Sub Title : ANALOG ELECTRONIC CIRCUITS		
Sub Code: ML31	**No of Credits :3= 3: 0: 0(L-T-P)**	**No of lecture hours/week : 3**
Exam Duration : 3 hours	**CIE+ Assignment+ SEE =45+5+50=100**	**Total no of contact hours:39**

COURSE OBJECTIVES: To make the Student understand:

1. The behavior of diode and study the application circuits of diode.
2. The transistor operating point and biasing circuits.
3. FET construction and characteristics.
4. MOSFET device construction and working
5. Design and analysis of MOSFET circuits.
6. Feedback concepts and Power amplifier circuit.

UNIT No	Syllabus Content	No of Hours
1	**DC Biasing BJTS:** Operating Point, Load line analysis, Voltage Divider Bias Configuration, Transistor switch. BJT AC Analysis : Hybrid Equivalent model, Voltage Divider Configuration **BJT Frequency Response:**, Low frequency analysis (Bode Plot excluded), low frequency response of BJT amplifier, Miller effect capacitance, High frequency response of BJT amplifiers- study of capacitors affecting frequency response,	8
2	**Feedack Amplifier:** Feedback concepts, feedback connection types **Power Amplifiers**: Definitions and amplifier types, Transformer coupled Class A amplifiers, Class B push-pull amplifier circuits Field Effect Transistor: Introduction, construction and characteristics of JFET, Transfer Characteristics	7
3	**MOSFETS:** Introduction, Device structure and physical operation - Device structure, operation with no gate voltage, creating a channel for current flow, Applying a small VDs, Operation as VDs is increased, Derivation of the id-VDS relationship, The P- Channel MOSFET, Complementary MOS or CMOS, operating the MOS transistor in the sub threshold region .	**8**
4	**Current voltage Characteristics** – Circuit symbol, id-VDS characteristics, characteristics of the P-Channel MOSFET **MOSFET Circuits at DC**: The MOSFET as an amplifier and as a switch - Large - signal operation, Graphical derivation of the transfer characteristic, operation as a switch, operation as a linear amplifier.	**8**

5	**Biasing in MOS amplifier circuits** - Biasing by fixing VGS, Biasing by fixing VG and connecting a resistor in the source , Biasing using a drain to gate feedback resistor, biasing using a current source. **Small - signal operation and models of MOSFETs** - The DC bias point, the signal current in the drain terminal ,the voltage gain, separating dc analysis and the signal analysis, small signal equivalent circuit models, the transconductance gm, the T equivalent circuit model.	**8**

Note 1: Assignment-1 from unit 1 and 2.
Asssignment-2 from unit 3, 4 and 5

COURSE OUTCOMES: On completion of the course the student will be able to

CO1: Design biasing circuits for BJTs and MOSFETS
CO2: Classify feedback amplifiers and power amplifiers
CO3: Determine the cut off frequencies for practical transistor amplifiers
CO4: Illustrate the procedure & working of construction of FET, MOSFET
CO5: Draw equivalent circuit models for BJTs and MOSFET
CO6: Differentiate the amplifier and switch functionality of BJTs and MOSFETs

COs	Mapping with POs
CO1	PO1,PO2,PO3,PO4
CO2	PO1,PO2,PO3,PO4
CO3	PO1,PO2,PO3,PO4
CO4	PO1,PO2,PO3,PO4,PO7

TEXT BOOK:

1. **Electronic Devices and Circuit Theory,** Robert L. Boylestad and Louis Nashelsky, PHI/Pearson Education, 9th Edition.
2. Microelectronic Circuits Theory and Applications, Adel S Sedra and Kenneth C Smith Oxford International Student edition, 6th edition

Text Book 1: Unit 1, Unit 2, Unit 5
Text Book 1: Unit 3, Unit 4,

REFERENCE BOOKS:

1. **Integrated Electronics,** Jacob Milman & Christos C. Halkias, Tata - McGraw Hill, 1991 Edition.
2. **Electronic Devices and Circuits,** David A. Bell, PHI, 4th Edition, 2004.

CHAIRMAN/BOS **DEAN (ACADEMIC)** **CHAIRMAN/ACADEMIC COUNCIL**

Sub Title : LOGIC DESIGN and VHDL		
Sub Code: ML32	**No of Credits : 3=3:2:0(L-T-P)**	**No of lecture hours/week : 3**
Exam Duration : 3 hours	**CIE+ Assignment+ SEE =45+5+50=100**	**Total no of contact hours:52**

COURSE OBJECTIVES: To make the Student understand

1. Principles of combinational and sequential logic.
2. Different Boolean expression reduction techniques.
3. The design and analysis of combinational circuits.
4. The integrated circuit technologies.
5. Different flip flops and its applications.
6. Sequential circuit models

UNIT No	Syllabus Content	No of Hours	Tutorials
1	**Principles of combinational logic-1:** Definition of combinational logic, Canonical forms, Generation of switching equations from truth tables, Karnaugh maps-3, 4 and 5 variables, Incompletely specified functions (Don't Care terms), Simplifying Max term equations. **Principles of combinational Logic-2:** Quine-McCluskey minimization technique-Quine-McCluskey using don't care terms, Reduced Prime Implicant Tables. **Introduction to VHDL:** Structure of VHDL Module, Operators, Data types, Types of Descriptions, simulation and synthesis. Data flow description, behavioral description and structural description.	8	4
2	**Analysis and design of combinational logic - I:** General approach, Decoders-BCD decoders, Encoders. **Analysis and design of combinational logic - II:** Digital multiplexers- Using multiplexers as Boolean function generators. Adders and subtractors-Cascading full adders, Binary comparators. **VHDL Implementation: D**ecoder, Encoder, Comparator, Adder/Subtractor	**8**	**4**
3	**Sequential Circuits – 1:** Basic Bistable Element, Latches, SR Latch, Application of SR Latch, A Switch Debouncer, The $\overline{S}\,\overline{R}$ Latch, The gated SR Latch, The gated D Latch, Master-Slave SR Flip-Flops, The Master-Slave JK Flip-Flop,T Flip Flop,D Flip flop. V**HDL Implementation** – Sequential Circuits: Flip Flops	**8**	**4**
4	**Sequential Circuits – 2:** Characteristic Equations, Registers, Counters - Binary Ripple Counters, Asynchronous counters, Synchronous Binary counters, Counters based on Shift Registers, Design of a Synchronous counters using JK Flip-Flop, D Flip-Flop, T Flip-Flop.	8	**-**
5	**Sequential Design - I:** Introduction, Mealy and Moore Models, State Machine Notation, Synchronous Sequential Circuit Analysis. **Sequential Design – II:** Construction of state diagrams, counter design.	**8**	**-**

