Dr. Ambedkar Institute of Technology

Department of Medical Electronics Engineering

The enclosed documents are verified and approved.

HOD

Head of the Department
Dept. of Medical Electronics Engineering
Dr. Ambedkar Institute of Technology
Bangalore - 560 056.

	DR AMBEDKAR INSTITUTE OF TECHNOLOGY, BANGALORE								
	MASTER LIST OF SYLLABUS FOR THE ACADEMIC YEAR 2018-19								
	BATCH 2017-18								
DEPARTMENT	Medical Electronics				SEMESTER :			III	
DOC NO :	1				NO OF CREDITS :			26	
ISS NO /DATE :					TOTAL NO OF HOURS				
REV NO/DATE:									
SLNO	SYLLABUS			TEXT	CATEGORY			Total Credits	REMARKS
	Subject Code	Iss no	Date		L	T	P		
1	MA31	1		Engineering Mathematics-III	3	2	0	4	
2	ML31	1		Analog Electronic Circuits	4	0	0	4	
3	ML32	1		Logic Design	3	2	0	4	
4	ML33	1		Network Analysis	3	2	0	4	
5	ML34	1		Sensors and Measurement	3	0	0	3	
6	ML35	1		OOPs & Data Structure	3	0	0	3	
7	MLL36	1		OOPs & Data Structure Lab	0	0	2	1	
8	MLL37	1		Analog Electronics Lab	0	0	3	1.5	
9	MLL38	1		Logic Design Lab	0	0	3	1.5	
					19	6	8	26	

	DR AMBEDKAR INSTITUTE OF TECHNOLOGY, BANGALORE								
	MASTER LIST OF SYLLABUS FOR THE ACADEMIC YEAR 2018-19								
	BATCH 2017-18								
DEPARTMENT	Medical Electronics				SEMESTER :			IV	
DOC NO :	1				NO OF CREDITS :			25	
ISS NO /DATE :					TOTAL NO OF HOURS				
REV NO/DATE:									
SLNO	SYLLABUS			TEXT	CATEGORY			Total Credits	REMARKS
	Subject Code	Iss no	Date		L	T	P		
1	MA41	1		Engineering Mathematics-IV	3	2	0	4	
2	ML41	1		Microcontrollers	4	0	0	4	
3	ML42	1		Communication System	3	0	0	3	
4	ML43	1		Signals & Systems	3	2	0	4	
5	ML44	1		Medical Science	4	0	0	4	
6	ML45	1		Linear IC’s And Applications	3	0	0	3	
7	MLL46	1		Microcontroller Lab	0	0	3	1.5	
8	MLL47	1		Linear Integrated Circuits Lab	0	0	3	1.5	
					20	4	6	25	

	DR AMBEDKAR INSTITUTE OF TECHNOLOGY, BANGALORE								
	MASTER LIST OF SYLLABUS FOR THE ACADEMIC YEAR 2019-20								
	BATCH 2017-18								
DEPARTMENT	Medical Electronics				SEMESTER :			V	
DOC NO :	1				NO OF CREDITS :			25	
ISS NO /DATE :					TOTAL NO OF HOURS				
REV NO/DATE:									

SLNO	SYLLABUS			TEXT	CATEGORY			Total Credits	REMARKS
	Subject Code	Iss no	Date		L	T	P		
1	HSO3	1		Management And Entrepreneurship	4	0	0	4	
2	ML51	1		Control System	3	2	0	4	
3	ML52	1		Biomedical Instrumentation	3	0	0	3	
4	ML53	1		Physiological Control System	3	0	0	3	
5	ML54	1		Digital Signal Processing	4	0	0	4	
6	ML55X	1		Elective 1 (Group A)	4	0	0	4	
7	MLL56	1		Medical Electronics Lab	0	0	3	1.5	
8	MLL57	1		Digital Signal Processing Lab	0	0	3	1.5	
					21	2	6	25	

Elective 1 (Group A)

ML551	Embedded Systems & IOT
ML552	Clinical Engineering

	DR AMBEDKAR INSTITUTE OF TECHNOLOGY, BANGALORE								
	MASTER LIST OF SYLLABUS FOR THE ACADEMIC YEAR 2019-20								
	BATCH 2017-18								
DEPARTMENT	Medical Electronics						SEMESTER :	VI	
DOC NO :	1						NO OF CREDITS :	26	
ISS NO /DATE :							TOTAL NO OF HOURS		
REV NO/DATE:									

SLNO	SYLLABUS			TEXT	CATEGORY			Total Credits	REMARKS
	Subject Code	Iss no	Date		L	T	P		
1	ML61	1		Medical Physics	4	0	0	4	
2	ML62	1		Medical Imaging System	4	0	0	4	
3	ML63	1		Biomedical Equipment	4	0	0	4	
4	ML64	1		Laser And Fiber Optics In Medicine	3	0	0	3	
5	ML65X	1		Elective 2(Group B)	4	0	0	4	
6	MLL66	1		Signal processing Lab using Lab View	0	0	3	1.5	
7	MLL67	1		Physiological Lab	0	0	3	1.5	
8	MLL68	1		Java Lab	0	0	4	2	
9	MLP69	1		Mini Project				2	
					19	0	10	26	

Elective 2(Group B)

ML651	Bio Mechanics
ML652	Medical Informatics

	DR AMBEDKAR INSTITUTE OF TECHNOLOGY, BANGALORE								
	MASTER LIST OF SYLLABUS FOR THE ACADEMIC YEAR 2020-21								
	BATCH 2017-18								
DEPARTMENT	**MEDICAL ELECTRONICS**				SEMESTER :				VII
					No. OF CREDITS :				24
REV NO/DATE:		Teaching Hrs./week			Examination				
SL.NO	Course Code	Course Title	Theory	Tutorial Practical		Duration in Hrs.	CIE Marks	SEE Marks	Total Marks	Credits
			L	T	P					
1.	HS04	Intellectual Property Rights (IPR)	2	0	0	03	50	50	100	2
2.	ML71	Biomedical Digital Signal Processing	3	0	0	03	50	50	100	3
3.	ML72	Digital Image Processing	3	0	0	03	50	50	100	3
4.	ML73	Bio-Mechanics	3	0	0	03	50	50	100	3
5.	ML74X	Elective 3(Group-C)	3	0	0	03	50	50	100	3
6.	ML75X	Elective 4(Group-D)	3	0	0	03	50	50	100	3
7.	MLL76	Biomedical Digital Signal & Image Processing Lab.	0	0	2	03	50	50	100	1
8.	MLS77	Seminar	0	0	2	-	50	-	50	2
9.	IDE	Inter Department Elective-1 (Group-E)	4	0	0	03	50	50	100	4
10.	MLP78	Project Phase I	0	0	2	0	-	-	-	0
			21	0	6	24	450	400	850	24

Professional Elective

Elective-3 Group-C		Elective- 4 Group-D	
ML741	Speech Processing	ML751	Bio-Statistics & Research Methodology
ML742	Biomaterials & Artificial Organs	ML752	Medical Devices & Regulations
ML743	Picture Archiving and Communication Standards	ML753	Hospital Design and Management

Inter Department Elective-1 (GROUP-E)	
MLE01	Bio Medical Engineering

	DR AMBEDKAR INSTITUTE OF TECHNOLOGY, BANGALORE									
	MASTER LIST OF SYLLABUS FOR THE ACADEMIC YEAR 2020-21									
	BATCH 2017-18									
DEPARTMENT		**MEDICAL ELECTRONICS**						SEMESTER :		VIII
								No. OF CREDITS :		24
REV NO/DATE:			Teaching Hrs./week			Examination				
SL.NO	Course Code	Course Title	Theory	Tutorial	Practical	Duration in Hrs.	CIE Marks	SEE Mark s	Total Marks	Credits
			L	T	P					
1	ML81X	Elective 5 (Group-F)	4	0	0	03	50	50	100	4
2	ML82X	Elective 6 (Group-G)	4	0	0	03	50	50	100	4
3	MLP83	Project Phase II	0	0	3	03	50	50	100	12
4	IDE	Inter Department Elective-2 (Group-H)	4	0	0	03	50	50	100	4
			12	0	3	12	200	200	400	24

Professional Elective 5 (Group-F)		**Professional Elective 6 (GROUP-G)**	
ML811	Neural Network & Pattern Recognition	ML821	Biometric Systems
ML812	Bio Sensors & Bio-MEMS	ML822	Rehabilitation Engineering
ML813	Infra Red Imaging & Applications	ML823	Programming with Python

Inter Department Elective-2 (GROUP-H)	
MLE02	Medical Devices Safety and Regulations

III SEMESTER

Sub Title : ENGINEERING MATHEMATICS – III		
Sub Code: MA31	**No of Credits : 4=3:1:0(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:

1. To understand Mathematical tools available to solve advanced engineering problems.

UNIT No	Syllabus Content	No of Hours	
		Theory	Tutorial
1	**Fourier Series**: Definition and Euler formulae (without proof), statement of sufficient condition for convergence of the series. Fourier series of functions of period 2π, functions having arbitrary period, even and odd functions. Half-Range Expansions. Applications to forced oscillations and practical harmonic analysis.	08	05
2	**Fourier transforms:** Fourier complex integrals, Fourier sine and cosine integrals, Complex Fourier transforms, Fourier sine and cosine Transforms, Properties of Fourier transforms: Linearity, Change of scale, Shifting, Modulation, Fourier transform of derivatives, Relationship between Fourier and Laplace transform, Convolution theorem (without proof), Parseval's identity (no proof).	08	05
3	**Z-Transformations:**Definition, damping rule, shifting rule, initial value and final value theorems. Inverse Z-transform. Difference equations, applications of Z-transforms to solve difference equations.	08	05
4	**Numerical Methods-I:** Finite differences, Forward and backward differences, Newton's forward and backward interpolation formulae, Numerical differentiation. Divided differences - Newton's divided difference formula, Lagrange's interpolation formula and inverse interpolation formula. Numerical Solution of algebraic and transcendental equations: Secant method, Regulafalsi method, Newton - Raphson method.	08	05
5	**Numerical Methods-II:** Numerical solution of ordinary differential equations of first and second order; Euler's and Modified Euler's method, Runge-Kutta method of fourth-order. Milne's and Adams - Bashforth predictor and corrector methods (No derivations).	08	05

COURSE OUTCOMES: After the completion of the above course students will be able to use

CO1:Fourier series tools to fit sinusoidal functions for I/O relations.
CO2:Fourier transform tools to estimate sinusoidal functions for engineering problems.
CO3:Z-transforms to solve discrete engineering problems..
CO4:Finite difference methods for polynomial approximations.
CO5:Numerical techniques to solve DE.

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

TEXTBOOKS:

1.**B.S. Grewal**, Higher Engineering Mathematics, Khanna Publishers, New Delhi

Sub Title : ANALOG ELECTRONIC CIRCUITS		
Sub Code: ML31	**No of Credits :4= 4: 0: 0(L-T-P)**	**No of lecture hours/week : 4**
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. 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	Diode Circuits: Clippers and clampers Field Effect Transistor: Introduction, construction and characteristics of JFET, Transfer Characteristics	**10**
2	**Transistor Biasing:** Operating point, load line, Voltage Divider Bias Configuration, Transistor switch. **Transistor at Low Frequencies:** Hybrid equivalent model, Voltage divider bias, frequency response of BJT amplifier: low frequency & high frequency- study of capacitors affecting frequency response (limited to circuit diagram & response curves, no derivations)	**12**
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 . **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. **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.	**12**

4	**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. IC Biasing - Current sources, current mirror and current steering circuits - The basic MOSFET current source, MOS current steering circuits	**10**
5	**Feedback Amplifier:** Feedback concept, Feedback connections type. **Power Amplifiers**: Definitions and amplifier types, Transformer coupled Class A amplifiers, Class B push-pull amplifier circuits	**08**

Note1: Unit 2 & Unit 3 will have internal choice
Note2: Assignment-1 from unit 1 and 2.
Asssignment-2 from unit 3, 4 and 5

COURSE OUTCOMES: On completion of the course the student would have learnt to

CO1:Design the diode application circuits such as clipping and clamping circuits
CO2:Design and analysis of BJT & MOSFET Amplifier
CO3:Analyse the frequency response of the amplifier
CO4:Would have understood the concepts of feedback amplifiers, power amplifiers

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

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.

Sub Title : LOGIC DESIGN		
Sub Code: ML32	**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 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.	**10**	**5**
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. **Integrated Circuit Technologies**: Characteristics and Parameters: TTL Circuits: NOT and NAND, ECL : OR, CMOS: NOR, Comparison **VHDL Implementation: D**ecoder, Encoder, Comparator, Adder/Subtractor	**8**	**5**
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**	**5**

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**
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**	**3**

Note1: Unit 2 & Unit 5 will have internal choice
Note2: Assignment-1 from unit 1 and 2.
Asssignment-2 from unit 3, 4 and 5

COURSE OUTCOMES: On completion of the course the student would have learnt to

CO1: Design and analyze various combinational and sequential logic circuits.
CO2: Analyze different IC technologies.
CO3: Design and develop applications of combinational and sequential circuits.
CO4: Design and simulate the logical circuits using VHDL.

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.

Sub Title : NETWORK ANALYSIS		
Sub Code: ML33	**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 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	**12**	**6**
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	**6**	**6**
3	**Resonant Circuits:** Series and parallel resonance (RLC circuit), Q–factor, Bandwidth, half power frequencies. **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.	**9**	**6**

4	**Laplace Transformation & Applications**: Solution of networks, step, ramp and impulse responses, waveform Synthesis.	**6**	**4**
5	**Two port network parameters:** Impedance, Admittance, Hybrid and Transmission parameters, relationship between two port parameters.	**6**	**4**

Note1: Unit 1 & Unit 3 will have internal choice

Note2: 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 would have learnt to

CO1: Analyse a network, and be able to 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 and analyse the given network and also familiarize EDA Tools (Electronic Design & Automation)

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.

Sub Title : Sensors and Measurement		
Sub Code: ML34	**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	**Introduction to Biosensors:** Biosensors, Advantages and limitations, various components of biosensors, the growing of biosensor. The biosensor family, the biomolecule ingredients, proteins, enzymes complexes, enzymes kinetics, the proteins of the immune systems.	**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: Unit 1 & Unit 2 will have internal choice

Note2: 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 would have learnt

CO1: Standard errors and its calculation in measuring equipments.
CO2: The working of test equipments.
CO3: Identify different transducers and biosensors for particular biomedical application
CO4: Medical device standards and 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.

Sub Title: OOPs AND DATA STRUCTURES		
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: 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: Unit 1 & Unit 2 will have internal choice
Note2: Assignment-1 from unit 1 and 2.
Asssignment-2 from unit 3, 4 and 5

COURSE OUTCOMES: On completion of the course the student would have learnt to

CO1:Write programs in object oriented programming language.
CO2:Analyze the various concepts of OOPs based language and also the concept of data structures.
CO3:Develop algorithm and write application oriented programs .

COs	**Mapping with POs**
CO1	PO3,PO5
CO2	PO3,PO5
CO3	PO11, 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.

Sub Title: OOPs AND DATA STRUCTURES LAB		
Sub Code: MLL36	**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:

CO1**:**The student will be able to realize the oops concepts and develop programs incorporating these concepts

COs	Mapping with POs
CO1	PO3,PO4,PO5,PO8,PO9,PO10,PO11,PO12

Sub Title : ANALOG ELECTRONIC CIRCUITS LAB		
Sub Code: MLL37	**No of Credits:1.5=0:0:1.5(L-T-P)**	**No of lecture hours/week : 3**
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	Half wave, Full wave and Bridge Rectifier circuits.
2	Design of Diode clipping (Single/Double ended) circuits for peak clipping, peak detection.
3	Design of Clamping circuits: positive clamping /negative clamping.
4	Design of RC Coupled Amplifier
3	Design of BJT-RC Phase shift Oscillator
4	Design of BJT – Hartley & Colpitts Oscillators.
7	Testing of a transformer less Class – B push pull power amplifier and determination of its conversion efficiency.
9	Verification of Thevinin's Theorem and Maximum Power Transfer theorem for DC Circuits.
10	Characteristics of Series and Parallel resonant circuits.
11	Open Ended experiment

COURSE OUTCOMES: The students would have learnt
CO1:To design and test fundamental analog electronic circuits.
CO2: To assemble and test an application device of their interest.

