3, L5, L6**

Applications • Used for removing power supply interference. • Used for removing spur in RF signals. **Sample questions** o Explain the effect of supply frequency interference while amplifying sensor signals. o Suggest a method for adjusting the Q factor of the frequency response of notch filter. o What is the purpose of going for Twin T notch filter circuit?	
7. Design of a self-tuned Filter **Aim:** Design and test a high-Q Band pass self-tuned filter for a given center frequency. **Applications:** • Used in spectrum analyzers **Sample Question:** o Discuss the effect of the harmonics when a square wave is applied to the filter o Determine the lock range of the self-tuned filter	L5, L6
8. Design of a function generator **Aim:** Design and test a function generator that can generate square wave and triangular wave output for a given frequency. **Applications:** • Used in testing, measuring instruments and radio receivers. • Used for obtaining frequency response of devices and circuits. • Used for testing and servicing of Electronic equipments. • Used in Electronic musical instruments. • Used for obtaining audiograms (Threshold of audibility Vs frequency) **Sample questions** o Discuss typical specifications of a general purpose function generator. o How can you obtain reasonably accurate sine wave from triangular wave. o Discuss the reason for higher distortion in sine wave produced by function generators. o What do you mean by Duty cycle and how can you vary the same in a function generator?	**L2, L3, L5, L6**
9. Design of a Voltage Controlled Oscillator **Aim:** Design and test voltage controlled oscillator for a given specification (voltage range and frequency range). **Applications:** • Used in Phase Lock Loop (PLL) circuits. • Used in frequency modulation circuits.	**L2, L3, L5, L6**

• Used in Function generators • Used in frequency Synthesizers of Communication equipments. **Sample Questions** o Discuss the following characteristics of a voltage controlled Oscillator. o Tuning range o Tuning gain and o Phase noise o Compare the performances VCO based Harmonic Oscillators and Relaxation Oscillators o What are the various methods adopted in controlling the frequency of oscillation in VCOs o Discuss any one method of obtaining FM demodulation using a VCO.	
10. Design of a Phase Locked Loop(PLL) **Aim:** Design and test a PLL to get locked to a given frequency 'f'. Measure the locking range of the system and also measure the change in phase of the output signal as input frequency is varied within the lock range. **Applications:** • Used in tracking Band pass filter for Angle Modulated signals. • Used in frequency divider and frequency multiplier circuits. • Used as Amplifiers for Angle Modulated signals. • Used in AM and FM Demodulators • Used in Suppressed Carrier Recovery Circuits **Sample Questions:** o Draw the block diagram of a PLL based divider and multiplier and explain the functions performed by each block. o Distinguish between Lock range and Capture Range, Explain the method of estimating the same for a given PLL circuit. o Discuss the differences between Analog Phase Lock Loop and Digital Phase Lock Loop.	**L2, L3, L5, L6**
11. Automatic Gain Control (AGC) Automatic Volume Control (AVC) **Aim:** Design and test an AGC system for a given peak amplitude of sine-wave output. **Applications** • Used in AM Receivers • Used as Voice Operated Gain Adjusting Device (VOGAD) in Radio Transmitters • Used in Telephone speech Recorders • Used in Radar Systems **Sample Questions** o Explain clearly the need for AGC in AM Receivers. o Draw the block diagram of feedback and feed forward AGC systems	**L2, L3, L5, L6**

and explain the functions of each block. o Discuss any one gain control mechanism present in biological systems. How can you use AGC in a Received Signal Strength Indicator (RSSI).	
12. Design of a low drop-out regulator **Aim:** Design and test a Low Dropout regulator using op-amps for a given voltage regulation characteristic and compare the characteristics with TPS7250IC **Applications:** • Used in Power Supply of all Electronic Instruments and Equipment's • Used as Reference Power Supply in Comparators • Used in Emergency Power Supplies • Used in Current Sources **Sample Questions** o Distinguish between Load Regulation and Line Regulation. o Mention some of the other important parameters in selecting a LDO. o What is power supply rejection ratio (PSRR)?	**L2, L3, L5, L6**
13. DC-DC Converter. **Aim:** Design of a switched mode power supply that can provide a regulated output voltage for a given input range using the TPS40200 IC. **Applications:** • Used is DSL/Cable Modems • Used in Distributed Power Systems **Sample Questions** Discuss the effect of varying the input voltage for a fixed regulated output voltage over the duty cycle of PWM.	**L2, L3, L5, L6**