Note 1: Assignment-1 Comparative study of different logic families
Asssignment-2 from unit 3, 4 and 5

COURSE OUTCOMES: On completion of the course the student will be able to

CO1: Simplify the Boolean equation and build logical circuits.
CO2: Design combinational circuits
CO3: Design shift registers, synchronous/ asynchronous counters
CO4: Draw state diagram for Melay & Moore Models
CO5: Write & simulate VHDL programs using the software tool Xilinx-ISE

Cos	Mapping with Pos
CO1	PO1,PO2,PO3,PO4,PO5
CO2	PO1,PO2,PO3,PO4,PO7
CO3	PO1,PO2,PO3,PO4,PO5,PO7
CO4	PO3,PO5,PO6,PO12

TEXT BOOKS:

1. **Digital Logic Applications and Design**, John M Yarbrough, Thomson Learning, 2001.
2. **Digital Principles and Design,** Donald D Givone, Tata McGraw Hill Edition, 2002.
3. **Fundamentals of Logic Design:** C H Roth, Thomas Learning, 5th Edition.

REFERENCE BOOKS:

1. **Fundamentals of logic design,** Charles H Roth, Jr, Thomson Learning, 2004.
2. **Logic and computer design Fundamentals,** Mono and Kim, Pearson, Second edition, 2001.

CHAIRMAN/BOS **DEAN (ACADEMIC)** **CHAIRMAN/ACADEMIC COUNCIL**

Sub Title : MEDICAL SCIENCE		
Sub Code: ML33	**No of Credits :3= 3: 0: 0(L-T-P)**	**No of lecture hours/week : 3**
Exam Duration : 3 hours	**CIE +Assignment+ SEE =45+5+50=100**	**Total no of contact hours:39**

COURSE OBJECTIVES:

1. To identify the various function and basics of tissues, cartilage propagation of action potential
2. To identify the functional component and basics of Nervous system.
3. To identify and understand complete cardiovascular system from blood vessel to parts of heart and also know about function of all parts of digestive system.
4. To identify the function of all the parts of respiratory system
5. To identify the importance function of skeletal system and various types of joints.

UNIT No	Syllabus Content	No of Hours
1	**INTRODUCTION: HOMEOSTASIS, TISSUE, CARTILAGE:** The internal environment and homeostasis, movement of substances within the body, body fluids, action potential, propagation of action potential. Epithelial tissue- simple epithelium, stratified epithelium, connective tissue- cells of connective tissue, loose connective tissue, Adipose tissue, Dense connective tissue, Lymphoid tissue, Cartilage- Hyaline cartilage, Fibrocartilage, Elastic cartilage.	**7**
2	**CARDIOVASCULAR SYSTEM:** Introduction, Blood vessels- Arteries and Arterioles, Veins and Venules, capillaries and sinusoids, control of blood vessel diameter, blood supply- internal respiration, cell nutrition. Heart- position, structure- pericardium, myocardium, endocardium, interior of the heart, flow of blood through the heart, blood supply to heart, Conducting system of the heart, factors affecting heart rate, the Cardiac cycle, cardiac output, blood pressure, control of blood pressure, pulse	**7**
3	**RESPIRATORY SYSTEM:** Introduction, Nose and Nasal cavity- position, structure and functions, pharynx, position, structure, functions. Larynx: position, structure and functions. Trachea, bronchi, bronchioles and alveoli, lungs- position, associated structure, pleura and pleural cavity. Respiration- muscles of respiration cycle of respiration, variables affecting respiration, lung volumes and capacity.	**8**
4	**NERVOUS SYSTEM:** Neurons: Properties of neurons, Cell bodies, Axon and Dendrites, Types of nerves, Synapse and neurotransmitters, neuromuscular junction. Central nervous system: neuroglia, meninges, ventricles of the brain and CSF. Brain: Cerebrum, functions of cerebrum, functional areas of the cerebrum. Brainstem: Cerebellum, Spinal cord- grey matter, white matter, motor nerve tracts, spinal nerves: nerve roots, plexuses, cranial nerves. **DIGESTIVE SYSTEM:** Introduction, Organs of the digestive system- mouth: tongue, teeth, salivary glands, oesophagus, stomach, gastric juice and functions of stomach- small intestine: structure, chemical digestion in small intestine, large intestine: structure, functions of the large intestine, rectum and anal canal. Pancreas, Liver	**9**

5	**SKELETAL SYSTEM:** Bone, Types of bone, structure, bone cells, functions of bone. Axial skeleton- skull, sinuses, Fontanelles, vertebral column- characteristics of typical vertebra, different parts of vertebral column (parts only), movements and functions of vertebral column, sternum, ribs, shoulder girdle and upper limb, pelvic girdle and lower limb **MUSCLES AND JOINTS (STUDY OF MUSCLES ALONG WITH JOINTS):** Muscle tissue: Skeletal muscle, Smooth muscle, Cardiac muscle, functions of muscle tissue, muscle tone and fatigue. Types of joint- Fibrous, Cartilaginous, Synovial, characteristics of synovial joints, shoulder joint, elbow joint, radioulnar joint, wrist joint, joints of hands and fingers, Hip joint, Knee joint, ankle joint, joints of foot and toes.	**8**

Note1: Assignment-1 from unit 1 and 2.
Asssignment-2 from unit 3, 4 and 5

COURSE OUTCOMES: On completion of the course the student will be able to

CO1: understand and explain the structural and functional anatomy of the Epithelial tissue & Connective tissue
CO2: understand the generation and transmission of action potential within the cells
CO3: understand and explain anatomy and physiology of, cardiovascular, respiratory, nervous, and digestive systems
CO4: understand the characteristics of skeletal system, joints of bones and movements
CO5: Identify the factors affecting performance of the vital systems

Cos	Mapping with Pos
CO1	PO1,PO2,PO3,PO4
CO2	PO1,PO2,PO3,PO4
CO3	PO1,PO2,PO3,PO4

TEXT BOOK:

1. **Ross & Wilson's Anatomy and Physiology in Health and Illness**, Anne Waugh and Allison Grant, Churchill Livingstone Publications,9th Edition.