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

Sub Title : LOGIC DESIGN LAB		
Sub Code: MLL38	**No of Credits:1.5=0:0:1.5(L-T-P)**	**No of lecture hours/week : 3**
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:
CO1:Testing and understanding of 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

IV SEMESTER

Sub Title : ENGINEERING MATHEMATICS – IV		
Sub Code: MA41	**No of Credits : 4=3:1:0(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:

1. To introduce Mathematical methods to test and solve highly complex engineering problems

UNIT No	Syllabus Content	No of Hours	
		Theory	Tutorial
1	**Functions of a complex variable:** Definitions of continuity, differentiability and analytic functions, Cauchy-Riemann equations in Cartesian and polar forms, properties of analytic functions: Harmonicity, orthogonality. Construction of analytic functions and its applications. Conformal Transformations, Bilinear Transformations, Discussion of transformations: $w = z^2$, $w=e^z$, $w = z+(a^2/z)$.	08	05
2	**Complex Integration:** Complex line integrals-Cauchy's theorem and Cauchy's integral formula. Taylor's and Laurent's series (no proof), Poles and Residues, Residue theorem(no proof), contour integration of Type-I and Type-II.	08	05
3	**Special functions**: Series solution of Bessel's differential equation leading to Bessel function of first kind, generating function. Recurrence relations of Bessel functions. Series solution of Legendre's differential equation leading to Legendre polynomials, Rodrigue's formula, generating function. Recurrence relations of Legendre functions.	08	05
4	**Curve fitting and Probability Distributions:** Method of least square, curve fitting- normal equations, Linear, exponential and quadratic forms. Recap of random variables. Probability distributions, Binomial and Poisson distributions with derivations of mean and standard deviations. Normal and Standard normal distribution (no derivations).	08	05
5	**Numerical Methods –III:** Evaluation of Integrals using Simpson's one-third, three-eighth and Weddle's rules (all rules without proof), Numerical solutions of PDE – finite difference approximation to derivatives, Numerical solution heat, wave and Laplace equations.	08	05

COURSE OUTCOMES: On completion of the course students would have learnt to

CO1:Determine complex functions like stream functions, potentials functions required in Engineering fields.
CO2:Evaluate highly complex integrals
CO3:Find series solutions of special differential equations.
CO4:Fit an optimal curve for discrete data using statistical and probabilistic methods.
CO5:Use numerical techniques to find quadrature and solution of Physical equations.

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

TEXTBOOKS:

1. **B.S. Grewal**, Higher Engineering Mathematics, Khanna Publishers, New Delhi

Sub Title : MICROCONTROLLERS		
Sub Code: ML41	**No of Credits:4= 4:0:0(L-T-P)**	**No of lecture hours/week : 4**
Exam Duration : 3 hours	**CIE+Assignment+SEE =45+5+50=100**	**Total no of contact hours:52**

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.	**8**
2	Addressing Modes: Introduction, Instruction syntax, Data types, Subroutines, Addressing modes: Immediate addressing , Register addressing, Direct addressing, Indirect addressing, relative addressing, Absolute addressing, Long addressing, Indexed addressing, Bit inherent addressing, bit direct addressing. 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.	**12**
3	8051 Interfacing and Applications: Basics of I/O concepts, Port structure and Operation, 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	**10**
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	**10**

5	8051 Serial Communication: Basics of Serial Data Communication, 8051 Serial Communication, connections to RS-232, 8051 Serial communication Programming in assembly language.	**12**

Note1: Unit 2 & Unit 5 will have internal choice
Note2: Assignment-1 from unit 1 and 2.
Asssignment-2 from unit 3, 4 and 5

COURSE OUTCOMES: On the completion of the course the students would have learnt

CO1: Different computer architectures, concepts of microprocessors & microcontrollers, addressing modes and instruction sets of 8051.
CO2:Programming using 8051
CO3: Develop application using timers, interrupts, memory and serial & parallel I/O ports of 8051
CO4: Interface microcontroller with external hardware for biomedical applications.

Cos	Mapping with Pos
CO1	PO2,PO3,PO5
CO2	PO3,PO5,PO11,PO12
CO3	PO3,PO5,PO11,PO12
CO4	PO4, PO5,PO11,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**

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 .	**11**
2	**ANGLE 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.	**6**
4	**PULSE MODULATION:** Sampling theorem for low pass and band pass signal, statement and proof, PAM, Natural Sampling, Flat-Top sampling, Quantization of Signals, Quantization error. **DIGITAL MODULATION:** PCM, Electrical representations of Binary digits, The PCM Systems, DPCM, Delta Modulation, ADM.	**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.	**6**

Note1: Unit 1 & Unit 4 will have internal choice

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

COURSE OUTCOMES: On completion of the course the student would have learnt to

CO1:Design and apply different modulation techniques for various application.
CO2:Analyze SNR in various circuits.
CO3:Analyze and apply the concepts of telemedicine.

COs	Mapping with POs
CO1	PO1,PO3,PO4,PO7
CO2	PO1,PO3,PO4,PO7,PO12
CO3	PO3,PO4,PO11,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.

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 MATLAB Exercises (Practice only)	**6**	**4**
2	**Time-domain representations for LTI systems –:** impulse response representation, Convolution integral, Convolution Sum, Differential and difference equation Representations, Block diagram representations. MATLAB Exercises (Practice only)	**9**	**6**
3	**Properties of impulse response**: Representation of LTI systems, **Computational Structures for implementing 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: Unit 4 & Unit 5 will have internal choice

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

COURSE OUTCOMES:

CO1:The students will develop an understanding of the signals and their representation in time domain and the operations and transformations in the time domain.
CO2:And the analysis of LTI systems and also analysing the signals and systems based on the fourier representation and Z transform.
CO3:They will also be able to study the systems represented by differential and difference equations and plot the magnitude and phase response of these systems

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

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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.

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

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	**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. Autonomic nervous system (in brief)- functions and effects.	**9**
3	**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 and factors affecting the pulse rate. Circulation of the blood- pulmonary circulation, systemic circulation, aorta, circulation of blood to head and neck, circulation of blood to upper limb, portal circulation. **DIGESTIVE SYSTEM:** Introduction, Organs of the digestive system- mouth: tongue, teeth, salivary glands, pharynx, 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	**13**
4	**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,	**10**

	associated structure, pleura and pleural cavity. Respiration- muscles of respiration cycle of respiration, variables affecting respiration, lung volumes and capacity.	
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), features of vertebral column, 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.	**13**

Note1: Unit 3 & Unit 5 will have internal choice
Note2: Assignment-1 from unit 1 and 2.
Asssignment-2 from unit 3, 4 and 5

COURSE OUTCOMES: On completion of the course the student would have learnt the

CO1: Essentials of structural and functional anatomy of the human body
CO2: Anatomy and physiology of various systems such as nervous system, cardiovascular system,
CO3: Anatomy and physiology of digestive system, respiratory system and skeletal system.

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.

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)	**10**
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 (**Demostration only**)	**10**
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.	**6**
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.	**6**

Note1: Unit 1 & Unit 2 will have internal choice
Note2: Assignment-1 from unit 1 and 2.

Asssignment-2 from unit 3, 4 and 5

COURSE OUTCOMES: On completion of the course the student would have learnt to

CO1:Design basic and complex circuits using the fundamental knowledge of OPAMP.
CO2:Build various applications using 555 timer IC
CO3:Analyze and perform analog to digital conversion and vice versa.

COs	**Mapping with POs**
CO1	PO1,PO2,PO3,PO4,PO5,PO7,PO12
CO2	PO1,PO2,PO3,PO4,PO5,PO7,PO12
CO3	PO1,PO2,PO3,PO4,PO5,PO7,PO12

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.

Sub Title : MICROCONTROLLER LAB		
Sub Code: MLL46	**No of Credits:1.5=0:0:1.5(L-T-P)**	**No of lecture hours/week : 3**
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
1	Write programs for all kinds of data manipulations.
2	Write programs for implementing ALU for given specifications.
3	Write programs to count different events.
4	Implementation of subroutines
5	Write programs to implement standard code convertors.
6	Programs to generate delay, Programs using serial port and on-Chip timer / counter.
	II. INTERFACING:
1	Alphanumeric LCD panel, LED and Hex keypad input interface
2	Generate different waveforms Sine, Square, Triangular, Ramp etc. using DAC interface
3	Stepper and DC motor control interface

COURSE OUTCOMES: On the completion of the course the students would have learnt to

CO1:Write program based on 8051 for any problem.
CO2: Interface the 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

Sub Title: LINEAR INTEGRATED CIRCUITS LAB		
Sub Code: MLL47	**No of Credits:1.5=0:0:1.5(L-T-P)**	**No of lecture hours/week :03**
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	Experiments on TI board
Open end experiment based on Telemedicine concepts.	

COURSE OUTCOME:

CO1:Design of electronic circuits using linear IC 741
CO2: The student will also learn to find hardware solution to problems using linear IC.

Cos	Mapping with Pos
CO1	PO1,PO2,PO3,PO4,PO5,PO7,PO9,PO10,P12
CO2	PO1,PO2,PO3,PO4,PO5,PO7,PO9,PO10,P12

V SEMESTER

Sub Title: MANAGEMENT AND ENTREPRENEURSHIP		
Sub Code: HS03	**No of Credits :4= 4: 0: 0(L-T-P)**	**No of lecture hours/week :4**
Exam Duration : 3 hours	**CIE+Assignment+SEE =45+5+50=100**	**Total no of contact hours:52**

COURSE OBJECTIVES:

1. To Help Students Understand The Concepts Of Management And Develop Managerial Skills
2. To Have A Clear Understanding Of The Activities Involved In Establishing A Business Venture

UNIT No	Syllabus Content	No of Hours
1	**MANAGEMENT:** Introduction-meaning-nature and characteristics of management, scope and functional area of management, management as a science or art of profession, management and administration, roles of management, levels of management, Development of management thought -Early management approaches, Modern management approaches.	10
2	**PLANNING, ORGANIZING, DIRECTING AND CONTROLLING:** **PLANNING:** Meaning and Nature, Types of Plans and Steps in Planning process. **ORGANIZING:** as Managerial function – Nature and purpose of organization, principles of organization, types of organization. Departmentation, committees, Centralization Vs Decentralization of authority and responsibility, span of control, MBO and MBE (Meaning only) Staffing: Nature and importance of staffing, process of selection and recruitment (in brief). Decision Making Process. **DIRECTING:** Meaning and nature of directing, leadership styles, motivation theories, Communication – meaning and importance **CO-ORDINATION:** Meaning and importance of Coordination, techniques of co-ordination. **CONTROLLING:** Meaning and steps in controlling-Essentials of a sound control system-Methods of establishing control (in brief), Control functions in Management, Types of Control – feed forward, concurrent and feedback controls, Factors in control effectiveness.	12
3	**ENTREPRENEUR**: Meaning, evolution of the concept, functions of an entrepreneur, types of entrepreneur, Intrapreneur – an emerging class. Concept of entrepreneurship, Evolution of entrepreneurship, development of	08

	entrepreneurship, Stages in entrepreneurial process, Role of entrepreneurs in economic development, entrepreneurship in India, entrepreneurship-its barriers.	
4	**SMALL SCALE INDUSTRY**: Definition; Characteristics; Need and rationale: Objectives, Scope and role of SSI in economic Development, Advantages of SSI, Steps to start an SSI, Government Policy towards SSI; Government support for SSI during Five years plans, Impact of Liberalization, Privatization Globalization on SSI, Effect of WTO/GATT. Ancillary Industry and Tiny Industry (definition only). **SUPPORTING AGENCIES OF GOVERNMENT FOR SSI:** Meaning Nature of support; Objectives, function, Types of Help. **INSTITUTIONAL SUPPORT:** Different Schemes, KIADB, KSSIDC, KSIMC DIC Single Window agency SISI NSIC SIDBI, KSFC.	12
5	**PREPARATION OF PROJECT:** Meaning, Project identification, Project selection, Project Report - Need and Significance of Project, Contents: formulation: Guidelines by Planning Commission for Project report, Network Analysis, Errors of project report, Project Appraisal, Identification of Business Opportunities. Feasibility Study-Market Feasibility Study, Technical Feasibility Study, Financial Feasibility Study, Social Feasibility Study.	10

Note1: Unit 2 & Unit 4 will have internal choice
Note2: Assignment-1 from unit 1 and 2.
Asssignment-2 from unit 3, 4 and 5

COURSE OUTCOMES:
CO1: Students would be able to analyze the importance of management concepts
CO2: Students will get an in depth knowledge in entrepreneurship and its importance in emerging India

COs	Mapping with POs
CO1	PO8,PO9,PO10,PO11,PO12
CO2	PO8,PO9,PO10,PO11,PO12

Text Books:

1) **Principles of Management** , PC Tripathi, and P N Reddy , Tata MacGraw Hill.
2) **Entrepreneurship and Management**, S Nagendra and V S Manjunath , Pearson Publication ,4th Edition, 2009.
3) **Management and Entrepreneurship** , NVR Naidu and T Krishna Rao, I K International Publishing House PVT LTD .

Reference Books:

1. **Dynamics of Entrepreneurial Development and Management**,Vasant Desai,Himalaya Publishing House.
2. **Entrepreneurship Development** , Poornima M Charanthimath ,Pearson Education ,2006.

Sub Title : CONTROL SYSTEMS		
Sub Code: ML51	**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:

1. To discuss the mathematical modeling of systems.
2. To discuss reduction of block diagram and signal flow graph.
3. Learn the time response of feedback control systems.
4. Learn the different methods of stability analysis (in time domain and frequency domain).

UNIT No	Syllabus Content	No of Lecture Hours	No of Tutorial Hours
1	**Modeling of Systems:** The control system, Mathematical models of physical systems – Introduction, Differential equations of physical systems – Mechanical systems, Friction, Translational systems (Mechanical accelerometer, Levered systems excluded), Rotational systems, Electrical systems, Analogous systems.	**6**	**4**
2	**Block diagrams and signal flow graphs:** Transfer functions, Block diagram algebra, Signal Flow graphs (State variable formulation excluded).	**6**	**4**
3	**Time Response of feedback control systems**: Standard test signals, Unit step response of First and second order systems, Time response specifications, Time response specifications of second order systems, steady – state errors and error constants. **MATLAB Exercise (Practice only) :** **Time domain Analysis of first order and second order system**	**8**	**4**
4	**Stability analysis:** Concepts of stability, Necessary conditions for Stability, Routh- stability criterion, Relative stability analysis; More on the Routh stability criterion. **Root–Locus Techniques**: Introduction, The root locus concepts, Construction of root loci.	**9**	**6**

5	**Stability in the frequency domain:** Mathematical preliminaries, Nyquist Stability criterion, (Inverse polar plots excluded), Assessment of relative stability using Nyquist criterion, (Systems with transportation lag excluded). **Frequency domain analysis:** Introduction, Correlation between time and frequency response, Bode plots, All pass and minimum phase systems. **MATLAB Exercise (Practice only) :** **Verifying the parameters computed for numerical examples using MATLAB for Root locus, Bode Plot and Nyquist Plot**	**10**	**8**

Note1: Unit 4 & Unit 5 will have internal choice
Note2: Assignment-1 from unit 1 and 2.
Asssignment-2 from unit 3, 4 and 5

COURSE OUTCOMES: The students would have learnt to

CO1: Apply the concepts of mathematical modeling to mechanical,electrical system.
CO2: Design and develop system transfer function through standard reduction techniques.
CO3: Analyse time domain response of first order and second order control system.
CO4: Understand and apply the different methods of stability analysis (in time domain and frequency domain) and verify the developed system using simulation tool such as Matlab.

COs	Mapping with POs
CO1	PO1,PO3,PO12
CO2	PO3
CO3	PO1
CO4	PO3,PO5

TEXT BOOK :

1**. Control Systems Engineering**, J. Nagarath and M.Gopal, New Age International (P) Limited, Fourth edition ,2005.

REFERENCE BOOKS:

1. **Modern Control Engineering ,** K. Ogata, Pearson Education Asia/ PHI, 4th Edition, 2002.
2. **Concepts of Control Systems,** P. S. Satyanarayana; Dynaram publishers, 2001.
3. **Control Systems Principles and Design,** M. Gopal, TMH, 1999.
4. **Feedback control system analysis and synthesis,** J. J. D'Azzo and C. H. Houpis, McGraw Hill, International student Edition.

Sub Title: BIOMEDICAL INSTRUMENTATION		
Sub Code: ML52	**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: 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,	**8**
2	**BIO AMPLIFIER**: Need for bio amplifier- single ended bio amplifier-right leg driven ECG amplifier, Band Pass filtering, isolation amplifiers-transformer and optical isolation- isolated DC amplifier and AC carrier amplifier. Chopper amplifier. Power line interference	**7**
3	**BIOMEDICAL RECORDERS:** Electrocardiograph-block diagram description, ECG leads, Artefacts, Vectorcardiograph, Phonocardiograph, Electroencephalograph, Electromyograph, measurement of heart rate, measurement of pulse rate, blood pressure measurement, measurement of temperature, measurement of respiratory rate.	**10**
4	**OXIMETERS:** Oximetry, ear oximeter, pulse oximeter, skin reflectance oximeter and intravascular oximeter. Cardiac Output Measurement-indicator dilution, dye dilution. Blood Flow Meters Electromagnetic blood flow meters, Ultrasonic blood flow meters, NMR blood flow meters.	**8**
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:** Electric shock hazards, Leakage currents, macro shock, micro shock hazards and preventions, safety codes and analyzer. safety & precautions	**6**

Note1: Unit 3 & Unit 4 will have internal choice
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 would have learnt to

CO1:Select suitable transducers for bio-signal application
CO2:Electrical interpretation of various biological signals & in-depth analysis
CO3:Design and develop systems for acquiring and measuring various physiological parameters.
CO4:Adherence to universal safety standards
CO5:Explore the latest trends & happenings in the subject

COs	Mapping with POs
CO1	PO1,PO2,PO3,PO12
CO2	PO1,PO3
CO3	PO1,PO3
CO4	PO7,PO8
CO5	PO10,PO12

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 .