NOTE: The above experiments can be conducted using TL 082/ MPY634/ ASLK Pro Kit/LM741

References:

1. Data Sheet: http://www.ti.com/lit/ds/symlink/tl082.pdf
2. Application Note: http://www.ti.com/lit/an/sloa020a/sloa020a.pdf
3. MPY634 Data Sheet: http://www.ti.com/lit/ds/symlink/mpy634.pdf
4. Application Note: http://www.ti.com/lit/an/sbfa006/sbfa006.pdf

ASLK Pro Manual: ASLK Manual

Course outcomes: This laboratory course enables students to:

- Gain hands-on experience in building analog systems for a given specification using the basic building blocks.
- Develop a macromodel for an IC based on its terminal characteristics, I/O characteristics, DC-transfer characteristics, frequency response, stability characteristic and sensitivity characteristic.
- Make the right choice for an IC for a given application.
- Able to perform basic fault diagnosis of an electronic system.

Conduct of Practical Examination:

1. All laboratory experiments are to be included for practical examination.

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

MICROCONTROLLERS FOR EMBEDDED SYSTEMS LABORATORY

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – IV

Laboratory Code	14XXL48	IA Marks	20
Number of Lecture Hours/Week	01Hr Tutorial (Instructions) + 02 Hours Laboratory	Exam Marks	80
		Exam Hours	03

CREDITS – 02

Course objectives: This laboratory course enables students to:

- Use Embedded C language to Develop embedded applications.
- Apply, Construct and Demonstrate various in-build interfaces/modules of MSP430 for specific application.
- Apply Embedded C code for utilizing Low power modes of MSP430.

Laboratory Experiments:	**Revised Bloom's Taxonomy (RBT) Level**
1. Interfacing and programming GPIO ports in C using MSP430 (blinking LEDs , push buttons) The main objective of this experiment is to blink the on-board, red LED (connected to P1.0) using GPIO. This experiment will help you to learn and understand the procedure for programming the MSP-EXP430G2 LaunchPad digital I/O pins. **Exercises:** a) Modify the delay with which the LED blinks. b) Modify the code to make the green LED blink. c) Modify the code to make the green and red LEDs blink: i. Together ii. Alternately d) Alter the code to turn the LED ON when the button is pressed and OFF when it is released. e). Alter the code to make the green LED stay ON for around 1 second every time the button is pressed. f). Alter the code to turn the red LED ON when the button is pressed and the green LED ON when the button is released.	**L3, L4, L5**
2. Usage of Low Power Modes: Use MSPEXP430FR5969 as hardware platform and demonstrate the low power modes and measure the active mode and standby mode current. The main objective of this experiment is to configure the MSP-EXP430G2 LaunchPad for Low Power Mode (LPM3) and measure current consumption " both in active and low power modes. This experiment will help in learning the Various low power modes of the MSP430G2553. **Exercises:** a) How many Low power modes are supported by the MSP430G2553 platform? b) Measure the Active and Standby Current consumption in LPM3 mode	**L2, L3**

for the same application using MSP430F5529 LaunchPad	
3. Interrupt programming examples through GPIOs The main objective of this experiment is to configure GPIO and interrupts for the MSP430G2553. This experiment will help to learn and understand the GPIO and interrupt Peripherals and their operation. **Exercises:** a) Write the code to enable a Timer interrupt for the pin P1.1. b) Write the code to turn on interrupts globally.	**L3, L4, L5**
4. PWM generation using Timer on MSP430 GPIO The main objective of this experiment is to implement Pulse Width Modulation to control the brightness of the on-board, green LED. This experiment will help you to learn and understand the configuration of PWM and Timer peripherals of the MSP430G2553. **Exercises:** a) Observe the PWM waveform on a particular pin using CRO. b) What is the maximum resolution of PWM circuitry in MSP430G2 LaunchPad? c) Change the above code to create a PWM signal of 75% duty cycle on particular PWM pin.	**L3, L4, L5**
5. Interfacing potentiometer with MSP430 The main objective of this experiment is to control the on-board, red LED by the analog input from a potentiometer. This experiment will help you to learn and understand how to configure an ADC to interface with a potentiometer. **Exercises:**a) Alter the threshold to 75% of V_{cc} for the LED to turn on. b) Modify the code to change the Reference Voltage from V_{cc} to 2.5V.	
6. PWM based Speed Control of Motor controlled by potentiometer connected to MSP430 GPIO The main objective of this experiment is to control the speed of a DC Motor using the potentiometer. This experiment will help to learn and understand how to configure the PWM and ADC modules of the processor to control the DC motor using potentiometer input. **Exercises:** a) Interface a Stepper motor with MSP-EXP430G2 LaunchPad to run it in a predetermined uniform speed. b) Describe the applications of PWM in a digital power supply control. c) Create Switch case code from the example code to run the DC Motor in 3 set of speeds.	**L3, L4, L5**
7. Using ULP advisor in Code Composer Studio on MSP430 The main objective of this experiment is to optimize the power efficiency of an application on MSPEXP430G2 LaunchPad using ULP Advisor in CCS Studio. This experiment will help to learn and understand the ULP Advisor capabilities and usage of ULP Advisor to create optimized, power-efficient applications on the MSP-EXP430G2 LaunchPad.	**L3, L4, L5**