REFERENCE BOOKS:

1. **Concise Medical Physiology**, Sujit K. Chaudhuri, New Central Book Agency Pvt. Ltd, 5th Edition.
2. **Essentials of Medical Physiology**, K. Sembulingam and Prema Sembulingam, Jaypee Publications,3rd Edition.
3. **Human Physiology- From Cells to Systems**, Lauralee Sherwood, Brooks Cole Publication,6th Edition.

CHAIRMAN/BOS **DEAN (ACADEMIC)** **CHAIRMAN/ACADEMIC COUNCIL**

Sub Title : NETWORK ANALYSIS		
Sub Code: ML34	**No of Credits : 3=3:0:0(L-T-P)**	**No of lecture hours/week :2+2=4**
Exam Duration : 3 hours	**CIE+ Assignment+ SEE =45+5+50=100**	**Total no of contact hours:52**

COURSE OBJECTIVES: To learn about

1. Nodal analysis and Mesh analysis of different complex networks.
2. Deduce networks using network theorems.
3. Analyze transient behaviour of a circuit.
4. Laplace transformation and its applications.
5. Analysis of two port networks

UNIT No	Syllabus Content	No. of Lecture Hours	No. of Tutorial Hours
1	**Basic Concepts**: Source transformations, Network reduction using Star – Delta transformation, Loop and node analysis with linearly dependent and independent sources for DC networks, Concepts of super node and super mesh. Simulation : Only for Practice schematic creation of circuits and Analysis using node based method, mesh based methods & ac circuits	**8**	**4**
2	**Network Theorems:** Superposition, Reciprocity and Millman's theorems. Thevenin's and Norton's theorems; Maximum Power transfer theorem. Only definition and Proof Simulation: Only for Practice- The problems for the above stated theorems	**8**	**4**
3	**Transient behavior and initial conditions**: Behavior of circuit elements under switching condition and their Representation, evaluation of initial and final conditions in RL, RC and RLC circuits DC excitation.	**8**	**-**
4	**Laplace Transformation & Applications**: Solution of networks, step, ramp and impulse responses, waveform Synthesis.	**8**	**2**
5	**Two port network parameters:** Impedance, Admittance, Hybrid and Transmission parameters, relationship between two port parameters.	**8**	**2**

<u>Note2</u>: Assignment-1 and Assignment-2 Simulation of numerical examples using the simulation software and submitting the report

COURSE OUTCOMES: On completion of the course the student will be able to

CO1: Apply nodal/mesh analysis for any type of network.
CO2: Analyse and solve transient behaviour of the network .
CO3: Analyse any two port network and apply laplace transform for any network.
CO4: Simulate a given network using EDA Tool – pspice

COs	Mapping with POs
CO1	PO1,PO2,PO3
CO2	PO1,PO2,PO3
CO3	PO1,PO2,PO3
CO4	PO5

TEXT BOOKS:

1. **Network Analysis**, M. E. Van Valkenburg , Pearson Education, 3rd Edition, Reprint 2002.
2. **Networks and systems**, Roy Choudhury, New Age International Publications, 2nd edition, Reprint 2006.

REFERENCE BOOKS:

1. **Engineering Circuit Analysis,** Hayt, Kemmerly and Durbin,TMH, 6th Edition, 2002.
2. **Network analysis and Synthesis,** Franklin F. Kuo, Wiley International Edition.
3. **Analysis of Linear Systems**, David K. Cheng, Narosa Publishing House, 11th reprint, 2002.
4. **Circuits**, Bruce Carlson, Thomson Learning, Reprint 2002.

CHAIRMAN/BOS **DEAN (ACADEMIC)** **CHAIRMAN/ACADEMIC COUNCIL**

Sub Title : SENSORS AND MEASUREMENT		
Sub Code: ML35	**No. of Credits : 3=3:0:0(L-T-P)**	**No of lecture hours/week : 3**
Exam Duration : 3 hours	**CIE+ Assignment + SEE =45+5+50=100**	**Total no of contact hours:39**

COURSE OBJECTIVES: To learn about

1. Measuring Instruments such as voltmeters, multimeters, digital voltmeters
2. Test instruments such as oscilloscope, DSO, and signal & function generators
3. Transducers such as resistive, and displacement transducers, Temperature transducers
4. Biosensors
5. Medical standards and ethics

UNIT No	Syllabus Content	No. of Hours
1	**Introduction Measurement Errors:** Gross errors and systematic errors, Absolute and relative errors, Accuracy, Precision, Resolution and Significant figures. **Voltmeters and Multimeters:** Introduction, Multirange voltmeter, Extension voltmeter ranges, Loading, AC voltmeter. **Digital Voltmeters:** Introduction, DVM's based on V – T, V – F and Successive approximation principles, Resolution and sensitivity, Digital Multi-meters, Digital frequency meters, Digital measurement of time.	**7**
2	**Oscilloscopes:** Introduction, Basic principles, Typical CRT connections, Dual beam and dual trace CROs, Electronic switch. Digital storage oscilloscopes. **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 generators	**9**
3	**Transducers – I:** Introduction, Electrical transducers, Selecting a transducer, Resistive transducer, Resistive position transducer, Strain gauges, Inductive transducer, Differential output transducers and LVDT. **Transducers – II:** Piezoelectric transducer, Photoelectric transducer, Photovoltaic transducer, Temperature transducers- Thermistors, RTD, Thermocouple.	**8**
4	**Biosensors:** Introduction to biosensors, advantages and limitations, various components of biosensors, applications of biosensors, characteristics, birth of biosensors, the growth of biosensor. Emerging and advanced multidisciplinary technologies , biosensor family	**7**

5	**Medical Devices Rules**: classification of medical devices (Rule 4), Parameters for classification of medical devices (First Schedule Part-1) Parameters for classification in vitro diagnostic medical devices (First Schedule Part-2), **Medical Ethics Committee:** Grant of permission for conducting clinical investigation, conditions for permission, cancellation of permission**,** medical management and compensation, power of search & seizure	**8**

Note1:
Assignment - 1 Laboratory experiment on Inducing various errors and measurement.
Asssignment- 2 from unit 3, 4 and 5

COURSE OUTCOMES: On completion of the course the student will be able to

CO1: Identify and calculate standard errors for the measuring equipments.
CO2: Operate and control the parameters of laboratory test equipments.
CO3: Choose transducers and biosensors for a particular biomedical application
CO4: Classify the medical devices and maintain Medical device standards
CO5: Chart the procedures of clinical ethical committee and to follow the ethics

COs	Mapping with POs
CO1	PO1,PO2,PO3,PO7
CO2	PO1,PO2,PO3,PO4
CO3	PO1,PO2,PO3,PO12
CO4	PO6, PO8

TEXT BOOKS:

1. **Electronic Instrumentation,** H. S. Kalsi, TMH, 2004.
2. **Biosensors**, Elizabeth A. H Hall - Open University press, Milton Keynes.
3. **Medical Device Rules 2017 GSR 78, January 31 2017 GSR 78**
4. **Electronic Instrumentation and Measurements,** David A Bell, PHI / Pearson Education, 2006.