Sub Title : PHYSIOLOGICAL CONTROL SYSTEMS		
Sub Code: ML53	**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 study various concepts of Engineering control system.
2. To distinguish physiological and engineering control system.
3. To learn mathematical modeling of the physiological system.
4. To learn the time domain and frequency domain analysis applied to physiological system.
5. To identify and optimization of physiological control system.

UNIT No	Syllabus Content	No of Hours
1	**INTRODUCTION TO PHYSIOLOGICAL CONTROL SYSTEMS** Preliminary considerations, Historical Background, System analysis, Physiological systems-A simple example, Differences between engineering & physiological control systems, The science of modeling.	6
2	**MATHEMATICAL MODELING** Generalized system properties, Models with combination of system elements, Linear models of Physiological systems, Distributed Vs Lumped parameter models, Linear systems & superposition principle, Laplace transforms & transfer functions, Impulse response & linear convolution, state space analysis.	8
3	**STATIC ANALYSIS OF PHYSIOLOGICAL SYSTEMS** introduction, open loop Vs closed loop, determination of steady state operating point, regulation of cardiac output, regulation of glucose, chemical regulation of ventilation. **TIME DOMAIN ANALYSIS OF LINEAR CONTROL SYSTEMS** Linearized respiratory mechanics, open & closed loop transient responses for 1^{st} & 2^{nd} order models, Impulse & step response descriptors, transient response analysis. Simulink experiments on modeling physiological systems	10

4	**FREQUENCY DOMAIN ANALYSIS OF LINEAR CONTROL SYSTEMS** Steady state responses to sinusoidal inputs, Graphical representation of frequency response, frequency response model of a circulatory control, frequency response of glucose-insulin regulation. **STABILITY ANALYSIS – LINEAR APPROACHES** stability & transient responses, root locus plots, routh-hurwitz stability criterion, stability analysis of pupillary light reflexes. Simulink experiments on Physiological Systems	9
5	**IDENTIFICATION OF PHYSIOLOGICAL CONTROL SYSTEMS** basic problems in physiological system analysis, non-parametric & parametric identification methods, Problems in parameter estimation, Identification of closed loop systems, identification under closed-loop conditions.	6

Note1: Unit 3 & Unit 4 will have internal choice
Note2: Assignment-1. from unit 1, and 2 and 3
Asssignment-2 from unit 3, 4 and 5 and report on simulation experiments

COURSE OUTCOMES: Students would have learnt

CO1: Mathematically model the physiological systems & relate it to the engineering control system
CO2: Analyze parameters in both time and frequency domain
CO3: Analysing & optimizing different PCS
CO4: Explore the latest trends & happenings in the subject.
CO5: Modelling and analysis of physiological systems using Simulink software

Cos	Mapping with Pos
CO1	PO1,PO2,PO6
CO2	PO3,PO4
CO3	PO3
CO4	PO10,PO12
CO5	PO5, PO12

TEXT BOOK

1. **Physiological Control Systems – Analysis, Simulation & Estimation**, Michael C Khoo, Wiley IEEE press.

Sub Title: **DIGITAL SIGNAL PROCESSING**		
Sub Code: ML54	**No of Credits : 4= 4: 0: 0(L-T-P)**	**No of lecture hours/week :4**
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 Discrete Fourier Transform
2. The Fast Fourier Transform
3. FIR and IIR Filters
4. Design of Digital filters
5. The concepts of DSP Processors

Unit No	Syllabus Content	No of Hours
1	**DISCRETE FOURIER TRANSFORM: INTRODUCTION**, definition of DFT, properties of DFT, circular convolution, linear convolution using DFT.	**10**
2	**FAST FOURIER TRANSFORM: INTRODUCTION**, decimation in time FFT algorithm, computational efficiency, decimation in frequency algorithm.	**10**
3	**FIR FILTER DESIGN:** Introduction, different types of windows- rectangular, Bartlett, Hanning, Hamming, Black Mann, and Kaiser windows, design of FIR filters using above windows, frequency sampling design, comparison of IIR & FIR digital filters. **ANALOG FILTER DESIGN:** Introduction, Butterworth filters, Chebyshev filters, general filter forms	**12**
4	**DESIGN OF IIR DIGITAL FILTER:** Introduction of filters, design of IIR digital filter through analog filters, impulse invariant transformations, bilinear transformations, design of digital Butter worth & Chebyshev filters, frequency transformation. comparison of IIR & FIR digital filters. **REALISATION OF DIGITAL SYSTEMS:** Introduction, Block diagram and signal flow graph,basic IIR filter structures (Direct forms I & II), cascade and parallel realisations, basic FIR filter structures (Direct forms I & II), and linear phase FIR structures	**12**
5	**Wavelet Transform**: Introduction to wavelet transforms and its biomedical application **DSP Processor:** Introduction to General purpose DSP Processor TMS 320C6713: architecture , addressing modes.	**8**

Note1: Unit 4 & Unit 5 will have internal choice

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

COURSE OUTCOMES: The student would have learnt to

CO1:Analyze the LTI systems based on DFT,FFT & develop computational skills.
CO2:Design IIR & FIR filters
CO3:Essentials of DSP architecture to develop biomedical application
CO4: Explore the latest DSP Processor

COs	Mapping with POs
CO1	PO1,PO2,PO3,PO5
CO2	PO1,PO2,PO3,PO4
CO3	PO7
CO4	PO10,PO12

TEXT BOOKS:

1. **Digital Signal Processing,** Proakis and Manolakis, Prentice Hall of India , 3rd Edition.
2. **Time frequency and wavelet applications in biomedical signal processing,** Metin Akay, IEEE Wiley Press.

REFERENCE BOOKS:

1. Digital Signal Processing, S K Mitra, Mc Graw-Hill, 4th Edition.
2. Theory and Application of DSP, Rabinar L R and Gold B, Prentice Hall of India, 1999.
3. Introduction to digital signal processing, Johnson, Prentice Hall of India ,1999.
4. Digital Signal Processing,Alan V Oppenheim, Prentice Hall of India.
5. DSP using Matlab, Prokis & Ingle , Cengage Learning, 1st edition.
6. TMS Processors Manual

ELECTIVE I (GROUP A)

Sub Title: EMBEDDED C		
Sub Code: ML551	**No of Credits : 4= 4:0: 0(L-T-P)**	**No of lecture hours/week :4**
Exam Duration : 3 hours	**CIE + Assignment + SEE =45+5+50=100**	**Total no of contact hours:52**

COURSE OBJECTIVES :To make the student learn

1.The concepts of embedded programming in the context of 8051
2 .Design constraints of 8051 for embedded applications
3. Embedded C
4. TI Processor- MSP 430

Unit No	Syllabus Content	No of Hours
1	**Programming Embedded Systems in C** Introduction ,What is an embedded system, Which processor should you use, Which programming language should you use, Which operating system should you use, How do you develop embedded software, Conclusions **Introducing the 8051 Microcontroller Family** Introduction The external interface of the Standard 8051, Reset requirements, Clock frequency and performance, Memory issues, I/O pins, Timers, Interrupts, Serial interface, Power consumption ,Conclusions	**12**
2	**Reading Switches** Introduction, Basic techniques for reading from port pins, Example: Reading and writing bytes, Example: Reading and writing bits (simple version), Example: Reading and writing bits (generic version), The need for pull-up resistors, Dealing with switch bounce, Example: Reading switch inputs (basic code), Example: Counting goats, Conclusions	**10**
3	**Adding Structure to the Code** Introduction, Object-oriented programming with C, The Project Header (MAIN.H), The Port Header (PORT.H), Example: Restructuring the 'Hello Embedded World' example, Example: Restructuring the goat-counting example, Further examples, Conclusions	**8**

4	**Meeting Real-Time Constraints** Introduction, Creating 'hardware delays' using Timer 0 and Timer 1, Example: Generating a precise 50 ms delay, Example: Creating a portable hardware delay, The need for 'timeout' mechanisms, Creating loop timeouts, Example: Testing loop timeouts, Example: A more reliable switch interface, Creating hardware timeouts, Example: Testing a hardware timeout,	**12**
5	**Case Study:** Intruder Alarm System: State diagram representation, program **MSP430G2553:** Block diagram, **MSP EXP 430 G2 Launch Pad –** components. **Examples**- LED control using a switch, serial communication	**10**

Note1: Unit 2 & Unit 4 will have internal choice
Note2: Assignment-1 from unit 1 and 2.
Asssignment-2 from unit 3, 4 and 5

COURSE OUTCOMES: The student would have learnt

CO1: Design and development of embedded system using microcontroller 8051
CO2: Apply the programming skills of embedded C for any microcontroller and hence design any embedded application.
CO3: Using the hardware resources in the given microcontroller family to develop the software applications
CO4: TI -MSP430 processor and coding using the launch pad

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

TEXT BOOKS:
1. Embedded C - Michael J. Pont, 2nd Ed., Pearson Education, 2008
2. TI- MSP430 Launch Pad Manual
REFERENCE BOOKS:
1. PICmicro MCU C-An introduction to programming, The Microchip PIC in CCS C - Nigel Gardner

Sub Title: CLINICAL ENGINEERING		
Sub Code: ML552	**No of Credits : 4= 4: 0: 0(L-T-P)**	**No of lecture hours/week :4**
Exam Duration : 3 hours	**CIE+Assignment+SEE =45+5+50=100**	**Total no of contact hours:52**

COURSE OBJECTIVES :To make the student

1. To understand the role of clinical engineer and importance of clinical engineering.
2. To learn the hospital managerial skills in all aspects.
3. The routine maintenance safety and other issues of medical devices.

Unit No	Syllabus Content	No of Hours
1	Definition, role of clinical engineering within the hospital organization, major functions of a clinical engineering department, flowchart and model of a clinical engineering department, computerized maintenance and management system, clinical information systems, picture archiving and communication systems (PACS).	**10**
2	Duties and responsibilities, clinical engineer as consultant, clinical engineer as investigator and expert witness. patient safety and clinical engineers, accident investigation, electromagnetic interference, WMTS interference issues.	**11**
3	Technology evaluation, strategic technology planning, technology and alternatives, risks, hazards, and clinical efficacy, conceptual needs analysis, testing laboratory and engineering evaluation, technical specifications and other requirements.	**10**
4	Management engineering in health care, cost effectiveness and productivity, personnel management, medical technology assessment process, in-house clinical and technical evaluations, planning strategies, quality.	**10**
5	Medical technology management practices, health care strategic planning utilizing technology assessment, vendor and service management, medical device research and design, maintenance and repair of medical devices, medical device troubleshooting, safety standards and regulations.	**11**

Note1: Unit 2 & Unit 5 will have internal choice
Note2: Assignment-1 from unit 1 and 2.
Asssignment-2 from unit 3, 4 and 5

COURSE OUTCOMES: The student would have learnt

CO1: The role of clinical engineer in health care management.
CO2:The importance of clinical engineer in maintaining safety standards in a clinical environment
CO3:Maintenance and repair of medical devices and also medical device research and design

COs	**Mapping with POs**
CO1	PO2,PO6,PO9,PO10,PO11
CO2	PO6,PO7,PO8,PO9,PO10,PO11
CO3	PO2,PO3,PO4,PO6,PO7,PO8,PO9,PO10,PO11,PO12

Text Book:

1. Joseph Dyro B.S. Clinical Engineering Handbook, Elsevier Academic Press, 2004.

Reference Books:

1. Yadin David, Clinical Engineering, Principles and Applications in Engineering Series, CRC Press, 2003.
2. Michael Nowicki, The Financial Management of Hospitals and Healthcare Organizations, Blackwell
Publishing Ltd, 2004.

Sub Title: MEDICAL ELECTRONICS LAB		
Sub Code: MLL56	**No of Credits :1.5= 0: 0: 1.5(L-T-P)**	**No of lecture hours/week :03**
Exam Duration : 3 hours		**Exam Marks : 50**

COURSE OBJECTIVES: The student will understand

1. The transducer principle, type,measurement of physiological parameter
2. The bio signal measurement
3. Analytical instruments such as colorimeter, pH meter
4. Medical Instrumentation such as X- ray, Ultrasound, Recorders

UNIT No	Syllabus Content
1	Plotting the characteristics & Determination of parameters of: Resistive strain gage (b) Photoelectric transducer (c) Temperature transducers: RTD / thermocouple / thermistor.
2	Determination of characteristics of: (a) Polarized electrode; (b) Non-polarized electrode (c) Multipoint electrode.
3	Design & Testing of: (a) DC amplifier (b) Isolation amplifier.
4	Design & Testing of: (a) Instrumentation amplifier; (b) Transducer bridge with amplifier.
5	Recording of ECG: (a) Determination of time & amplitude of QRS complex, (b) Calculation of Heart Rate, (c) Determination of Cardiac Vector.
6	Recording of EEG .
7	Measurement of Hearing threshold using Audiometer and plot its characteristics.
8	Measurement of pH of a given solution using pH meter.
9	Determination of solution concentration using Colorimeter/Spectrophotometer.
10	Measurement of Blood Pressure using Sphygmomanometer & Digital meter.
11	Study of (a) Ultrasound transducers & Ultrasonic blood flow meters, (b) X-ray
12	Hospital Training –Diagnostics and therapeutic instruments. Global standards and safety measures.Training duration -10 working days and a training report has to be submitted.

COURSE OUTCOMES: Awareness about biomedical engineer professional ethics.
CO1: Study of medical electronics laboratory provides the knowledge of measurements of physiological parameters. Hospital training provides thorough knowledge of the practical application of the medical instruments and working.

COs	Mapping with POs
CO1	PO6,PO7,PO8,PO9,PO10,PO11,PO12

Sub Title: DIGITAL SIGNAL PROCESSING LAB		
Sub Code: MLL57	**No of Credits:1.5= 0:0:1.5(L-T-P)**	**No of lecture hours/week :03**
Exam Duration : 3	**Exam Marks : 50**	

COURSE OBJECTIVES: To make the students

1. Verify sampling theorem, linear & circular convolution, and correlation
2. To implement and verify FFT algorithm.
3. Realization of FIR and IIR filter.
4. Familiarize with programming of DSP Processor

UNIT No	Syllabus Content
1	Representation and display of basic sequences.
2	Verify the Sampling theorem.
3	Determine linear convolution, Circular convolution and Correlation of two given sequences. Verify the result using theoretical computations.
4	Computation and verification of FFT of a sequence.
5	Determine the linear convolution and correlation of two given point sequences , using FFT algorithm..
6	Display of original sequence along with operation on sequence like shifting, folding, time scaling and multiplication.
7	Compute DTFS , DTFT of a sequence.
8	Realization and design of FIR filter for a given specification and verification for (a) LP
9	Design and test FIR filter using Windowing method (Hamming window and Kaiser window) for the given order and cut-off frequency.
10	Realization of design of IIR filter for a given specification and verification.
11	Convolution, FIR filters using DSP Processor TMS32C6713.

COURSE OUTCOMES: The students would have learnt

CO1:To write programs for all DSP operations both in MATLAB and also DSP processor TMS32C6713

CO2:Open ended project will ensure that the student is capable of developing any DSP application

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

VI SEMESTER

Sub Title: MEDICAL PHYSICS		
Sub Code: ML61	**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: This course analyzes the human body from the basic principles of physics. Principles derived in physics are applied directly to the human body.

1. To describe effects of heat and cold in medicine, and energy metabolism in human body.
2. To describe effects of physics of lung and breathing mechanism.
3. To discuss the pumping action of the heart and how the blood pressure changes occur.
4. To discuss the electrical conduction system of the nerves in the brain, the heart and the eyes, application of low and high frequency electricity in medicine, magnetism in medicine
5. To discuss how the ultrasound is helpful in Medicine, physics of ear and hearing to know about how light is helpful in Medicine.