Exercises: a) How does the ULP Advisor software help in designing power optimized code? b) Which ULP rule violation helps us to detect a loop counting violation?	
8. Connect the MSP430 to terminal on PC and echo back the data The main objective of this experiment is to use UART of the MSP430G2553 to communicate with the computer. This experiment will help to learn and understand the configuration of Universal Serial Communication Interface (USCI) module of MSP430G2553 for UART based serial communication. **Exercise:** Modify the above code to transmit the set of strings to the serial terminal via UART as shown below: **char str1[]="MSP430G2 launchpad"** **char str2[]= "Ultra low power mixed signal processing applications"**	**L3, L4**
9. Master Slave Communication between 2 MSP430s using SPI The main objective of this experiment is to establish the SPI master-slave communication using 3-wire mode in MSP430F5529 Launchpad. This experiment will help understand the configuration of USCI_A0 SPI 3-Wire Master Incremented Data in MSP430F5529. **Exercises:** a) Which port pins of MSP430 can be configured for SPI communication? b) What is the data transfer rate supported by MSP430 for SPI communication?	**L3, L4**
10. A basic Wi-Fi application The main objective of this experiment is to configure CC3100 Booster Pack as a Wireless Local Area Network (WLAN) Station. This experiment will help you understand the WLAN concepts and communication between Station and Access Point. **Exercises:** a) In the terminal output window, we have received a debug message "Pinging...!". Search in the code and change the message to "Pinging the website". Repeat the experiment to observe this change in the Serial Window. b) In main. C replace www.ti.com with any non existing web address and repeat the Experiment and observe what happens. **#define** HOST_NAME www.ti.com c) In main. C replace again with www.ti.com and repeat the experiment.	**L3, L5**
11. Enable Energy Trace and Energy Trace ++ modes in CCS The main objective of this experiment is to enable Energy Trace and Energy Trace++ modes in MSP-EXP430G2 LaunchPad by using MSP430FR5969. This experiment will help you learn how to analyze the Energy and Power graphs by enabling the Energy Trace Technology of MSP430 in CCS studio.	**L3, L4**

Exercises: a) What is the difference between the Energy Trace and Energy Trace ++? b) What hardware options available that supports Energy Trace++?	
12. Compute Total Energy, and Estimated lifetime of an AA battery running MSP430 application The main objective of this experiment is to compute the total energy of MSP-EXP430G2 Launchpad running an application and to estimate the lifetime of a battery. **Exercises:** Compute the energy measurement and the estimated lifetime of a battery for Experiments 4 to 7.	**L3, L4, L5**

Books and other References:

MSP430 Microcontroller Basics by John H. Davis
http://processors.wiki.ti.com/index.php/MSP430_LaunchPad_Low_Power_Mode
http://processors.wiki.ti.com/index.php/MSP430_16-Bit_Ultra-Low_Power_MCU_Training

Note: The above experiments can be conducted using MSP 430 IC/ MSP 430 Launch pad.

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

- Get hands-on exposure in MSP430 platform and will gain confidence in building Embedded C based applications for MSP430 platform.
- Design Embedded C programs that are low power and optimized for a building specific applications.
- Apply various TI design tools, methodologies and use them for testing and designing embedded applications.

Conduct of Practical Examination:

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