REFERENCE BOOKS:

1. **Principles of measurement systems,** John P. Bentley, Pearson Education, 3rd Edition, 2000.
2. **Modern electronic instrumentation and measuring techniques,** Cooper D & A D Helfrick, PHI/Pearson Education, 1998.
3. **Electronic and Electrical measurements and Instrumentation,** J. B. Gupta, S. K. Kataria & Sons, Delhi.
4. **Electronics & electrical measurements,** A K Sawhney, Dhanpat Rai & sons, 9th edition.

CHAIRMAN/BOS **DEAN (ACADEMIC)** **CHAIRMAN/ACADEMIC COUNCIL**

Sub Title: OOPs AND DATA STRUCTURES		
Sub Code: ML36	**No. of Credits :3=3:0:0(L-T-P)**	**No of lecture hours/week : 3**
Exam Duration : 3 hours	**CIE+ Assignment+ SEE =45+5+50=100**	**Total no of contact hours:39**

COURSE OBJECTIVES: The course will enable the student to learn

1. Object Oriented Programming concepts
2. Objects and classes
3. File Handling
4. Function overloading, operator overloading and data conversions
5. The concepts of inheritance and data structures

UNIT No	Syllabus Content	No of Hours
1	**C++ PROGRAMMING BASICS:** Need of object oriented programming, procedural languages, characteristics of OOP, preprocessor directives, data types, manipulators, Structures, enumerated data types, Boolean type, Functions: passing arguments, returning values, reference arguments, overloaded functions, inline functions, variable and storage classes.	**9**
2	**OBJECTS AND CLASSES:** objects as data types, constructors, destructors, overloaded constructors. Arrays: Arrays as class member data types, passing arrays, arrays as objects, strings, arrays of strings. Pointers, pointers to objects, linked list, virtual functions, static functions, files and streams, input/output operations.	**9**
3	**OPERATOR OVERLOADING:** over loading of unary operators, binary operators, data conversion.	**7**
4	**INHERITANCE:** Inheritance, derived class and base class, overriding member functions, scope resolution, levels of inheritance, multiple inheritances.	**7**
5	**DATA STRUCTURES:** data representation, Data structure types, stacks, Queues, Linked lists and binary trees. Programs practice on Classes and Objects, Stack, Queue and Linked lists.	**7**

Note1: Assignment-1 from unit 1 and 2.
Asssignment-2 from unit 3, 4 and 5

COURSE OUTCOMES: On completion of the course the student will be able to

CO1: Understand concepts of OOPs based language and also the concepts of data structures
CO2: Understand the concepts of constructors & destructors and write programs
CO3: Understand inheritance, overloading and to write programs
CO4:Write Programs on data structure using stacks & queue and linked list
CO5: Develop application programs using OOPS

Cos	Mapping with Pos
CO1	PO3,PO5
CO2	PO3,PO5
CO3	PO3,PO5
CO4	PO3,PO5
CO5	PO12

TEXT BOOKS:

1. **Object oriented programming in TURBO C++**-Robert Lafore, Galgotia Publications,2002.
2. **Data Structures, Algorithms and Applications in C++-** Sartaj Sahni, Tata McGrawHill Publications.

REFERENCE BOOKS:

1. **Object Oriented Programming with C++-**E Balaguruswamy, TMH, Third edition, 2006.
2. **C++ the complete reference**-Herbert Schildt, TMH, Fourth edition, 2003.
3. **Data Structures using C++-** D.S.Malik, Thomson, 2003.

CHAIRMAN/BOS **DEAN (ACADEMIC)** **CHAIRMAN/ACADEMIC COUNCIL**

Sub Title : ANALOG ELECTRONIC CIRCUITS LAB		
Sub Code: MLL37	**No of Credits:1=0:0:1(L-T-P)**	**No of lecture hours/week :2**
Exam Duration : 3 hours	**Exam Marks : 50**	

COURSE OBJECTIVES: To wire up and understand the working of the following circuits

1. Diode circuits such as rectifiers, clipping and clamping circuits
2. Design of RC coupled amplifiers
3. RC phase shift oscillators
4. Power Amplifiers
5. Verify the Network theorems.

UNIT No	Syllabus Content
1	Rectifiers: Half wave, Full wave and Bridge Rectifier circuits.
2	Clipping Circuits: Single & Double ended with and without bias voltages
3	Clamping circuits: Positive clamping & Negative clamping.
4	RC Coupled Amplifier: BJT & FET
5	BJT Oscillators-RC Phase shift Oscillator
6	BJT/ FET Oscillators – Hartley & Colpitts Oscillators
7	Power Amplifiers : Push Pull Amplifiers
8	Open Ended experiment

COURSE OUTCOMES: The student will be able to
CO1: To design and test Recifiers Circuits
CO2: To design clipping and clamping circuits to generate
CO3: To design Oscillators
CO4: To Test the working of power amplifiers
CO5: To design & develop a system based on analog circuits

Cos	Mapping with Pos
CO1	PO1,PO2,PO3,PO4,PO5,PO7,PO8,PO9,PO10
CO2	PO1,PO2,PO3,PO4,PO5,PO7,PO8,PO9,PO10
CO3	PO1,PO2,PO3,PO4,PO5,PO7,PO8,PO9,PO10
CO4	PO1,PO2,PO3,PO4,PO5,PO7,PO8,PO9,PO10
CO5	PO12

CHAIRMAN/BOS **DEAN (ACADEMIC)** **CHAIRMAN/ACADEMIC COUNCIL**

Sub Title : LOGIC DESIGN LAB		
Sub Code: MLL38	**No of Credits:1=0:0:1(L-T-P)**	**No of lecture hours/week : 2**
Exam Duration: 3 hours	**Exam Marks : 50**	