UNIT No	Syllabus Content	No of Hours
1	**Heat and cold in medicine:** Introduction, physics basis of heat and temperature, thermography and temperature scales, mapping of body's temperature, heat therapy, use of cold in medicine, cryosurgery and safety aspects. **Energy, work, power and pressure:** Conservation of energy in the body, energy changes in the body, work and power, heat losses from the body, measurement of the pressure in the body, pressure inside skull ,eye ,digestive system, skeleton & urinary bladder, hyperbaric oxygen therapy.	**12**
2	**Physics of lung and breathing:** Introduction, the air ways, blood & lung interaction, measurement of lung volumes, pressure air flow volume relationship of the lungs .Physics of alveoli, breathing mechanism, air-way resistance, work of breathing, physics of some common lung diseases.	**8**
3	**Physics of cardiovascular system:** Introduction to cardiovascular system, major components of cardiovascular system, oxygen and carbon-di-oxide exchange in the capillary system, work done by the heart, blood pressure and its measurements, transmural pressure, Bernoulli's principle applied to cardiovascular system, blood flow laminar & turbulent ,heart sounds, physics of some cardiovascular diseases.	**8**

4	**Electricity within the body:** The nervous system & neurons ,electrical potential of nerves, electromyogram, electrocardiogram, electroencephalogram,electroretionogram,electrooculogram,magneto cardiogram & magnet encephalogram, electric shock ,high frequency and low frequency electricity in medicine, magnetism in medicine.	**12**
5	**Sounds in medicine**: General properties of sound, body of drum, the stethoscope, ultrasound picture of the body, ultrasound to measure motion, physiological effects of ultrasound in therapy, the production of sound. **Physics of ear and hearing:** The outer ear, middle ear and the inner ear, sensitivity of ears, testing hearing, deafness & hearing aids. **Light in medicine:** Measurement of light and its units, application of visible light in medicine, application of UV and IR in medicine**.**	**12**

Note1: Unit 4 & Unit 5 will have internal choice
Note2: Assignment-1 from unit 1 and 2.
Asssignment-2 from unit 3,4 and 5

COURSE OUTCOMES: At the end of the course the students would have learnt

CO1:Application of heat and cold for diagnostic & therapeutic purpose.
CO2:All the vital mechanisms of human body by relating to the fundamental concepts of physics.
CO3: Application of sound and light for diagnostic & therapeutic purpose.
CO4: Suggest/device a suitable system depending upon the body condition.

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

TEXT BOOK:

1. **Medical Physics**, John R. Cameron and James G. Skofronick, John Wiley & Sons 1978.

REFERENCE BOOK:

1. **Physics of the Human Body,** Herman I.P., Springer.

Sub Title: MEDICAL IMAGING SYSTEMS		
Sub Code: ML62	**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:

1. To understand fundamentals of x-ray and its generation and biological effects.
2. To study different x-ray diagnostic methods.
3. To study CT imaging concepts, fundamental of Magnetic resonance imaging..
4. To study fundamentals of ultrasound and working different ultrasound techniques.
5. To study the principles of Radionuclide imaging.

UNIT No	Syllabus Content	No of Hours
1	**X-RAY IMAGING:** Fundamentals of X-ray – Electromagnetic radiation, Interactions between X-rays and matter, Intensity of X-ray beam, Attenuation, Generation and Detection of X-rays – X-ray generation, X-ray generators, Filters, Beam restrictors and grids, Intensifying screens, fluorescent screens, and image intensifiers, X-ray detectors, X-ray image characteristics – Spatial resolution, Image noise, Image contrast, Receiver operating curve (ROC), Biological effects of ionizing radiation.	**8**
2	**X-RAY DIAGNOSTIC METHODS:** Conventional X-ray radiography, Fluoroscopy, Angiography, Mammography and Xeroradiography, Image subtraction. **COMPUTED TOMOGRAPHY:** Conventional tomography, Computed tomography – Radon Transform (Projections) and Fourier Slice theorem, Algorithms for image reconstruction: parallel and Fan beam data, Spiral CT. Recent developments – Digital radiography.	**10**
3	**ULTRASOUND IMAGING:** Fundamentals of acoustic propagation - Stress strain relationship, Characteristic impedance, Intensity, Reflection and refraction, Attenuation, absorption & scattering, Doppler effect, Generation and detection of Ultrasound-Piezoelectric effect, Ultrasonic transducers, **ULTRASONIC DIAGNOSTIC METHODS :**Pulse echo systems-Amplitude mode (A-mode), Brightness mode (B-mode), Motion mode (M-mode), Constant depth mode (C-mode), Doppler methods, Duplex imaging, Tissue characterization, Colour Doppler flow imaging, Image characteristics – Ultrasonic texture or speckle, Speckle reduction, Compensation of phase aberration, Biological effects of ultrasound.	**13**

4	**RADIONUCLIDE IMAGING:**Introduction, Fundamentals of Radioactivity – Nuclear particles, Nuclear activity and half-life, Units of measuring nuclear activity, Specific activity, Interaction of nuclear particles and matter, Attenuation of Gamma radiation, Radionuclides, Generation & Detection of Nuclear Emission – Radionuclide generators, nuclear radiation detectors, Collimators, Radionuclide imaging systems- Gamma Camera, SPECT, PET. **BASICS OF MAGNETIC RESONANCE IMAGING:** fundamentals of nuclear magnetic resonance- Angular momentum, magnetic dipole moment, magnetization, Larmor frequency, Rotating frame of reference and RF magnetic field, Free induction decay (FID), Fourier spectrum of the NMR signal, Spin density, Relaxation times, Pulse sequences.	**13**
5	**MRI SYSTEM & IMAGING METHODS:**magnetic field gradients, NMR Coil/Probe, Transmitter, Receiver, Data acquisition. Imaging Methods- Introduction, slice selection, frequency encoding, phase encoding, Spin-Echo imaging- Gradient echo imaging, Characteristics of MRI images- spatial resolution, image contrast. Biological effects of magnetic fields- Static magnetic fields, Radio-frequency fields, Gradient magnetic fields, Imaging safety, Functional MRI.DICOM Standards **Mandatory** assignments/seminars on latest developments in each of the modalities.	**8**

Note1: Unit 3 & Unit 4 will have internal choice

Note2: Assignment-1 from unit 1 and 2.

Asssignment-2 from unit 3,4 and 5

COURSE OUTCOMES: On the completion of the course the students would have learnt

CO1: Different imaging modalities such as x-ray, CT, Ultrasound & MRI

CO2: Advanced imaging techniques

CO3: Reconstruction of images from above imaging modalities using different transforms.

CO4: The medical image communication standard.

CO5: Explore the latest trends & happenings in the subject

COs	Mapping with POs
CO1	PO1,PO6,PO12
CO2	PO1,PO6,PO12
CO3	PO5,PO12
CO4	PO6,PO8,PO12
CO5	PO10,PO11, PO12

.

TEXT BOOKS:

1. **Principles of Medical Imaging**, Kirk Shung, Michael B. Smith and Banjamin Tsui, Academic Press, 1992.
2. **Handbook of Biomedical Instrumentation**, R.S.Khandpur, Tata McGraw Hill, 2nd Edition, 2003.
3. **Fundamentals of Medical Imaging**, Paul Suetens, Cambridge University Press, 2002.

Sub Title: BIOMEDICAL EQUIPMENTS		
Sub Code: ML63	**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:

1. To study spectrophotometer, clinical flame photometer.
2. To study different blood gas analyzers
3. To study different types of Audiometers
4. To understand the working principle of surgical diathermy.
5. To study haemodialysis and different ventilators

Note1: Unit 4 & Unit 5 will have internal choice

UNIT No	Syllabus Content	No of Hours
1	**CLINICAL LABORATORY INSTRUMENTS:** Medical diagnosis with clinical tests, spectrophotometry-components, clinical flame photometer, ion-selective electrode based analyzers.	**8**
2	**BLOOD GAS ANALYZERS:** Acid-base balance, blood pH measurement, measurement of blood pCO2, measurement of blood pO2, intra-arterial blood gas monitoring, complete blood gas analyzer. **BLOOD CELL COUNTERS**: Types of blood cells, Coulter counter, automatic recognition and differential counting of cells.	**10**
3	**AUDIOMETER AND HEARING AIDS:** Mechanism of hearing, measurement of sound, basic audiometer, pure-tone audiometer, speech audiometer, audiometer system Bekesy, evoked response audiometer system, hearing aids-digital hearing aid, cochlear implants.	**10**
4	**INSTRUMENTS OF SURGERY:** Principles of surgical diathermy, surgical diathermy machine, automated electro-surgical systems, electrodes used with surgical diathermy, safety aspects in electro- surgical units, surgical diathermy analyzer. **PHYSIOTHERAPY AND ELECTROTHERAPY EQUIPMENTS:** High frequency ,heat therapy, short wave diathermy, microwave diathermy, ultrasound therapy unit, electro diagnostic therapeutic apparatus, pain relief through electrical stimulation ,bladder and cerebral stimulators.	**12**
5	**HAEMODIALYSIS MACHINE:** Function of kidney, artificial kidney, dialyzer, membranes for hemodialysis, portable kidney machine. **VENTILATORS:** Mechanics of respiration, artificial ventilation, ventilators, types of ventilators, ventilator terms, classification of ventilators, pressure volume flow diagrams, modern ventilators, high frequency ventilators, humidifiers, nebulizers and aspirators	**12**

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

COURSE OUTCOMES: On the completion of the course the students would have learnt

CO1: Biomedical equipments such as clinical test equipments, blood gas analyzers, blood cell counters and surgical equipments.
CO2: To record and interpret the auditory response of the human. Suggest suitable hearing aid.
CO3: The principles of designing & developing artificial organs such as kidney & lungs.
CO4: Explore the latest trends & happenings in the subject

COs	Mapping with POs
CO1	PO1,PO2,PO3,PO4,PO7
CO2	PO7
CO3	PO3,PO7,PO8,PO11,PO12
CO4	PO10,PO11, PO12

TEXT BOOK:

1. **Handbook of Biomedical Instrumentation** – by R.S.Khandpur, 2nd Edition, Tata McGraw Hill, 2003

REFERENCE BOOK:

1. **Biomedical Instrumentation and Measurement** – by Leslie Cromwell, Fred J Weibell and Erich A. Pfeiffer, Prentice-Hall India Pvt. Ltd.

Sub Title: LASERS AND FIBER OPTICS IN MEDICINE		
Sub Code: ML64	**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:

1. To study the production of lasers, its properties and types.
2. To study the effects of laser-tissue interaction.
3. To know the need for optic fibers and its applications in Medicine.
4. To gain knowledge regarding fiber fabrication and fiber bundles.
5. To study the basic principle of endoscopy, its uses in diagnosis and therapeutic field.

UNIT No	Syllabus Content	No of Hours
1	**INTRODUCTION:** Historical background. Medical Lasers: Introduction, Laser physics-fundamentals, principles, advances, Medical Lasers-fundamentals, principles(co2, Nd-YAG, eximer, dye - lasers), advances(semiconductor laser, free electron laser, Miscellaneous laser techniques). Medical Laser Systems-fundamentals, principles. Laser safety-fundamentals.	**07**
2	**APPLICATIONS OF LASERS IN THERAPY & DIAGNOSIS:** Introduction, laser assisted diagnosis and therapy-fundamentals, interaction of laser beams and materials-principles (except 3.3.4). Laser interaction with tissue-principles; laser assisted diagnostics-principles, applications of lasers in diagnosis and imaging-advances, laser surgery and therapy-principles-photo thermal & photomechanical mechanisms, thermal interaction between laser and tissue-advances.	**08**
3	**SINGLE OPTICAL FIBERS :** Introduction, historical background ,Introduction to OFC**,** block diagram of OFC, analog link and digital link, optical fibers-fundamentals, light transmission in optical fibers-principles, optical properties of optical fibers-advances, fabrication of optical fibers-principles, optical fibers for UV, visible, IR light-principles, power transmission through optical fibers-principles, modified fiber ends and tips-principles, fiber lasers-advances.	**08**
4	**OPTICAL FIBER BUNDLES:** Introduction, non-ordered fiber optic bundles for light guides-fundamentals & principles, ordered fiber optic bundles for imaging devices-fundamentals & principles, fiber scopes and endoscopes-fundamentals, fiber optic imaging systems-advances.	**07**
5	**CLINICAL APPLICATIONS OF FIBER OPTIC LASER SYSTEMS:** Endoscopy: Introduction, endoscopic imaging systems-fundamentals, principles, advances, endoscopic diagnostics-advances, endoscopic therapy-fundamentals, endoscopic ultrasound imaging-principles. Introduction, fiber optic laser systems in cardiovascular disease (except 9.2.6), flow diagram for laser angioplasty & photodynamic therapy.	**09**

Note1: Unit 3 & Unit 5 will have internal choice
Note2: Assignment-1 from unit 1 and 2.
Asssignment-2 from unit 3,4 and 5

COURSE OUTCOMES: On the completion of the course the students would have learnt

CO1:Different lasers and its applications in diagnosis & therapy.
CO2:Optical fibers fundamentals & principles
CO3:Various applications of fiber optic laser in imaging systems.
CO4: Explore the latest trends & happenings in the subject

COs	Mapping with POs
CO1	PO1,PO2,PO4
CO2	PO1,PO2
CO3	PO3,PO7
CO4	PO10,PO11, PO12

TEXT BOOK:

1. **Lasers and Optical Fibers in Medicine** , Abraham Katzir, Academic Press, 1998.

REFERENCE BOOKS:

1. **Therapeutic Lasers – Theory and practice** , G.David Baxter, Churchill Livingstone Publications.
2. **Medical Lasers and their safe use,**David H Shiney, Stephen and L.Trokel, Springer, Springer Verlag publications.
3. **Elements of fiber optics**, S.L.Wymer, Regents PHI.
4. **Biomedical Electronics and Instrumentation**, S.K.Venkata Ram Galgotia publications.

ELECTIVE II (Group B)

Sub Title : BIOMECHANICS		
Sub Code: ML651	**No of Credits :4= 4: 0: 0(L-T-P)**	**No of lecture hours/week : 4**
Exam Duration : 3 hours	**CIE+Assignment+SEE =45+5+50=100**	**Total no of contact hours:52**

COURSE OBJECTIVES: Understand the mechanical aspects of human motion:

1. Quantitative and qualitative analysis of human motion and performance.
2. Use physical laws of motion to solve problems of human motion.
3. Understand the relationship between mechanical properties and anatomical functions.
4. Understand how biomechanical principles can be applied to examine human activities such as sport and orthopaedic rehabilitation.

UNIT No	Syllabus Content	No of Hours
1	**BIO-FLUID MECHANICS:** Newton's laws, stress, strain, elasticity, Hook's-law, viscosity, Newtonian Fluid, Non-Newtonian fluid, viscoelastic fluids. Vascular tree. Relationship between diameters, velocity and pressure of blood flow, Resistance against flow **FLOW PROPERTIES OF BLOOD:** physical, Chemical and Rheological properties of blood Apparent and relative viscosity. Blood viscosity variation: Effect of shear rate, hematocrit, temperature and protein contents of blood. Casson's Equation. Problems associated with extra corporeal blood flow	13
2	**BIOVISCOELASTIC FLUID:** Viscoelasticity, Viscoelastic Models: Maxwell, Voigt and Kelvin Models Response to harmonic variation. Use of viscoelastic models. Bio-Viscoelasticfluids : Protoplasm. mucus, saliva, semen, synovial fluids. Rheology of blood in microvessels: Fahreus·Lindqulst effect and inverse effect, hematocrit in very narrow tube.	7
3	**CARDIAC MECHANICS:** Cardiovascular system. Mechanical properties of Blood vessels: arteries, arterioles, capillaries, veins, Blood flow: laminar and turbulent. Physics of cardiovascular diseases. Prosthetic heart valves and replacements. **RESPIRATORY MECHANICS:** Alveoli mechanics, Interaction of blood and lung P-V curve of lung. Breathing mechanism. Airway resistance. Physics of lung diseases.	13
4	**SOFT TISSUE MECHANICS:** Pseudoelasticity, non-linear stress-strain relationship, visco elasticity. Structure, function and mechanical properties of skin, ligaments and tendons. **ORTHOPEDIC MECHANICS:** Mechanical properties of cartilage. Diffusion properties of articular, cartilage, Mechanical properties of bone. Kinetics and Kinematics of joints, Lubrication of joints. Fundamental concepts of Gait	13
5	Measuring principles of Cutometer, Durometer. Electrodynamometer, Microindentometer & Ballistometer.	6

Note1: Unit 3 & Unit 4 will have internal choice
Note2: Assignment-1 from unit 1 and 2.
Asssignment-2 from unit 3, 4 and 5

COURSE OUTCOMES: On the completion of the course the students would have learnt

CO1: Linear kinematics and dynamics, projectile motion and conservation of angular momentum..
CO2: To solve problems incorporating vectors, kinematics and dynamics
CO3:Concepts of various human system mechanics
CO4: Principles of various biomechanic measuring equipments.

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

TEXT BOOKS:

1. **Biomechanics, Mechanical Properties of Living Tissues,**Y.C Fung,Springer Verlag, Edition2, 1993.
2. **Introduction to Biomechanics of Joints & Joint Replacement Mechanical Engg,** D.Dowson, V Wright publication, 1987.
3. **The Biomedical Hand Book**,Joseph.D.Bronzino ,CRC Press, 2nd Edition,2000.

Sub Title: MEDICAL INFORMATICS		
Sub Code: ML652	**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: To make the student learn

1. Identify the fundamentals medical informatics
2. Develop practical health care applications using suitable database management system
3. Utilise knowledge, skills and concepts on health information technology
4. Apply principles of information security, ethics and policy information
5. Assesses existing information exchange system standards
6. Analyse and develop project, manage strategies health information technology

UNIT No	Syllabus Content	No of Hours
1	Medical Informatics: Introduction - Structure of Medical Informatics –Internet and Medicine -Security issues, Computer based medical information retrieval, Hospital management and information system, Functional capabilities of a computerized HIS, e-health services, Cloud computing: Introduction, cloud computing in medical applications	**12**
2	Computerised Patient Record : Introduction - History taking by computer, Dialogue with the computer, Components and functionality of CPR, Development tools, Intranet, CPR in Radiology- Application server provider, Clinical information system, Computerized prescriptions for patients.	**12**
3	Computers in Clinical Laboratory and Medical Imaging: Automated clinical laboratories-Automated methods in hematology, cytology and histology, Intelligent Laboratory Information System - Computerized ECG, EEG and EMG, Computer assisted medical imaging- nuclear medicine, ultrasound imaging ultrasonography-computed X-ray tomography, Radiation therapy and planning, Nuclear Magnetic Resonance	**9**
4	Computer Assisted Medical Decision-Making**:** Neuro computers and Artificial Neural Networks application, Expert system – General model of CMD, Computer – assisted decision support system-production rule system, cognitive model, semester networks , decisions analysis in clinical medicine-computers in the care of critically patients-computer assisted surgery-designing	**10**
5	Recent Trends in Medical Informatics: Virtual reality applications in medicine, Computer assisted surgery, Surgical simulation, Telemedicine - Tele surgery computer aids for the handicapped, computer assisted instrumentation in Medical Informatics - Computer assisted patient education and health - Medical education and health care information	**9**

Note1: Unit 2 & Unit 4 will have internal choice

Note2: Assignment-1 from unit 1 and 2.

Asssignment-2 Based on industry expert talk on cloud computing, recent trends in medical informatics

COURSE OUTCOMES: On the completion of the course the students would have learnt

CO1:Concepts of medical informatics systems,security,ethics,standards & policy information..
CO2: Develop Practical Health Care Applications Using Suitable Data Base Management Systems
CO3:Application of computers in clinical laboratory,medical imaging,education & decision making..
CO4: Explore the latest trends & happenings in the subject

COs	Mapping with POs
CO1	PO1,PO6,PO7,PO8
CO2	PO2,PO3,PO5
CO3	PO1,PO2,PO7,PO12
CO4	PO10,PO11, PO12

TEXT BOOKS:

1. **Medical Informatics**, Mohan Bansal, T M H, 2003 .
2. **Introduction to Bioinformatics** , T. K. Attwood & D. J. Parry-Smith, Pearson Education Low Price Edition, 2004.

References:

1. **Computers In Medicine Progress In Medical Informatics**, R. D. Lele, TMH, 2005.

Sub Title: SIGNAL PROCESSING LAB USING LABVIEW		
Sub Code: MLL66	**No of Credits :1.5= 0:0:1.5(L-T-P)**	**No of lecture hours/week :03**
Exam Duration : 3 Hours		**Exam Marks : 50**

COURSE OBJECTIVES:

The course is designed to make the student familiarise with the software tool Lab VIEW. The basic concepts of signal processing and DSP operations are implemented using Lab VIEW.

Sl. No	Contents
	Getting started with Labview
1	To add, multiply, subtract and divide two numeric inputs.
2	To evaluate the expression.
3	To realize code converters,half adder,full adder
4	To illustrate the use of for loop,while loop and delays.
5	To create vi for array and matrix manipulation.
6	To illustrate the use of formula node, Mathscript.
	Signal Processing.
1	To display step,ramp,exponential,sine,cosine,square signal.
2	To perform linear convolution,correlation.
3	To calculate FFT of a signal.
4	To calculate power spectral density of a signal.
5	To perform lowpass,high pass and bandpass filtering.
6	To perform filtering using window technique.

COURSE OUTCOME:

CO1:The student will develop the proficiency in Lab VIEW and learn to implement DSP operations in Lab VIEW

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

Sub Title: PHYSIOLOGICAL LAB		
Sub Code: MLL67	**No of Credits :1.5= 0:0:1.5(L-T-P)**	**No of lecture hours/week :03**
Exam Duration : 3 hours		**Exam Marks : 50**

COURSE OBJECTIVES:

The course is meant to provide the student a comprehensive study of bio medical signals, involving real time bio signal acquisition, telemetry and analysis. The student will also learn to design required physiological variable converting into bioelectrical signals.Furthermore the student will be able to analyze the data.

Unit No	Syllabus Content
Experiments using Power Lab and LabVIEW/Lab chart	
1	Real Time data Acquisition and Analysis of the following physiological parameters ECGs (EKGs), EMGs, and EEGs
2	Blood Pressure (BP) Amplifier
3	Recording of Electromyogram/ nerve conduction velocity.
4	The Galvanic Skin Response Amplifier
5	Study of lung and cardiovascular models
Transducers and Instrumentation	
6	Bridge Amplifier: Testing of various transducers including commonly available force, pressure, and displacement transducers, temperature probes, light meters, and similar devices
7	Study and usage of Automatic defibrillators
Telemetry of bio signals	
8	Optical fibre communication link – biotelemetry

COURSE OUTCOME:

CO1:The student will be fluent in handling Power Lab (bio acquisition system) biomedical applications. The student will learn about the vvarious transducers, physiological variables, bio amplifiers, analysis of acquired signals electrical safety methods

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

Sub Title : JAVA LAB		
Sub Code: MLL68	**No. of Credits:2=0: 0:2(L-T-P)**	**No of lecture hours/week :04**
Exam Duration : 3 hours	**Exam Marks : 50**	

COURSE OBJECTIVES

To enable the students learn the fundamentals of programming language Java and also develop programming skills in Java

1	Simple Java Programs to illustrate the data operators
2	Program for string reversal
3	Program for demonstration of control statements
4	Program for demonstrating constructors
5	Program for demonstrating Overloading and overriding
6	Program for demonstrating multilevel Inheritance
7	Program for exception handling (try & catch methods and nested try statement and)
8	Program for demonstration of multi threading : Implementing runnable & extends, producer-consumer problem synchronization
9	Program for demonstrating event handling
10	Developing Applet program

COURSE OUTCOME: The students would have

CO1: Acquired programming skills in Java and will be able to develop applications using Java

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

Sub Title: MINIPROJECT		
Sub Code: MLP69	**No of Credits : 00:00:2**	**No of lecture hours/week : ---**
Exam Duration : 3 hours	**Exam Marks : 50**	

COURSE OBJECTIVES: To enable the students to come up with their own innovative ideas and realize it.

Note:

- Mini project should be carried by a group of 3 or 4 and not more than 4 in a group.
- PCB soldering and Testing
- Evaluation should be based on the demonstration, viva-voce and final report.

COURSE OUTCOME:

CO1:The students will develop and conceptualise new ideas and build working models for biomedical applications

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

VII SEMESTER

Sub Title: BIOMEDICAL DIGITAL SIGNAL PROCESSING		
Sub Code: ML71	**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 enable the students to study

1. To learn the nature of various biomedical signals and its analysis.
2. To know about neurological signal generation.
3. To study sleep EEG types and their features.
4. To study adaptive filters and their applications in biomedical signal processing.
5. To gain knowledge about various artefacts and methods to eliminate it.
6. To study cardiological signal processing

UNIT No	Syllabus Content	No of Hours
1	**INTRODUCTION TO BIOMEDICAL SIGNALS:** The nature of biomedical signals, the action potential, objectives of biomedical signal analysis, Difficulties in biomedical signal analysis, computer aided diagnosis. Neurological signal processing: The brain and its potentials, The electrophysiological origin of brain waves, The EEG signal and its characteristics, EEG analysis. EMG signal characteristic and analysis	**7**
2	**SLEEP EEG:** Data acquisition and classification of sleep stages, The Markov model and Markov chains, Dynamics of sleep-wake transitions, Hypnogram model parameters, and Event history analysis for modeling sleep.	**6**
3	**ADAPTIVE FILTERS:** Principle of an adaptive filter, the steepest descent algorithm, adaptive noise canceller, cancellation of 60 Hz interference in electrocardiography, applications of adaptive filters. Canceling donor - heart interference in heart-transplant electrocardiography, Cancellation of ECG signal from the electrical activity of the chest muscles, canceling of maternal ECG in fetal ECG, Cancellation of High frequency noise in Electro - surgery.	**9**
4	**SIGNAL AVERAGING:** Basics of signal averaging, a typical signal averager, signal averaging as a digital filter, Removal of artifacts by averaging. Filtering for removal of artifacts**:** Introduction, Random noise, structured noise and physiological interference, stationary versus non stationary process, high frequency noise in ECG, motion artifact in ECG, power line interference in ECG signals, Maternal interference in Fetal ECG, muscle contraction interference in VAG signals.	**9**
5	**CARDIOLOGICAL SIGNAL PROCESSING:** Pre-processing. ECG QRS Detection techniques. Rhythm analysis. Arrhythmia detection Algorithms. Automated ECG Analysis. ECG Pattern Recognition. Heart rate variability analysis, ST–segment analyzer, portable, arrhythmia monitors.	**8**

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

COURSE OUTCOMES: The students will be able to
CO1: Understand the characteristics & analysis of EEG signal
CO2: Acquire and Analyse sleep EEG signals
CO3: Understand the principle & application of adaptive filter in acquiring physiological signals
CO3: Cancel the effects of ECG signals in other physiological signals of interest
CO4: Filter the interferences caused in ECG signal and the nature of the noise
CO5: Analysis of ECG signals

Cos	Mapping with Pos
CO1	PO1,PO2,PO4, PO6, PO7,PO12
CO2	PO2,PO3,PO4,PO6, PO7, PO12
CO3	PO2,PO3,PO4, PO6, PO7, PO12
CO4	PO2,PO3,PO4, PO6, PO7, PO12
CO5	PO2,PO3,PO4,PO6, PO7, PO12

TEXT BOOKS:

1. **Biomedical Digital Signal Processing**,Willis J.Tompkins, PHI.
2. **Biomedical Signal Processing- principles and techniques**, Tata McGraw-Hill, D.C.Reddy, 2005.
3. **Biomedical Signal Analysis**, Rangaraj M. Rangayyan, IEEE Press, 2001.
4. **Wavelet Transforms** , Raghuveer M. Rao and Ajit S. Bopardikar, Pearson, 1998.

REFERENCE BOOKS:

1. **Biomedical Signal Processing ,**Akay M, Academic Press ,1994
2. **Biomedical Signal Processing ,**Cohen.A, Vol. I , CRC Press, 1986.

Sub Title: DIGITAL IMAGE PROCESSING		
Sub Code: ML72	**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 OBJECTIVE: To enable the students to study

1. To discuss the fundamental concepts of digital image processing
2. To discuss image enhancement technique in spatial and frequency domain.
3. To discuss image segmentation and restoration technique in spatial and frequency domain

UNIT No	Syllabus Content	No of Hours
1	**DIGITAL IMAGE FUNDAMENTALS** Digital image representation, fundamental steps in digital image processing, Simple image model, basic relationships between pixels: neighborhood of a pixel, connectivity. Color models and transformations, pseudo color image processing,	8
2	**IMAGE ENHANCEMENT** Basic gray level transformations, histogram, histogram equalization, basics of spatial filtering, smoothing and sharpening spatial filters, edge detection method. Introduction to the frequency domain, smoothing and sharpening frequency domain filters, homomorphic filtering.	8
3	**IMAGE SEGMENTATION** Detection of discontinuities, edge linking & boundary detection, thresholding, region based segmentation, morphological watersheds.	8
4	**IMAGE RESTORATION** Degradation model, Noise models, restoration in the presence of noise only (Spatial and frequency domain filters), Inverse filtering, LMS filtering, Wiener filter.	8
5	**IMAGE COMPRESSION** Fundamentals, image compression models, error-free compression, lossy and lossless predictive coding, wavelet coding, JPEG 2000 coding,	7

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<u>Note1</u>: Assignment-1 from unit 1 and 2.
Asssignment-2 from unit 3, 4 and 5

COURSE OUTCOMES: The students will be able to

CO1: Understand the basic image processing concepts such as relationship between pixels and color models
CO2: Implement image enhancement techniques in spatial & frequency domain
CO3: Understand and apply image segmentation techniques to any given image
CO4: Understand various degradation models and apply the image restoration techniques
CO5: Perform image compression using lossy and lossless techniques

Cos	**Mapping with Pos**
CO1	PO1,PO2,PO3,PO4
CO2	PO1,PO2,PO3
CO3	PO1,PO2,PO3,PO4, PO12
CO4	PO1,PO2,PO3,PO4,PO12
CO5	PO1,PO2,PO3,PO4,PO5, PO12

Text Books:

1. **Digital Image Processing** , R C Gonzalez & R E Woods, Pearson Education, 3 edition.
2. **Digital Image Processing and Computer Vision** , Milan Sonka, Cengage learning, First edition.

Reference Books:

1. **Digital Image Processing** , S.Jayaraman, S.Esakkirajan, T.Veerakumar, Tata Mcgraw Hill, 2009.
2. **Fundamentals of Digital Image processing** , A K Jain, PHI / Pearson Education, 1989.
3. **Digital Image Processing** , Sid Ahmed, McGraw Hill.

Sub Title : BIOMECHANICS		
Sub Code: ML73	**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: Understand the mechanical aspects of human motion:

1. Quantitative and qualitative analysis of human motion and performance.
2. Use physical laws of motion to solve problems of human motion.
3. Understand the relationship between mechanical properties and anatomical functions.
4. Understand how biomechanical principles can be applied to examine human activities such as sport and orthopaedic rehabilitation.

UNIT No	Syllabus Content	No of Hours
1	**BIO-FLUID MECHANICS:** Newton's laws, stress, strain, elasticity, Hook's-law, viscosity, Newtonian Fluid, Non-Newtonian fluid, viscoelastic fluids. Vascular tree. Relationship between diameters, velocity and pressure of blood flow, Resistance against flow	08
2	**VISCOELASTIC FLUID:** Viscoelasticity, Viscoelastic Models: Maxwell, Voigt and Kelvin Models Response to harmonic variation. Use of viscoelastic models.	08
3	**RESPIRATORY MECHANICS:** Alveoli mechanics, Interaction of blood and lung P-V curve of lung. Breathing mechanism. Airway resistance. Physics of lung diseases.	08
4	**ORTHOPEDIC MECHANICS:** Mechanical properties of cartilage. Diffusion properties of articular, cartilage, Mechanical properties of bone. Kinetics and Kinematics of joints, Lubrication of joints. Fundamental concepts of Gait analysis.	08
5	Measuring principles of Cutometer, Durometer. Electrodynamometer, Microindentometer & Ballistometer.	07

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

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

CO1: Understand the concepts of bio-fluids.

CO2: Understand the various viscoelastic models.

CO3: Understand the concepts of respiratory mechanics

CO4: Understand the concept of orthopaedic mechanics.

CO5: Understand the principles of various biomechanic measuring equipments.

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

TEXT BOOKS:

1. **Biomechanics, Mechanical Properties of Living Tissues,**Y.C Fung,Springer Verlag, Edition2, 1993.
2. **Introduction to Biomechanics of Joints & Joint Replacement Mechanical Engg,** D.Dowson, V Wright publication, 1987.
3. **The Biomedical Hand Book**,Joseph.D.Bronzino ,CRC Press, 2nd Edition,2000.

ELECTIVE 3 (GROUP C)

Sub Title: SPEECH PROCESSING		
Sub Code: ML741	**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 enable the students to study

1. Speech Producing Mechanism and classification of speech signals
2. Quantization of Speech signals
3. Various characteristics of the speech signal
4. Speech Synthesis and Recognition

UNIT No	Syllabus Content	No of Hours
1	**DIGITAL MODELS FOR SPEECH SIGNALS:** Process of Speech Production, Lossless tube models, and Digital models for Speech signals. **DIGITAL REPRESENTATIONS OF THE SPEECH WAVEFORM:** Sampling speech signals, Review of the statistical model for speech, Instantaneous quantization, Adaptive Quantization, General theory of differential quantization, Delta modulation.	9
2	**TIME DOMAIN MODELS FOR SPEECH PROCESSING:** Time dependent processing of speech, Short time Energy and average magnitude, Short time average zero crossing rate, Speech Vs silence discrimination using energy and zero crossing. Pitch period estimation, Short time autocorrelation function, Short time average magnitude difference function, Pitch period estimation using autocorrelation function.	10
3	**LINEAR PREDICTIVE CODING OF SPEECH:** Basic principles of linear predictive analysis, Solution of LPC equations, and Prediction error signal, Frequency domain interpretation, Relation between the various speech parameters, Applications of LPC parameters	7
4	**SPEECH SYNTHESIS** Principles of Speech synthesis, Synthesis based on waveform coding, analysis synthesis method, speech production mechanism, Synthesis by rule, Text to speech conversion.	7
5	**SPEECH RECOGNITION**: Principles of Speech recognition, Speech period detection, Spectral distance measures, Structure of word recognition systems, Dynamic time warping (DTW), Word recognition using phoneme units.	6

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

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

CO1:Understand the human physiological sound producing system and the different speech models
CO2:Interpret and extract various parameters of interest from speech spectrogram
CO3:Generate speech synthesizing and recognizing processes
CO4:Develop speech applications and algorithms for speech impaired persons

COs	**Mapping with POs**
CO1	PO1,PO2,PO4
CO2	PO1,PO2,PO3,PO4,PO5
CO3	PO1,PO2,PO3,PO4,PO5
CO4	PO1,PO2,PO3,PO4,PO5,PO7,PO11,PO12

TEXT BOOKS:

1. **Digital Processing of Speech Signals,** L R Rabiner and R W Schafer, Pearson Education 2004.
2. **Digital Speech Processing- Synthesis and Recognition,**Sadoaki Furui, Mercel Dekker, Second Edition, 2002.