COURSE OBJECTIVES: To design and Implement the following digital circuits:

1. Basic Gates, and simple logic circuits
2. Typical Combinational circuits
3. All types of flip flops
4. Typical Sequential circuits

UNIT No	Syllabus Content
1	Design of Half/Full adder and Half/Full Subtractors using logic gates.
2	(i) Realization of parallel adder/Subtractors using 7483 chip (ii) BCD to Excess-3 code conversion and vice versa.
3	Design of Binary to Gray code convertors and vice versa.
4	Study of 74153 IC(MUX) and designing different combinational circuits based on 74153.
5	Designing of One/Two bit comparator and study of 7485 magnitude comparator.
6	i)Design a decoder circuit for seven segment LED display ii) Study of Priority encoder
7	Implementation of given flip flops both at gate and IC level.
8	Designing of 3 bit counters and MOD – N counter (7476, 7490)
9	Design of Universal shift register using 74LS95.
10	Design sequence generator using Ring counter/Johnson counter.

COURSE OUTCOMES: The student will be able to
CO1: Design and Verify basic combinational and sequential circuits.
CO2: Design any given combinational and sequential circuits using logic gates and standard ICs.

COs	Mapping with POs
CO1	PO1,PO2,PO3,PO4,PO5,PO7,PO8,PO9,PO10
CO2	PO9,PO10,PO11,PO12

CHAIRMAN/BOS **DEAN (ACADEMIC)** **CHAIRMAN/ACADEMIC COUNCIL**

IV SEMESTER

Sub Title : MICROCONTROLLERS		
Sub Code: ML41	**No of Credits:3= 3:0:0(L-T-P)**	**No of lecture hours/week : 3**
Exam Duration : 3 hours	**CIE+Assignment+SEE =45+5+50=100**	**Total no of contact hours:39**

COURSE OBJECTIVES: To study

1. Different computer architectures and the detailed architecture of 8051
2. Addressing modes and instruction sets of 8051.
3. Internal interrupts, timers, counters
4. External interface with devices like LCD, ADC, DAC and Stepper motor
5. Serial communication ,Architecture and address modes of 8086

UNIT No	Syllabus Content	No of Hours
1	Microprocessors and microcontroller: Introduction, Microprocessors and Microcontrollers, RISC & CISC CPU Architectures, Harvard & Von-Neumann CPU architecture. Introduction to 8086: Architecture, addressing modes. The 8051 Architecture: Introduction, Features of 8051, Architecture of 8051, Pin diagram of 8051, Memory organization.	**7**
2	Addressing Modes: Introduction, Instruction syntax, Data types, Subroutines, Instruction set: Instruction timings, 8051 instructions: Data transfer instructions, Arithmetic instructions, Logical instructions, Branch instructions, Subroutine instructions, Bit manipulation instruction. 8051 programming: Assembler directives, Assembly language programs. **8051 Ports**: Basics of I/O concepts, Port structure and Operation,	**8**
3	**8051 Interfacing and Applications**: Interfacing 8051 to LCD, ADC, DAC, Stepper motor interfacing and DC motor interfacing. Programming examples in assembly language Biomedical Application: Body temperature measurement and display using sensor LM35	**8**
4	8051 Interrupts and Timers/counters: Time delay calculations. Basics of interrupts, 8051 interrupt structure, 8051 timers/counters. Interfacing with external memory: memory address decoding	**8**
5	8051 Serial Communication: Basics of Serial Data Communication, 8051 Serial Communication, connections to RS-232, 8051 Serial communication Programming in assembly language.	**8**

Note1: Assignment-1 from unit 1 and 2.
Asssignment-2 Interfacing applications

COURSE OUTCOMES: On the completion of the course the students will be able to

CO1: Compare & Differentiate different computer architectures
CO2: Identify the different addressing modes of 8051 & 8086
CO3:Write software programs using all the instructions of 8051
CO4:Design interface for ADC/DAC, LCD, Stepper & DC Motor and external memory with 8051
CO5: Incorporate the Timer, Interrupts and Serial Communication in developing application programs.

Cos	Mapping with Pos
CO1	PO2,PO3,PO5
CO2	PO3,PO5, PO12
CO3	PO3,PO5, PO12
CO4	PO4, PO5, PO12
CO5	PO4, PO5, PO12

TEXT BOOKS:

1. **The 8051 Microcontroller and Embedded Systems –** using assembly and C, Muhammad Ali Mazidi and Janice Gillespie Mazidi and Rollin D. McKinlay, PHI, 2006.
2. **8051 Micrcontroller-Hardware, Software and Applications,** V.Udayashankara and M.S. Mallikarjunaswamy ,Tata McGraw-Hill, 2009.

Reference Books:

1. **The 8051 Microcontroller and embedded systems,** Kenneth J. Ayala and Dhananjay V.Gadre , Cenegage learning.
2. **Programming and Customizing the 8051 Microcontroller,** Predko ,TMH.
3. **Microcontrollers- Theory and Applications**, Ajay V.Deshmukh ,TMH,2005.
4. **Texas Instruments Manual LM35**

CHAIRMAN/BOS **DEAN (ACADEMIC)** **CHAIRMAN/ACADEMIC COUNCIL**

Sub Title: COMMUNICATION SYSTEMS		
Sub Code: ML42	**No. of Credits:3=3:0:0(L-T-P)**	**No of lecture hours/week :03**
Exam Duration : 3 hours	**CIE+ Assignment+ SEE =45+5+50=100**	**Total no of contact hours:39**

COURSE OBJECTIVES: To make the students

1. Develop an understanding of the concept of a communication system.
2. To distinguish between amplitude and angle modulation.
3. Understand the signal to noise ratio and understand the SNR in different techniques.
4. To learn the concepts of sampling and quantization.
5. Be able to understand Digital Modulation Techniques.

UNIT No	Syllabus Content	No of Hours
1	**AMPLITUDE MODULATION:** Time-Domain Description, Frequency domain description, Generation of AM waves, Detection of AM waves, AM/DSB, Time-Domain Description, Frequency domain description, Generation of DSBSC waves, Coherent Detection of DSBSC Modulated waves. Costas loop, Quadrature Carrier multiplexing, AM-SSBSC generation, Frequency - Domain Description, Frequency discrimination method for generation an SSB Modulated wave, time domain description and generation .	**9**
2	**FREQUENCY MODULATION:** Basic Concepts, Frequency Modulation, Spectrum Analysis Of sinusoidal FM wave, NBFM, WBFM, Constant Average power, Transmission bandwidth of FM waves, Generation of FM waves, Direct FM, demodulation of FM waves, frequency discriminator, ZCD.	**8**
3	**NOISE IN ANALOG MODULATION:** Signal to noise Ratio :AM Receiver Model, DSBSC Receiver, SSB Receiver, FM Receiver Model, Noise in FM Reception, FM Threshold effect, Pre-Emphasis and De-Emphasis in FM.	**7**
4	**DIGITAL MODULATION:** Sampling theorem for low pass and band pass signal, statement and proof, PAM, Natural Sampling, Flat-Top sampling, Quantization of Signals, Quantization error. PCM, Electrical representations of Binary digits, The PCM Systems, DPCM, Delta Modulation, ADM, ASK, FSK	**8**
5	**TELEMEDICINE:** Introduction, A remote health monitoring system: The concepts and the functions, example of system operation, Diagnostic equipment: ECG and heart frequency monitoring, Blood glucose monitoring, Physical activity monitoring, Breathing frequency monitoring, oximetry monitoring, Arterial pressure monitoring, Body temperature.	**7**

Note1: Assignment-1 from unit 1 and 2.
Asssignment-2 from unit 3, 4 and 5

COURSE OUTCOMES: On completion of the course the student will be able to
CO1: Understand the Amplitude and frequency modulation techniques.
CO2: Understand and derive SNR for AM & FM .
CO3: Understand digital modulation techniques
CO4: Applications of Communication in the field of telemedicine.

COs	Mapping with POs
CO1	PO1,PO3,PO4,PO7
CO2	PO1,PO3,PO4,PO7
CO3	PO3,PO4
CO4	PO3,PO4,PO12

TEXT BOOKS:

1. **Analog and Digital communication-**Simon Haykin, John Willey, 2nd edition.
2. **Principles of communication systems,** Taub and Schilling, TMH, 3rd edition.
3. **Innovative Medical Devices for Telemedecine Application** , Agostino Giorgia.

REFERENCE BOOKS:

1. **Electronic Communication Systems**, Blake, Thomson , 2nd Edition.
2. **Communication Systems**- Sam Shanmugam, John Wiley.
3. **Contemporary Communication Systems using Matlab,** Proakis ,Cengage Learning, 2nd edition.
4. **Electronic Communication Systems**- George Kennedy.

CHAIRMAN/BOS **DEAN (ACADEMIC)** **CHAIRMAN/ACADEMIC COUNCIL**

Sub Title : SIGNALS & SYSTEMS		
Sub Code: ML43	**No of Credits : 4=3:2:0(L-T-P)**	**No of lecture hours/week : 3+2=5**
Exam Duration : 3 hours	**CIE+ Assignment+ SEE =45+5+50=100**	**Total no of contact hours:65**

COURSE OBJECTIVES: To make the students learn

1. The general classification of the signal and standard signals
2. Linear Time Invariant Systems and convolution both in continuous time domain and discrete time domain.
3. The representation of LTI systems through convolution, differential equation and difference equations
4. Fourier representations of continuous and discrete systems and also Z transform.

UNIT No	Syllabus Content	No of Lecture Hours	No of tutorials Hours
1	**Introduction**: Definitions of a signal and a system, classification of signals, basic Operations on signals, elementary signals, Systems viewed as Interconnections of operations, properties of systems. Stationary signals, Biomedical signals	**6**	**4**
2	**Time-domain representations for LTI systems –:** Impulse response representation, Convolution integral, Convolution Sum, Properties of convolution.	**9**	**6**
3	**Properties of impulse response**: Representation of LTI systems, **Computational Structures:** for implementing Differential and difference equation Representations, Block diagram representations. **Discrete-Time systems:** Direct form I, Direct form II, cascade and parallel forms.	**5**	**5**
4	**Fourier representation for signals :** Discrete time, continuous time Fourier series and examples Continuous Fourier transforms (derivations of transforms are excluded) and Discrete Fourier transforms and their properties and examples	**9**	**6**
5	**Z-Transforms :** Introduction, Z – transform, properties of ROC, properties of Z – transforms, inversion of Z – transforms. Transform analysis of LTI Systems, unilateral Z- Transform and its application to solve difference equations.	**9**	**6**

Note1: Assignment-1 from unit 1 and 2. And MATLAB simulations
Asssignment-2 from unit 3, 4 and 5

COURSE OUTCOMES: The students will be able to

CO1: Understand the signals and its properties, classify and perform different operations on them
CO2: Perform Continuous & Discrete convolution
CO3: Draw the block diagram representation of LTI Systems
CO4: Understand the properties of Fourier and Z Transform and solve problems
CO5: To solve LTI systems using the properties of Z Transform

COs	Mapping with POs
CO1	PO1,PO2,PO3,PO4,PO5
CO2	PO2,PO3,PO4,PO5
CO3	PO1,PO2,PO3,PO4
CO4	PO2,PO3,PO4,
CO5	PO2,PO3,PO4,

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TEXT BOOK

1. **Signals and Systems,** Simon Haykin & Barry Van Veen, John Wiley & Sons, Second Edition.

REFERENCE BOOKS:

1. **Signals and Systems ,** Alan V Oppenheim, Alan S, Willsky and A Hamid Nawab**,** Pearson Education Asia / PHI, 2nd edition, Indian Reprint 2002.
2. **Signals and Systems, Schaum's outlines,** H. P Hsu, R. Ranjan, TMH, 2006.
3. **Linear Systems and Signals,** B. P. Lathi, Oxford University Press, 2005.
4. **Signals and Systems,** Ganesh Rao and Satish Tunga, Sanguine Technical Publishers, 2004.

CHAIRMAN/BOS **DEAN (ACADEMIC)** **CHAIRMAN/ACADEMIC COUNCIL**

Sub Title: BIOMEDICAL INSTRUMENTATION		
Sub Code: ML44	**No. of Credits : 4=4: 0: 0(L-T-P)**	**No of lecture hours/week :04**
Exam Duration : 3 hours	**CIE+ Assignment+ SEE =45+5+50=100**	**Total no of contact hours:52**

COURSE OBJECTIVES: Is to make the student understand

1. The human physiology, anatomy and evolution of bio signals.
2. The concepts of bio signal transducers and measurement.
3. The working of all major biomedical equipments.
4. The safety of biomedical devices.