REFERENCE BOOKS:

1. **Introduction to Data Compression**,Khalid Sayood, Elsivier Publications, Third Edition
2. **Digital Speech**, A M Kondoz, Wiley Publications, Second Edition.

Sub Title: BIOMATERIALS & ARTIFICIAL ORGANS		
Sub Code: ML742	**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 enable the students to study

1. To know about various synthetic biomaterials.
2. To know about composite biodegradable polymeric and tissue derived material.
3. To understand the various artificial organs such as artificial heart, artificial kidney artificial lung.

UNIT No	Syllabus Content	No of Hour
1	**BIOMATERIALS:** Introduction to biomaterials, uses of biomaterials, biomaterials in organs & body systems, materials for use in the body, performance of biomaterials. **METALLIC BIOMATERIALS:** Introduction, Stainless steel, Cobalt-Chromium alloy, Titanium alloys, Titanium-Nickel alloys, Dental metals, Corrosion of metallic implants, Manufacturing of implants. **CERAMIC BIOMATERIALS:** Introduction, nonabsorbable /relatively bioinert bioceramics, biodegradable/resorbable ceramics, bioreactive ceramics, deterioration of ceramics, bioceramic-manufacturing techniques. **POLYMERIC BIOMATERIALS:** Introduction, polymerization and basic structure, polymers used as biomaterials, sterilization, surface modifications to for improving biocompatibility.	**10**
2	**COMPOSITE BIOMATERIALS:** Structure, bounds on properties, anisotropy of composites, particulate composites, fibrous composites, porous materials, biocompatibility. **BIODEGRADABLE POLYMERIC BIOMATERIALS:** Introduction, Glycolide based biodegradable homopolymers polyesters, non-glycolide linear aliphatic polyesters, aliphatic and aromatic polycarbonates, and biodegradation properties of synthetic biodegradable polymers. **TISSUE DERIVED BIOMATERIALS:** Structure and properties of collagen and collagen-rich tissues, biotechnology of collagen, design of resorbable collagen-based medical implant. 3D Printing	**7**
3	**ARTIFICIAL ORGANS INTRODUCTION:** Substitutive medicine, outlook for organ replacement, design consideration, evaluation process. **ARTIFICIAL HEART AND CIRCULATORY ASSIST DEVICES:** Engineering design, Engg design of artificial heart and circulatory assist devices, blood interfacing implants – introduction, total artificial hearts & ventricular assist devices, vascular prostheses, Non-blood interfacing implants for soft tissues- sutures and allied augmentation devices, percutaneous and skin implants, maxillofacial implants, eye and ear implants. Cardiac Valve Prostheses: Mechanical valves, tissue valves, current types of prostheses, tissue versus mechanical, engineering concerns and hemodynamic assessment of prosthetic heart valves, implications for thrombus deposition, durability, current	**8**

	trends in valve design, vascular grafts-history, synthetic grafts, regional patency, thrombosis, neointimal hyperplasia, graft infections.	
4	**ARTIFICIAL KIDNEY:** Functions of the kidneys, kidney disease, renal failure, renal transplantation, artificial kidney, dialyzers, membranes for haemodialysis, haemodialysis machine, peritoneal dialysis equipment-therapy format, fluid and solute removal.	**7**
5	**ARTIFICIAL LUNGS:** Gas exchange systems, Cardiopulmonary bypass (heart-lung machine)-principle, block diagram and working, artificial lung versus natural lung. Liver functions, hepatic failure, liver support systems, general replacement of liver functions.	**7**

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

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

CO1: Understand the different biocompatible materials such as metallic, ceramic and polymers.
CO2: Understand the biodegradable biomaterials
CO3: Identify different artificial implants and assistive devices for cardio-vascular system
CO4:Design of artificial organs such as heart, kidney and lung.

COs	**Mapping with POs**
CO1	PO1,PO3,PO6,PO7
CO2	PO1,PO2,PO3,PO4,PO6,PO7,PO8
CO3	PO1,PO2,PO3,PO4,PO6,PO7,PO8,PO12
CO4	PO10,PO11,PO12

.

TEXT BOOK:

1. **Biomedical Engineering Handbook**, J.D.Bronzino ,CRC Press ,Volume1 ,2nd Edition, 2000.
2. **Biomedical Engineering Handbook,** J.D.Bronzino ,CRC Press ,Volume2 ,2nd Edition, 2000.
3. **Handbook of Biomedical Instrumentation ,** R.S.Khandpur **,**Tata McGraw Hill, 2nd Edition , 2003.

Sub Title: PICTURE ARCHIVING AND COMMUNICATION STANDARDS		
Sub Code: ML743	**No. of Credits : 3**	**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 enable the students to study

1. Technical requirements & financial implication to maintain PACS
2. Image processing fundamentals and medical imaging
3. Medical data storage & recovery

UNIT No	Syllabus Content	No. of Hours
1	**Introduction to PACS:** Interpretation Workstations, Strategic Plan, PACS Impact Analysis, Financial Analysis, Technical Requirements, Project Planning and Evaluation, Contract Negotiations .DICOM Standard, Queuing Perspective, Quality Assurance, HL7, IHE.	**7**
2	**Computer Fundamentals:** Digital Imaging Fundamentals, Image Acquisition, Image Processing Algorithms, Quality Assurance, Future trends, Image Compression, Compression Applications to medical imaging.	**8**
3	**PACS Architecture**: Centralized model, Medical-legal Archive, Networking Fundamentals, Factors to consider in building a network**.** **Servers and Operating Systems:** Disaster recovery, Storage and enterprise archiving, RAID, Direct attached storage, Storage area network, Hierarchical storage.	**8**
4	**Image Displays:** Digital Mammography, Web distribution. **PACS Workstation Software**: Role of Workstation, User Interface, Future of Workstations, Breast Imaging, CAD, CASS.	**8**
5	**3 Dimensional Imaging In Radiology**: Voice recognition, Order entry in Radiology. **Tele Radiology:** Image Acquisition and Image Digitization, Image Transmission, Applications of Tele Radiology, Legal and Socioeconomic Issues ACR Standards.	**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 students would have learnt to

1. Explain the fundamental concepts of PACS and DICOM standards.
2. Apply the various operations performed on digital image
3. Understand the architecture of a typical PACS and requirements for implementations
4. Apply display techniques for medical images.
5. Apply the PACS in different domains of medical imaging and radiology

COs	**Mapping with POs**
CO1	PO2, PO3, PO4, PO6
CO2	PO2, PO3, PO4, PO12
CO3	PO2, PO3, PO4,
CO4	PO2, PO3, PO4,
CO5	PO2, PO3, PO4, PO6, PO12

Text Books: PACS – A guide to the Digital Revolution- Keith Dreyer – Springer, 2006.

Reference Books: PACS in Medicine by H.K.Huang, Wiley-IEEE, 2004.

ELETIVE 4 (GROUP D)

Sub Title: BIOSTATISTICS & RESEARCH METHODOLOGY		
Sub Code: ML751	**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 enable the student to learn

1. The statistical data analysis and bio statistical analysis
2. Systematic approach to research studies
3. Various data analysis model

UNIT No	Syllabus Content	No of Hours
1	**INTRODUCTION TO BIOSTATISTICS:** Introduction, Some basic concepts, Measurement and Measurement Scales, Simple random sample, Computers and biostatistical analysis. **DESCRIPTIVE STATISTICS:** Introduction, ordered array, grouped data-frequency distribution, descriptive statistics – measure of central tendency, measure of dispersion, measure of central tendency computed from grouped data, variance and standard deviation-grouped data.	7
2	**Introduction to Research methodology:** Meaning of research, objectives of research, motivation in research, types of research, research approaches, Research methods versus methodology, Defining research problem: selecting the problem, defining the problem, techniques involved in defining a problem, meaning of research design, need for research design, important concepts of research design .	8
3	**ESTIMATION:** Introduction, confidence interval for population mean, t-distribution, confidence interval for difference between two population means, population proportion and difference between two population proportions, determination of sample size for estimating means. **HYPOTHESIS TESTING :** Introduction, hypothesis testing – single population mean, difference between two population means, paired comparisons, hypothesis testing-single population proportion, difference between two population proportions, single population variance.	8
4	**ANALYSIS OF VARIANCE (ANOVA):** Introduction, completely randomized design, randomized complete block design, factorial experiment. **LINEAR REGRESSION AND CORRELATION:** Introduction, regression model, sample regression equation, evaluating the regression equation, using the regression equation, correlation model, correlation coefficient.	8
5	**MULTIPLE REGRESSION AND CHI-SQUARE DISTRIBUTION:**	8

	Multiple linear regression model, obtaining multiple regression equation, evaluating multiple regression equation, using the multiple regression equation, multiple correlation model, mathematical properties of Chi-square distribution, tests of goodness of fit, tests of independence, tests of homogeneity.	

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

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

CO1: Understand the basic concepts of biostatistics & research methodology.
CO2: Apply estimation & hypothesis technique for human health.
CO3: Apply Statistical analysis model like ANOVA, regression, chi-square

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

TEXT BOOK:

1. **Biostatistics-A Foundation for Analysis in the Health Sciences** , Wayne W. Daniel, John Wiley & Sons Publication, 6th Edition.
2. **Research Methodology**, C R Kothari, New Age International Publishers, Second Revised Edition.

REFERENCE BOOKS:

1. **Principles of Biostatistics,** Marcello Pagano and Kimberlee Gauvreu, Thomson Learning Publication, 2006.
2. **Introduction to Biostatistics,** Ronald N Forthofer and Eun Sul Lee, Academic Press
3. **Basic Biostatistics and its Applications,** Animesh K. Dutta 2006.

Sub Title: MEDICAL DEVICES AND REGULATIONS		
Sub Code: ML752	**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 enable the students to study

1. Device types, Regulations and Standards and approval process of Medical Devices
2. Knowledge of FDA terminologies
3. Validation process for medical device hardware and software

Unit No.	Syllabus Contents	No. of Hours
1	**Medical Device**: Definition, product definition process, overview of quality function deployment(QFD), QFD process, business proposal. **Reliability**: Concept of failure, various methods of CAPA. **Safety and Risk Management**: Personnel safety and hygiene, medical device safety and risk management, effectiveness/performance of medical devices, Phases in the life span of a medical device, risk management processes, shared responsibility for medical device safety and performance.	**7**
2	**The Food and Drug Administration:** Device classification, 510 (k) Process, Declaration of conformance, PMA application, Investigational Device Exemptions (IDEs), Good Laboratory Practices (GLPs), Good Manufacturing Practices (GMPs), Human Factors, Design Control. ***The European Union:*** European Directives, Conformity Assessment and Testing, European Organization for Testing and Certification, Benefits of the GHTF, Final documents from the GHTF, Global Medical Device Nomenclature (GMDN)	8
3	**Standards and Regulations Background** ***Standards:*** Voluntary and mandatory standards, Standards development process, Conformity assessment with standards, National and international standards systems, Identification of standards, Current trends in the use of standards in medical device regulations. The ISO 9000 Series of Standards, ISO 14000 Series of Standards. **The Medical Devices Directives:** Medical Devices Directives process, Choosing the appropriate directive, Essential requirements, Classification of the device based on conformity, Medical Devices Directives, Active Implantable Medical Devices Directives, *In-vitro* Diagnostic Medical Devices Directives. NABH, NABL, JCI, AERB , WHO guidelines on medical devices.	8
4	**Software and Quality System Regulation** Software as a Technology, Domestic Software Regulations, Domestic Software Standards, International Software Regulations, International Software Standards, Design controls, Document controls, Purchasing controls, Identification and traceability, Production and process controls, Acceptance activities, Non-conforming product, corrective and preventive action.	8

5	**Medical Device Testing** The basis and types of testing, Parsing test requirements, Test protocol, Test methodology, Purpose of the test, Failure definition, Determining sample size and test length, Types of testing. **Validation:** Hardware verification and validation, Software verification and validation,	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: Define the medical device, its processes encompassing safety and risk management.
CO2: Identify the objectives and functions of FDA and EU.
CO3: Analyze various medical device standards and regulations
CO4: Document the procedure in software quality system regulations
CO5: Implement test protocol for medical device testing.

COs	Mapping with POs
CO1	PO1,PO4,PO6
CO2	PO1,PO6,PO7,PO8
CO3	PO1,PO5,PO6,PO7,PO8
CO4	PO1,PO5,PO12
CO5	PO1,PO2,PO11,PO12

TEXT BOOKS

1. **Reliable Design of Medical Devices**, Second Edition by Richard Fries, CRC Press, 2006.
2. **Medical Device Quality Assurance and Regulatory Compliance** , Richard C Fries, CRC Press, 1998.

REFERENCE BOOKS

1. **Medical device regulations: global overview and guiding principles** , Michael Cheng, World Health Organization.
2. **Product Safety in the European Union** , Gabor Czitan, Attila Gutassy, Ralf Wilde, TUV Rheinland Academia, 2008.

Sub Title: HOSPITAL DESIGN AND MANAGEMENT		
Sub Code: ML753	**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 enable the students to study

1. The hospital plan for construction with all the essential hospital facilities
2. The design details of radiation services, nursing & operation departments
3. Providing electrical & water services and waste management
4. Safety & security issues

UNIT No	Syllabus Content	No of Hours
1	**Planning & Building a New Hospital:** Role of Hospital in Health Care, Hospital Planning & Design, Guiding principle in Hospital facilities & services, Functional Plans for Hospital construction, Design items, Functional program & design stage, Planning the Hospital building.	**7**
2	**Effective Hospital Management**: Planning, Organization, Directing & Leading, Controlling, Financial Management Administrative Service: Medical Record, Hospital Infection, Hospital Utilization Statistics, Material Management, Evaluation of Hospital services.	**8**
3	**Planning & Designing Medical Services**: Out Patient service, Emergency service, Clinical laboratories, Radiology services, Radiation Therapy Department, Surgical Department, Nursing Department, Operation Theater, CSSD Nursing services.	**8**
4	**Planning & Designing Engineering Services:** Engineering Department, Maintenance management, Clinical [Bio-medical] Engineering, Electrical System, Air Condition System, Water supply & sanitary system, Centralized Medical Gas System, Telecommunication System, Environmental Control, Safety & Security System, Disposal of Hospital Wastes.	**8**
5	**Planning & Design of Supportive Services:** Admitting Department, Medical Record Department, Centralized Sterilization & Supply department, Pharmacy Material Management, Food service.	**8**

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

Course Outcomes: On Completion of this course the students will be able to
1. Design the hospital layout with an effective administration and financial management.
2. Plan and develop an effective hospital supportive system for all types of hospital services.
3. Evaluate the proper functioning and services provided by the hospitals
4. Plan and design providing essential services considering safety, security & waste disposal

COs	Mapping with POs
CO1	PO3, PO11
CO2	PO3, PO6
CO3	PO3, PO6
CO4	PO3, PO6

Textbook

1. **Principles of Hospital Administration & Planning** - by B. M.Sakharkar, Jaypee Publications, 1998.
2. **Hospital Facilities, Planning & Managemen**t - by G. D. Kunders, Tata McGraw Hill, 2004.

REFERENCE BOOKS:

1. **Hospital Administration & Management** - by S. L. Goel & R. KumarDeep & Deep Publications
2. **Applied Clinical Engineering** - by Barry N. Feinberg, Prentice Hall,1984.
3. **Clinical Engineering Principle & Practices** - By John G. Webster &Albert M. Cook, Prentice Hall.

Sub Title : BIO-MEDICAL DIGITAL SIGNAL & IMAGE PROCESSING LAB		
Sub Code: MLL76	**No. of Credits:1=0: 0:2(L-T-P)**	**No of lecture hours/week :02**
Exam Duration : 3 hours	**Exam Marks : 50**	

COURSE OBJECTIVES: To enable the students to study

1. Signal conditioning of Biomedical signals using FIR and IIR filters and to plot and observe the nature of these signals using MATLAB.
2. And familiarize with the basic concepts of image processing such as enhancement and segmentation using MATLAB.

UNIT No	Syllabus Content
	Biomedical Signal Processing using MATLAB
1	Analysis of ECG data: Original signal, Noise signal and filtered signal
2	Realization of IIR and FIR filters for ECG
3	PSD estimation for ECG, EEG, and EMG
4	R-R interval sequence interpretation
5	Analysis of Real time ECG, EEG signals acquired through Power Lab data acquisition system
	Image Processing using MATLAB
6	Basic operations on an image: Logical operations, Resizing, Rotation, Translation, Negative of an image
7	Plotting Histogram and histogram equalization
8	Image Segmentation: Threshold, multiple threshold
9	Implementation of spatial domain filters: LP, Median, HP
10	Implementation of edge detection using gradient filters.
11	Display of bit planes of an image
Open End Experiment	

COURSE OUTCOME: The student will be able

CO1: To implement digital filters using acquired signals

CO2: To Compute frequency spectrum of ECG & EEG signals

CO3: To Implement image enhancement techniques

CO4: To implement image segmentation techniques

CO5: Design and develop any biomedical signal & image processing application using MATLAB

CO6: To maintain the document and accomplish the work in stipulated time

Cos	**Mapping with Pos**
CO1	PO3,PO4,PO5,PO12
CO2	PO3,PO4,PO5,PO12
CO3	PO3,PO4,PO5,PO12
CO4	PO3,PO4,PO5,PO12
CO5	PO3,PO4,PO5,PO12
CO6	PO10, PO11,

Sub Title: Seminar		
Sub Code: MLS77	**No of Credits 02:00:00**	**No of lecture hours/week :**
	Exam Marks : 50	

Course Objectives: To enable the students to learn

1. Read and disseminate technical papers
2. Prepare and present a document before the peers
3. Understand the latest happenings in their field of interest

The seminar topics must relate to the current trend in technology depending on the students interest in the field of medical electronics. And the students must carry out an elaborate literature survey on the related field referring standard international journals/conferences. The students will finally make a oral presentation and also submit a technical report.

Course Outcome: To enable the students to learn
CO1: Read and interpret technical papers
CO2: Express the ideas and communicate clearly
CO3: Prepare Technical documentation

COs	**Mapping with POs**
CO1	PO2,PO3,PO4,PO6
CO2	PO10
CO3	PO10,PO12

Sub Title: Project Phase I		
Sub Code: MLP78	**No of Credits 0:00:00**	**No of lecture hours/week :**
	Exam Marks :	

COURSE OBJECTIVES: To enable the students to learn

1. Develop their own ideas
2. Interact with outside world
3. Work in a group in a collaborative and productive manner

The project topics and batch mates are decided in Project Phase 1. The project work is carried out in group of 3 or 4. Industry projects are encouraged and promoted. The Project topic and the design presented in the phase I. The students will make a presentation of the abstract and synopsis and also submit a report showing the design & implementation along with the literature survey.

COURSE OUTCOME: The students will be able to

CO1: Carry out the literature survey
CO2: Convert the ideas of their interest into a conceptual model
CO3: Interact with outside world in identifying a suitable problem
CO4: Prepare proposals and approach funding agencies

COs	**Mapping with POs**
CO1	PO2,PO3,PO4,PO5, PO6, PO7, PO12
CO2	PO3, PO6, PO12
CO3	PO9,PO10, PO12
CO4	PO10, PO11,

INTER DEPARTMENT ELECTIVE 1(GROUP E)

Sub. Title : BIO-MEDICAL ENGINEERING		
Sub Code: MLE01	**No of Credits : 04:00:00**	**No of lecture hours/week :04**
Exam Duration : 3 hours	**Exam Marks : 100**	**Total No. of Contact Hrs: 52**

COURSE OBJECTIVES : To enable the student to learn

1. The nature of various physiological signals.
2. The measurement of blood pressure, pulse rate etc. and cardiac pacemakers & defibrillators
3. The basics of auditory mechanisms and the hearing aids & surgical systems.
4. The medical imaging modalities such as ultrasonic and MRI

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 and EGG.	**10**
2	**BIOMEDICAL RECORDERS:** Electrocardiograph-block diagram description, ECG leads, Artefacts. blood pressure measurement: korotkoff's method respiratory measurements: Impedance Pneumograpy. Oximeters: Principle, pulse oximeter. **CARDIAC PACEMAKERS AND DEFIBRILLATORS**: Need for cardiac pacemaker, types of pacemaker, need for defibrillators. AC and DC defibrillators.	**12**
3	**AUDIOMETER AND HEARING AIDS:** Mechanism of hearing, measurement of sound, basic audiometer, pure-tone audiometer, speech audiometer, hearing aids- conventional, digital hearing aid, cochlear implants. **VENTILATORS:** Mechanics of respiration, artificial ventilation, ventilators.	**10**
4	**INSTRUMENTS OF SURGERY:** Principles of surgical diathermy, surgical diathermy machine, automated electro-surgical systems, electrodes used with surgical diathermy. **HAEMODIALYSIS MACHINE:** Function of kidney, artificial kidney, dialyzer, membranes for hemodialysis, portable kidney machine.	**8**

5	**ULTRASOUND IMAGING:** Fundamentals of acoustic propagation - stress strain relationship, characteristic impedance, intensity, reflection and refraction, attenuation, absorption & scattering, Doppler effect, generation and detection of ultrasound-piezoelectric effect, ultrasonic transducers. **ULTRASONIC DIAGNOSTIC METHODS :** Pulse echo systems- Amplitude mode (A-mode), Brightness mode (B-mode), Motion mode (M-mode), Constant depth mode (C-mode), Colour Doppler flow imaging. **BASICS OF MAGNETIC RESONANCE IMAGING:** Fundamentals of nuclear magnetic resonance- angular momentum, magnetic dipole moment, magnetization, Larmor frequency, rotating frame of reference and RF magnetic field, Free Induction Decay (FID), Fourier spectrum of the NMR signal, spin density, relaxation times, pulse sequences.	**12**

Assignment Question from unit 1, 2 &3

Assignment 2 Question from unit 4 & 5

After the successful completion of the course, the students will be able to :

CO1: Interpret a typical biomedical measuring system, its constraints & precautions

CO2: Understand the principle of the origin of biomedical signals and devise systems for measurement

CO3: Understand the use of electrical & heat energy in surgical processes & apply the safety aspects in improving the design

CO4: Apply the principles of audiometers, ventilators, haemodialysis to evolve new devices

CO5: Understand the fundamentals of Ultrasound Imaging & Magnetic Resonance Imaging

COs	**Mapping with POs**
CO1	PO1,PO2,PO4, PO6
CO2	PO1,PO2,PO3,PO4,PO6
CO3	PO1,PO2,PO3,PO4,PO6
CO4	PO1,PO4, PO12
CO5	PO1,PO2,PO4,PO6,PO9

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
3. **Principles of Medical Imaging**, Kirk Shung, Michael B. Smith and Banjamin Tsui, Academic Press, 1992

REFERENCE BOOK:

1. **Biomedical Instrumentation and Measurement** – by Leslie Cromwell, Fred J Weibell and Erich A. Pfeiffer, Prentice-Hall India Pvt. Ltd.
2. **BIO MEDICAL TRANSDUCERS AND INSTRUMENTS**, Tatsuo Togawa, Toshiyo Tamura and P. Ake Oberg, CRC Press, 1997.
3. **Introduction to Biomedical Equipment Technology,** Joseph J Carr and John M Brown , Pearson Education ,4th Edition , 2001.

VIII SEMESTER

ELECTIVE 5 (GROUP F)

Sub Title: NEURAL NETWORK & PATTERN RECOGNITION		
Sub Code: ML811	**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: The enable the students to learn

1. The concepts of biological neuron and analogy to the artificial neuron model
2. Different neural network architecture
3. Various learning paradigms and comparisons

UNIT No	**Syllabus Content**	**No of Hours**
1	**INTRODUCTION TO BIOLOGICAL NEURAL NETWORK:** Classic neuron, Bioelectric potential, Electrochemical mechanism of action potential, Nernst equation-electrochemistry give rise to electrical events, Membrane potential distributed model, Synaptic electrical events, slow potential theory of neurons. **ARTIFICIAL NEURAL NETWORK:** introduction to artificial neural network, model of a neuron, Types of activation function, neural networks viewed as directed graphs, architectural graph of a neuron with feedback, Network Architectures, Artificial intelligence and Neural Networks.	**10**
2	Learning Processes: Learning in context to neural Networks, learning paradigms, supervised & unsupervised learning, Five basic learning rules-Error correction Learning, Memory based learning. Hebbian learning, Competitive and Boltzmann learning, learning tasks, Memory, adaptation, Statistical nature of learning processes, Statistical learning theory.	**9**
3	**SINGLE LAYER PERCEPTION:** Introduction, Adaptive filtering problem, Unconstrained optimization techniques, Newton's method, Gauss-Newton method, Linear least square filter, Least mean square algorithm, Learning curves, Learning Rate, Annealing techniques, Perceptron, convergence theorem	**9**
4	**MULTILAYER PERCETRON:** Introduction, Some Preliminaries, Back propagation algorithm, XOR Problem, Heuristics for making the back propagation algorithm perform better, Feature detection, Hessian matrix, generalization, Cross validation, Virtues and limitations of back propagation algorithm.	**12**

5	**Random Variables**-Binomial distribution, Poission distribution Continuous Random variables uniform density, exponential density, normal density **Introduction to pattern Recognition** **Statistical Decision Making:** Introduction, Bayes' theorem, multiple features, conditionally independent features, Decision boundaries: Two Dimensional decision boundaries **Clustering:** Introduction, Hierarchical clustering-agglomerative, single linkage, average linkage, ward's method. Partitional clustering-Forgy's, k-means.	**12**

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

COURSE OUTCOMES: The students will be able to

CO1: Understand the concepts of artificial intelligence and neural network.
CO2: Understand the different learning algorithms and neural network architecture
CO3: Apply perceptron and multiple perceptron for classification
CO4: Apply the probabilistic models for data classification

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

TEXT BOOKS:

1. **An Introduction To Neural Networks,** James A. Anderson, PHI, 2nd edition ,1995.
2. **Neural Networks**, Simon Haykin Pearson Education/PHI, 2001.
3. **Neural Networks** , Satish Kumar, Tata Mcgraw-hill 2009
4. **Pattern Recognition & Image Analysis**, Earl Gose, Richard Johnsonbaugh Steve Jost, Prentice Hall of India, 2002.

REFERENCE BOOKS:-

1. **Introduction To Artificial Neural Systems**, Jacck M Zurada, Jaico publishing
2. **Artificial Neural Networks**, B Yegnanarayana, PHI, 2001
3. **Pattern Recognition**, Robert Schalkoff, Wiley India Pvt. Ltd.

Sub Title: BIOSENSORS AND BIOMEMS		
Sub Code: ML812	**No. of Credits:4=4:0:0(L-T-P)**	**No of lecture hours/week: 4**
Exam Duration : 3 hours	**CIE+Assignment+SEE =45+5+50=100**	**Total no of contact hours:52**

COURSE OBJECTIVES: To study

1. The components used for various biosensors and biosensor family.
2. The principles of different types of transducers.
3. The applications of biosensor in different fields.
4. Different types of photometric assay techniques.

UNIT No	Syllabus Content	No of Hours
1	**Transducers in Biosensors:** Various types of transducers; principles and applications - Calorimetric, optical, potentiometric / amperometric conductrometric/resistormetric, piezoelectric, semiconductor, impedimetric, mechanical and molecular electronics based transducers. Chemiluminescences - based biosensors.	**10**
2	**Applications and Uses of Biosensors:** Bio-Sensors in Clinical Chemistry, Medicine and Health Care, biosensors for personal diabetes management, application of biosensors to environmental samples. Biochips and their application to genomics	**10**
3	**Introduction to Biomems and Biomaterilals:** BIOMEMS, The driving force behind biomedical applications, bio-compatiability, Silicon fabrication: Hard fabrication considerations, lithography, etching techniques, Thin film deposition process, ion implantation, substrate bonding. Biomaterials: Soft lithography, micro molding, smart polymers & hydrogels, nanomedicine, thick film technologies, polymers, physical properties, copolymers. **Microfluidic Principles**: Introduction, transport process, electrokinetic	**12**
4	**Microactuators & Drug Delivery:** Introduction, activation methods, microactuators for microfluids, equivalent circuit representation, drug delivery, Clinical laboratory medicine: introduction, chemistry, hematology, immunology, urine analysis. **Micro-Total-Analysis Systems:** Lab-On A-Chip, capillary electrophoresis arrays, cell, molecule & particle handling, surface modification, Microspheres**.**	**10**
5	**Emerging Bio-MEMS Technology:** introduction, Minimal invasive surgery, cardiovascular, neurosciences, diabetics, point-of-care diagnosis, cell-based biosensors, Oncology.	**10**

<u>Note 1</u>: 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 characteristics of types of bio transducer

CO2: Understand the general applications of biosensors in medicine & health

CO3: Understand the biomaterials and fabrication of Bio-MEMS

CO4: Understand the principle of micro drug delivery system

CO5: Apply the Bio materials for major health issues

COs	**Mapping with POs**
CO1	PO3,PO4,PO6,PO7
CO2	PO1, PO2, PO3,PO4,PO6,PO7,
CO3	PO1,PO2, PO3,PO4,PO6,PO7,
CO4	PO1,PO2, PO3,PO4,PO6,PO7,PO12
CO5	PO1,PO2,PO7, PO11,PO12

TEXT BOOKS:

1. **Biosensors**, Elizabeth A. H Hall - Open University press, Milton Keynes.
2. **Commercial Biosensors,** Graham Ramsay, John Wiley and son, 1998.

REFERENCE BOOKS:

1. **Biosensors,** Eggins.
2. **Biosensors** , AEG CASS , OIRL press, Oxford University.
3. **Transducers and Instrumentation**, Murthy D V S. ,Prentice Hall, 1995

Sub Title: INFRARED IMAGING & APPLICATIONS		
Sub Code: ML813	**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:39**

COURSE OBJECTIVES: To enable the student learn

1. To Understand the scope and practice of the field of infrared imaging system
2. To Understand the basic techniques used in thermography
3. To Examine and grasp the principle of camera and image acquisition techniques
4. To identify and Demonstrate proficiency in developing applications

UNIT No	Syllabus Content	No of Hours
1	**Introduction to thermography:** History and evolution of thermography, Electromagnetic Spectrum, Principles of black body radiation laws: Blackbody, Plank's law, Wien's displacement law, Stefan Boltzmann Law, Emissivity, Kirchoff's law, IR absorption characteristics, Radiometric measurements.	10
2	**Heat Transfer Mechanisms and measurements:** Heat and Temperature, Heat Transfer Mechanism, Principle of Conduction, Convection and Radiation, Temperature measurements: Contact and Non contact.	10
3	**Principle of Infrared Camera:** Optics, Detectors, Scanning and Imaging, Detector performance parameters: Responsivity, Noise Equivalent Power, Specific detectivity, System performance parameters: Temperature range, Accuracy, Thermal sensitivity, 4 Bar Target, Minimum Resolvable Temperature Difference (MRTD), Calibration of IR camera.	12
4	**Passive and Active Techniques:** Passive Thermography, Active Thermography: Pulsed Thermography, Lock-in Thermography, Pulsed Phase Thermography, Vibro Thermography, Eddy current Thermography, Frequency Modulated Thermal Wave Imaging	10
5	**Applications:** Standards and Procedures, Diagnosis and Monitoring of Pain-Acupuncture-Breast Thermography and Detection of Breast Cancer-Other Medical Applications-Raynaud's Phenomenon- Pressure Ulcers.	10

COURSE OUTCOMES: On completion of the course the student will be able to
CO1: Identify the objectives and background of infrared imaging
CO2: Apply the temperature measurements for various applications
CO3: Demonstrate the working operation of IR Camera
CO4: Analyze the various thermography calibration procedure.
CO5: Design of basic thermography imaging procedure for various clinical applications

COs	**Mapping with POs**
CO1	PO1,PO6,PO7,PO8
CO2	PO2,PO3,PO5
CO3	PO1,PO2,PO7
CO4	PO7,PO11, PO12
CO5	PO10,PO11, PO12

TEXT BOOKS:

1. **Infrared Thermal Imaging: Fundamentals,** Michael Vollmer, Klaus-Peter Mollmann ,Research and Applications, John Wiley, 2010.
2. **Common sense approach to thermal imaging,** Holst, Gerald C. Washington, DC, USA: SPIE Optical Engineering Press, 2000.
3. **Infrared Imaging: A casebook in clinical medicine**, Francis Ring , Anna Jung , Janusz Zuber, IOP Publishing, Temple Circus, Temple Way, Bristol, BS1 6HG, UK 2015.