Unit No.	Syllabus Content	No. of Hours
1	**FUNDAMENTAL CONCEPTS:** Sources of biomedical signals, Basic medical instrumentation system, performance requirements of medical instrumentation systems, General constraints in design of medical instrumentation systems. **Bioelectric Signals and Electrodes**: Electrocardiogram (ECG), Electroencephalogram (EEG), Electromyogram (EMG), Electrodes for ECG, Electrodes for EEG, Electrodes of EMG. EOG, EGG.	**10**
2	**BIO POTENTIAL AMPLIFIERS**: Need for bio amplifier- single ended bio amplifier-right leg driven ECG amplifier, Transient protection, Common-Mode and Other Interference -Reduction Circuits, Amplifiers for other bio potential signals, Band Pass filtering, isolation amplifiers-transformer and optical isolation- isolated DC amplifier and AC carrier amplifier. Chopper amplifier. Power line interference.	**10**
3	**BIOMEDICAL RECORDERS:** Electrocardiograph-block diagram description, ECG leads, artefacts, Vector cardiograph, Phonocardiograph, Electroencephalograph, Electromyograph, measurement of heart rate, measurement of pulse rate, blood pressure measurement, measurement of temperature, measurement of respiratory rate.	**12**
4	**OXIMETERS:** Oximetry, ear oximeter, pulse oximeter, skin reflectance oximeter and intravascular oximeter. **Cardiac Output Measurement:** Indicator-Dilution Method- Continuous infusion, Rapid injection. **Blood Flow Meters:** Electromagnetic blood flow meters, Ultrasonic blood flow meters, NMR blood flow meters, Photoplethysmography.	**10**
5	**CARDIAC PACEMAKERS AND DEFIBRILLATORS:** Need for cardiac pacemaker, External pacemaker, Implantable pacemaker, Types of Implantable pacemakers, Programmable pacemaker, Rate-responsive pacemakers. DC defibrillator, Implantable defibrillators. **PATIENT SAFETY:** Physiological effects of electrical currents on humans. Electric shock hazards, Leakage currents, macro shock, micro shock hazards and preventions, Electrical safety analyzer & precautions. Electrical safety codes standards.	**10**

Note2: Assignment-1 from unit 1 and 2.
Asssignment-2 from unit 3, 4 and 5

COURSE OUTCOMES: By the completion of this course the student will be able to

CO1: Understand the generation of bio electric signals, identify the basic components of a measuring system
CO2: Understand the working of electrical amplifiers & filters for acquiring and measuring the physiological parameters
CO3: Record ECG according to 5/12 lead standard system
CO4: Understand the principle of measurement of blood pressure, blood flow , body temperature and pulse rate
CO5: Understand the working and also the application of cardiac pacemakers & defibrillators
CO6: Understand the patient safety standards

COs	Mapping with POs
CO1	PO1,PO2,PO3
CO2	PO1,PO3,PO4,PO6
CO3	PO1,PO3, PO4,PO6
CO4	PO3, PO4,PO6,PO7,
CO5	PO3, PO4,PO6,PO7,
CO6	PO8

TEXT BOOK:

1. **Handbook of Biomedical Instrumentation**, R.S.Khandpur, Tata McGraw Hill, 2nd Edition, 2003.
2. **Medical Instrumentation Application and Design, John G WebsterJohn Wiley and Sons, New York 2004**

REFERENCE BOOK:

1. **BIOMEDICAL TRANSDUCERS AND INSTRUMENTS**, Tatsuo Togawa, Toshiyo Tamura and P. Ake Oberg, CRC Press, 1997.
2. **Biomedical Instrumentation and Measurement**, Leslie Cromwell, Fred J Weibell and Erich A. Pfeiffer, Prentice-Hall India Pvt. Ltd.
3. **Introduction to Biomedical Equipment Technology**, Joseph J Carr and John M Brown Pearson Education ,4th Edition , 2001 .
4. **The Biomedical Engineering Handbook**, Ed.Joseph Bronzino, Boca Raton: CRC Press LLC, 2000.

CHAIRMAN/BOS **DEAN (ACADEMIC)** **CHAIRMAN/ACADEMIC COUNCIL**

Sub Title : LINEAR IC's AND APPLICATIONS		
Sub Code: ML45	**No. of Credits: 3=3:0:0(L-T-P)**	**No of lecture hours/week : 3**
Exam Duration : 3 hours	**CIE+ Assignment+ SEE =45+5+50=100**	**Total no of contact hours:39**

COURSE OBJECTIVES:

1. This subject aims to give the students a complete understanding of operational amplifiers,their characteristics, operating parameters and all arithmetic circuits built using opamp.
2. The students will get to learn the qualitative and quantitative analysis of the following application circuits: Amplifiers, waveform generators, precision rectifiers , filters ,timers and their applications and A to D , D to A converters.

Unit No	Syllabus Content	No of Hours
1	**Operational Amplifier Fundamentals**: Introduction, basic information of op-amp , ideal operational amplifier, operational amplifier internal circuit, IC741 op-amp circuit. **Operational Amplifier characteristics**: Introduction, DC characteristics, AC characteristics. **Introduction to TI simulation software** : Toolkit for Interactive Network Analysis(TINA)	**8**
2	**Operational Amplifier applications:** Introduction, basic op-amp application, instrumentation amplifier, AC amplifier, V to I and I to V converter, op-amp circuits using diodes, sample and hold circuit, log and antilog amplifier, differentiator, integrator. Simulation of various circuits using TINA (**Demonstration only**)	**8**
3	**Comparators and Waveform generators**: Introduction, comparator, Schmitt trigger, astable multivibrator, monostable multivibrator, triangular wave generator, oscillators.	**7**
4	**Active filters:** Introduction, first and second order low pass &high pass filters. **555 Timer:** Introduction, functional diagram, monostable, astable and Schmitt trigger operations.	**8**
5	**D-A and A-D converter:** Introduction, DAC techniques: Specifications Binary weighted resistor network, R-2R Ladder Network. A-D converters: Specifications, Dual Slope converters, Flash Converters, Successive Approximation **Mandatory assignment**: Developing any application using simulation software TINA.	**8**

Note 1: Assignment-1 from unit 1 and 2.
Asssignment-2 from unit 3, 4 and 5

COURSE OUTCOMES: On completion of the course the student will be able to

CO1: Design basic and complex circuits using the fundamental knowledge of op-amp
CO2: Build various op-amp application circuits
CO3: Determine various comparators usage and waveform generation techniques
CO4: Design of filters and 555 Timer.
CO5: Develop D-A and A-D converters

Cos	Mapping with Pos
CO1	PO1,PO2,PO3,PO4,PO5,PO7
CO2	PO2,PO3,PO4,PO5,PO6,PO7
CO3	PO2,PO3,PO4,PO5,PO6, PO7
CO4	PO2,PO3,PO4,PO5,PO6, PO7
CO5	PO2,PO3,PO4,PO5,PO6, PO7

Text Books:

1. **Linear Integrated Circuits**, D. Roy Choudhury and Shail B. Jain, New Age International 3rd edition, 2010.
2. **Op - Amps and Linear Integrated Circuits**, Ramakant A. Gayakwad, PHI, 4 th edition.

Reference Books:

1. **Operational Amplifiers and Linear Integrated Circuits**, Robert. F. Coughlin & Fred.F. Driscoll, PHI/Pearson, 2006.
2. **Design with Operational Amplifiers and Analog Integrated Circuits**, Sergio Franco, TMH, 3e, 2005.

CHAIRMAN/BOS **DEAN (ACADEMIC)** **CHAIRMAN/ACADEMIC COUNCIL**

Sub Title: OOPs AND DATA STRUCTURE LAB		
Sub Code: MLL46	**No of Credits :1= 0:0:1(L-T-P)**	**No of lecture hours/week : 2**
Exam Duration : 3 hours	**Exam Marks : 50**	

COURSE OBJECTIVES: To enable the students to write programs

1. To access/store different data
2. Making use of functions
3. To Sort/Search an element
4. For Dynamic memory allocation

UNIT NO	Contents: Write Programs for the following problems
1	Read and display student information by structure variable initialization.
2	Find the largest number.
3	Swap two numbers using functions(pass by value, pass by reference)
4	Store student details using array of objects.
5	Sort an array of elements in ascending/descending order.
6	Search a given element in an array.(Binary search)
7	Display the memory address of an object.
8	Perform the stack operation using static/dynamic memory allocation.
9	Perform the queue operation using static/dynamic memory allocation.
10	Perform the circular queue operation.
11	Illustrate single, double linked list.
12	Implement binary tree.

COURSE OUT COMES: The student will be able to

CO1**:** Write Programs using structures ; C02: Write Programs using functions
CO3: Write Program implementing data Structure

COs	Mapping with POs
CO1, CO2, CO3	PO3,PO4,PO5,PO8,PO9,PO10, PO12

CHAIRMAN/BOS **DEAN (ACADEMIC)** **CHAIRMAN/ACADEMIC COUNCIL**

Sub Title : MICROCONTROLLER LAB		
Sub Code: MLL47	**No of Credits:1=0:0:1(L-T-P)**	**No of lecture hours/week : 2**
Exam Duration : 3 hours	**Exam Marks : 50**	

COURSE OBJECTIVES: To make the student proficient in

1. The complete instruction set.
2. Writing and executing Standard programming examples like sorting, code conversion etc.
3. Writing and execution of certain interfacing programs.
4. Working with a programming tool such as Keil.

UNIT No	Syllabus Content
	I. PROGRAMMING for 8051
1.	Familiarisation of Addressing modes
2.	Write programs for all kinds of data manipulations.
3.	Write programs for implementing ALU for given specifications.
4.	Write programs to count different events.
5.	Implementation of subroutines
6.	Write programs to implement standard code convertors.
7.	Programs to generate delay, Programs using serial port and on-Chip timer / counter.
	II. INTERFACING:
8	Alphanumeric LCD panel, LED and Hex keypad input interface
9	Generate different waveforms Sine, Square, Triangular, Ramp etc. using DAC interface
10	Stepper and DC motor control interface

COURSE OUTCOMES: On the completion of the course the students will be able to

CO1: Write program based on 8051.
CO2: Interface typical external hardware to 8051
CO3: Handle versatile tool: Keil IDE.

COs	Mapping with POs
CO1	PO1,PO2,PO3,PO4,PO5
CO2	PO2,PO3,PO4,PO5,PO9,PO10
CO3	PO3,PO6,PO11,PO12

CHAIRMAN/BOS **DEAN (ACADEMIC)** **CHAIRMAN/ACADEMIC COUNCIL**

Sub Title: LINEAR INTEGRATED CIRCUITS LAB		
Sub Code: MLL48	**No of Credits:1=0:0:1(L-T-P)**	**No of lecture hours/week :02**
Exam Duration : 3 hours	**Exam Marks : 50**	

COURSE OBJECTIVES: The student will learn

1. To rig up ,test and verify the BASIC linear integrated circuits .
2. The application circuits such as filters, waveform generators, multivibrators.

Unit No	Syllabus Content
1.	Study of Opamp characteristics.
2.	Design of Inverting and non-inverting amplifier.
3.	Design of various application circuits of Opamp: i)Adder and Subtractor ii)Integrator iii)Differentiator.
4.	Design Waveform generator using Schmitt trigger.
5.	Design of active first order filter: Low pass, High Pass, Band pass, Band elimination.
6.	Design of active second order filter: Low pass, High Pass, Band pass, Band elimination
7.	Design of multivibrator using 555 timer.: i) Astable ii) Bistable
8.	Building of PAM, PWM and PPM
9.	Experiments on TI board
Open end experiment based on Telemedicine concepts.	

COURSE OUTCOME: The students will be able to

CO1: Design & Testing of linear circuits using opamp IC 741
CO2: Design & test Digital Communication Circuits Using 555
CO3: Build & test applications of 555 Timer IC
CO4: Realise different modules using Industry standard TI Board and develop application circuits

COs	Mapping with Pos
CO1	PO2,PO3,PO4,PO5,PO7,PO9,PO10,P12
CO2	PO2,PO3,PO4,PO5,PO7,PO9,PO10,P12
CO3	PO2,PO3,PO4,PO5,PO7,PO9,PO10,P12
CO4	PO2,PO3,PO4,PO5,PO7,PO9,PO10,P12

CHAIRMAN/BOS **DEAN (ACADEMIC)** **CHAIRMAN/ACADEMIC COUNCIL**