REFERENCE BOOKS:

1. **Medical Infrared Imaging**, Nicholas A. Diakides, Joseph D. Bronzino, CRC Press,2007

2. **Nondestructive Evaluation of Materials by Infrared Thermography**, Xavier P.V. Maldague, Springer Science & Business Media

ELECTIVE 6 (GROUP G)

Sub Title: BIOMETRIC SYSTEMS		
Sub Code: ML821	**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: To enable the students to Study

1. To understand the technologies of fingerprint, iris, face and speech recognition
2. To understand the general principles of design of biometric systems and the underlying trade-offs.
3. To recognize personal privacy and security implications of biometrics based identification technology.
4. To identify issues in the realistic evaluation of biometrics based systems.

UNIT No	Syllabus Content	No of Hours
1	**Introduction to Biometrics** Introduction and back ground biometric technologies passive biometrics active biometrics - Biometrics Vs traditional techniques Benefits of biometrics - Operation of a biometric system Key biometric processes: verification, identification and biometric matching. Development of biometric authentication. Basic terms, biometric data, biometric characteristics, biometric features, biometric templates and references. Performance measures in biometric systems: False Accept Rate (FAR), False Reject Rate (FRR), Failure To Enroll (FTE) Rate, Failure To Acquire (FTA) rate and- Need for strong authentication Protecting privacy and biometrics and policy Biometric applications	10
2	**Fingerprint Identification Technology** Fingerprint capture, sensor types, latent fingerprints. Fingerprint image preprocessing, segmentation, binary and skeletal images. Fingerprint Patterns, Fingerprint Features, Fingerprint Image, width between two ridges - Fingerprint Image Processing - Minutiae Determination - Fingerprint singularities, detection of loops, deltas, whirls and cores. Fingerprint Matching: Fingerprint Classification, Matching policies. Galton's details, base and complex minutiae, detection of minutiae. Fingerprint recognition, minutiae- and correlation-based methods. Fingerprints in forensics and biometrics, similarities and differences.	12

3	**Face Recognition:** Introduction to the face processing pipeline: acquisition, face detection, alignment, feature extraction, matching. Classic subspace methods. Hand-tuned feature descriptors. Distance, similarity and learning-based matching. components, Facial Scan Technologies, Face Detection, Face Recognition, Representation and Classification, Kernel- based Methods and 3D Models, Learning the Face Spare, Facial Scan Strengths and Weaknesses, Methods for assessing progress in Face Recognition.	**12**
4	**Voice Scan:** Introduction, Components, Features and Models, Addition Method for managing Variability, Measuring Performance, Alternative Approaches, Voice Scan Strengths and Weaknesses, NIST Speaker Recognition Evaluation Program, Biometric System Integration.	**10**
5	**Fusion in Biometrics:** Introduction to Multibiometric - Information Fusion in Biometrics - Issues in Designing a Multibiometric System - Sources of Multiple Evidence - Levels of Fusion in Biometrics - Sensor level, Feature level, Rank level, Decision level fusion - Score level Fusion. Examples biopotential and gait based biometric systems.	**08**

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: Identify the objectives and background of biometrics

CO2: Determine fingerprint identification techniques.

CO3: Demonstrate knowledge engineering principles underlying face recognition.

CO4: Analyze various speech features and models for speaker recognition system

CO5: Design of basic biometric system applications.

COs	**Mapping with POs**
CO1	PO1,PO3,PO4, PO6, PO7,
CO2	PO1,PO2,PO3,PO4, PO6, PO7, PO12
CO3	PO1,PO2,PO3,PO4,PO12
CO4	PO1,PO2,PO3,PO4,PO12
CO5	PO1,PO2,PO3,PO4,PO12

Text Books:

1. **Fundamentals of BioMEMS & Medical Microdevices**, Steven Salitreman, Cengage Learning India, 2006.
2. **Lab-On-A-Chip: Miniaturized systems for chemical analysis & synthesis**, Edwin ooterrbroek, Alert Berg, Elsevier, 2003.

Sub Title: REHABILITATION ENGINEERING		
Sub Code: ML822	**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: To enable the students to Study

1. Concept of Rehabilitation, Diagnosis of disability.
2. Rehabilitation team role of physiatrist.
3. Therapeutic exercise technique.
4. Principle in Management of communication.
5. Orthotic devices in Rehabilitation Engg. and to know about level of amputation.
6. Prosthetic device and mobility aids.

UNIT No	Syllabus Content	No of Hour
1	**INTRODUCTION TO REHABILITATION & REHABILITATION TEAM:** What is Rehabilitation, Epidemiology of Rehabilitation, Health, Levels of Prevention, Preventive Rehabilitation, Diagnosis of Disability, Functional Diagnosis, Importance of Physiatry in Functional diagnosis, Impairment disability handicap, Primary & secondary Disabilities, Effects of prolonged inactivity & Bed rest on body system. REHABILITATION TEAM**:** Classification of members, The Role of Physiatrist, Occupational therapist, Physical therapist, Recreation therapist, Prosthetist - Orthotist, Speech pathologist, Rehabilitation nurse, Social worker, Corrective therapist, Psychologist, Music therapist, Dance therapist & Biomedical engineer.	**12**
2	**THERAPEUTIC EXERCISE TECHNIQUE :** Co-ordination exercises, Frenkels exercises, Gait analyses-Pathological Gaits, Gait Training, Relaxation exercises-Methods for training Relaxation, Strengthening exercises-Strength training, Types of Contraction, Mobilisation exercises, Endurance exercises.	**7**
3	**PRINCIPLES IN MANAGEMENT OF COMMUNICATION:** Impairment-introduction to communication, Aphasia, Types of aphasia, Treatment of aphasic patient, Augmentative communication-general form of communication, types of visual aids, Hearing aids, Types of conventional hearing aid, Writing aids.	**7**
4	**ORTHOTIC DEVICES IN REHABILITATION ENGINEERING:** General orthotics, Classification of orthotics-functional & regional, General principles of Orthosis, Biomechanics of orthoses, merits & demerits of orthotics, Material design consideration in orthotics, Calipers-FO, AFO, KAFO, HKAFO. Spinal Orthosis, Cervical, Head cervical thoracic orthosis, Thoraco lumbar sacral orthosis, Lumbo sacro orthosis, Splints-its functions & types. **AMPUTATION:** Levels of Amputation – Surgical process, Expected Outcomes, Post operative dressings – Rigid dressings, Semi rigid dressings, Soft	**13**

	dressings, Examination- Range of Motion, Muscle Strength, Status of Residual Limb, Status of the un involved limb, Functional status, emotional status.	
5	**PROSTHETIC DEVICES:** Introduction, Partial Foot Prostheses- Foot-ankle assembly, Trans femoral Prostheses – Knee unit, Axis system, Friction Mechanisms, Extension aid, Stabilizers, Socket. Disarticulation Prostheses-Knee Disarticulation Prostheses, Hip Disarticulation Prostheses **MOBILITY AIDS:** Walking frames, Parallel bars, Rollators, Quadripods, Tripods & walking sticks, Crutches, Wheel chairs. Post cardiac operation rehab	**13**

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

COURSE OUTCOMES: The student will be able to

CO1: Understand the concept of rehabilitation and the role of rehabilitation team.

CO2: Implement and suggest therapeutic exercise techniques.

CO3: Understand aphasia and suggest different visual aids,hearing aids and writing aids.

CO4: Design and develop orthotic and prosthetic devices.

CO5: Differentiate between the different mobility aids.

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

TEXT BOOKS:

1. **Rehabilitation Medicine,** Dr. S. Sunder, Jaypee Medical Publications, New Delhi.
2. **Physical Rehabilitation**, Susan B O'Sullivan, Thomas J Schmitz. 5th edition

Sub Title: PROGRAMMING WITH PYTHON		
Sub Code: ML823	**No. of Credits : 4**	**No of lecture hours/week : 4**
Exam Duration : 3 hours	**CIE+Assignment+SEE =45+5+50=100**	**Total no. of contact hours: 52**

COURSE OBJECTIVES: To enable the students to Study
1. Understanding the syntax and semantics of the Python language.
2. To create Functions in Python.
3. To handle Files & Regular expressions in Python.
4. To apply Object Oriented Programming concepts in Python.

UNIT No	Syllabus Content	No of Hou
1	Introduction to Python Programming: Variables, Expressions and Statements: Values and types, Variables, Variable names and keywords, Statements, Operators and operands, Expressions, Order of operations, Modulus operator, String operations, Asking the user for input, Comments, Choosing mnemonic variable names. Conditional Execution: Boolean expressions, Logical operators, Conditional execution, Alternative execution, Chained conditionals, Nested conditionals, Catching exceptions using try and except, Short circuit evaluation of logical expressions.	10
2	Functions Iteration, Strings : Function calls, Built-in functions, Type conversion functions, Random numbers , Math functions, Adding new functions, Dentitions and uses, Flow of execution, Parameters and arguments, Fruitful functions and void functions, Why functions? Iteration: Updating variables, The while statement, Infinite loops and break, Finishing iterations with continue, Definite loops using for, Loop patterns. Strings: A string is a sequence, Getting the length of a string using len, Traversal through a string with a loop, String slices, Strings are immutable, Looping and counting, The in operator, String comparison, String methods, Parsing strings, Format operator.	**10**
3	Files ,Lists, Dictionaries, Tuples, Regular Expressions: Persistence, Opening files, Text files and lines, Reading files, Searching through a file, Letting the user choose the file name, Using try, except, and open, Writing files. 9 Lists: A list is a sequence, Lists are mutable, Traversing a list, List operations, List slices, List methods, Deleting elements, Lists and functions, Lists and strings, Parsing lines, Objects and values, Aliasing, List arguments. Dictionaries: Dictionary as a set of counters, Dictionaries and files, Looping and dictionaries, Advanced text parsing. Tuples: Tuples are immutable, Comparing tuples, Tuple assignment, Dictionaries and tuples, Multiple assignments with dictionaries, The most common words, Using tuples as keys in dictionaries, Sequences: strings, lists, and tuples. Regular expressions: Character matching in regular expressions, Extracting data using regular expressions, Combining searching and extracting, Escape character	**12**

4	**Classes and objects, Classes and functions, Classes and methods** User-defined compound types, Attributes, Rectangles, Instances as return values, Objects are mutable, Copying. Classes and Functions: Time, Pure functions, Modifiers, Prototyping development versus planning. Classes and Methods: Object-oriented features, Printing objects, Another example, A more complicated example, The init method, Operator overloading, Polymorphism.	**10**
5	**Linked Lists and Stack:** Embedded references, The Node class, Lists as collections, Lists and recursion, Infinite lists, The fundamental ambiguity theorem, Modifying lists, Wrappers and helpers, The Linked List class, Invariants. Stacks: Abstract data types, The Stack ADT, Implementing stacks with Python lists, Pushing and popping, Using a stack to evaluate postfix, Parsing, Evaluating postfix, Clients and providers. Queues: The Queue ADT, Lnked Queue, Performance characteristics, Priority queue, The Golfer class	**10**

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

COURSE OUTCOMES: On Completion of the course the students should be able to:

CO1: Examine Python syntax and semantics and be fluent in the use of Python flow control and functions.
CO2: Demonstrate proficiency in handling Strings and File Systems.
CO3: Create, run and manipulate Python Programs using core data structures like Lists, Dictionaries and use Regular Expressions.
CO4: Interpret the concepts of Object-Oriented Programming as used in Python.
CO5: Implement exemplary applications related to Network Programming, Web Services and Databases in Python.

COs	Mapping with POs
CO1	PO1, PO2, PO3, PO4, PO12
CO2	PO1, PO2, PO3, PO12
CO3	PO1,PO2,PO3, PO4, PO9
CO4	PO1,PO2,PO3, PO9
CO5	PO1, PO2,PO3,PO4, PO5, PO10, PO12

TEXT BOOKS:

1. **Python for Informatics** , Charles Severance, 1st Edition, CreateSpace Independent Publishing Platform, 2013.
2. **How to Think Like a Computer Scientist: Learning with Python** , Peter Wentworth, Jeffrey Elkner, Allen B. Downey, Chris Meyers 2nd Edition, Open Book Project, 2012.

REFERENCE BOOKS:

1. **Learning Python**, Mark Lutz, 5th Edition, O'Reilly Media, 2013.
2. **Core Python Applications Programming** Wesley Chun 3rd Edition, 2012
3.**Python in a Nutshell**, Alex Martelli, 2nd Edition, 2006 .
4. http://openbookproject.net/thinkcs/python/english2e/

Sub Title: Project Phase II		
Sub Code: MLP83	**No of Credits 12:00:00**	**No of lecture hours/week :**
	Exam Marks : 100	

COURSE OBJECTIVES: To enable the students to Study

1. Realise their technical ideas into a working mode
2. Interact with outside world
3. Work in a group in a collaborative and productive manner

The project topics and batch mates are decided in Project Phase 1. The project work is carried out in group of 3 or 4. Industry projects are encouraged and promoted. The Project topic and the design presented in the phase I has to be implemented with the guidance of a teacher assigned to the batch. The students will finally make an oral presentation and also submit a technical report.

Course Outcome: The students will be able to

CO1: Realise innovative ideas into working models
CO2: Discuss ideas, plan and work in a peer team to develop a system
CO3: Design a cost effective model within the time
CO4: Interact with industry experts
CO5: Document and present the technical project report

Cos	**Mapping with Pos**
CO1	PO1,PO2,PO3,PO4,PO5,PO6,PO7, PO12
CO2	PO9,PO10, PO11,
CO3	PO4, PO5, PO11, PO12,
CO4	PO9, PO10,PO11, PO12
CO5	PO10, PO12

INTER DEPARTMENT ELECTIVE 2 (GROUP H)

Sub Title: MEDICAL DEVICES SAFETY & REGULATIONS		
Sub Code: MLE02	**No of Credits : 04:00:00**	**No of lecture hours/week :04**
Exam Duration : 3 hours	**Exam Marks : 100**	**Total No. of Contact Hrs. 52**

COURSE OBJECTIVES: To enable the students to study

1. Device types, Regulations and Standards and approval process of Medical Devices
2. Patient safety and precautions
3. Knowledge of FDA terminologies
4. Validation process for medical device hardware and software

UNIT No	Syllabus Content	No of Lecture Hours
1	**Classification of Device:** Device classes, **PATIENT SAFETY**: Electric shock hazards, Leakage currents, macro shock, micro shock hazards and preventions, safety codes and analyzer. safety & precautions Safety aspects in electro surgical systems	10
2	**Safety Aspects in Medical Imaging systems:** Biological effects of ionizing radiation- Determinants of biological effects, Short term & long term effects Ultrasound bio-effects, Radio biology of nuclear medicine, biological effects of magnetic field Laser safety- fundamentals, safety consideration of lasers **Reliability**: Types of Reliability, Optimizing reliability, Reliability's effects on medical devices	10
3	**Definition:** Defining the device, The product definition process, Overview of quality function deployment, The QFD process, The business proposals **Concept of Failure**: Various methods of CAPA **Safety and Risk Management:** Personnel safety and hygiene, Medical device safety and risk management, The role of each participant/stakeholder, Shared responsibility for medical device safety and performance. Electrical safety and different standards. Testing and verification of medical devices	10

4	**The Food and Drug Administration:** Device classification, Registration and listing, The 510 (k) Process, Declaration of conformance to a recognized standard, The PMA application, Investigational Device Exemptions (IDEs), Good Laboratory Practices (GLPs), Good Manufacturing Practices (GMPs), The FDA and Software, Software classification, The FDA Inspection **The European Union Directives:** European Directives, European Standardization Bodies, European Standards Development Process, Other European Standards Considerations, Conformity Assessment and Testing, European Organization for Testing and Certification, Final documents from the GHTF, Global Medical Device Nomenclature (GMDN), ECRI	**12**
5	**Standards and Regulations Background:** Voluntary and mandatory standards, Standards development process, Conformity assessment with standards, National and international standards systems, Identification of standards, Current trends in the use of standards in medical device regulations. **The ISO 9000 Series of Standards, The Medical Devices Directives:** Definition of a medical device, The Medical Devices Directives process, Choosing the appropriate directive, Identifying the applicable essential requirements, Identification of corresponding harmonized standards, Essential requirements, Classification of the device based on conformity, Medical Devices Directives, Active Implantable Medical Devices Directives, *In-vitro* Diagnostic Medical Devices Directives. NABH, NABL, JCI, AERB , WHO guidelines on medical devices	**10**

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

COURSE OUTCOMES: Completion of this course the student would have learnt
CO1: Classify medical device, its processes encompassing safety and precautions
CO2: Identify the hazards in various modalities of imaging systems and adapt safety measures
CO3: Define the medical device, its processes and risk management.
CO4: Identify the objectives and functions of FDA and EU.
CO5: Analyze various medical device standards and regulations

Cos	**Mapping with Pos**
CO1	PO6, PO7, PO8
CO2	PO6,PO7,PO8
CO3	PO6, PO7, PO8
CO4	PO7,PO8, PO12
CO5	PO6, PO7, PO8, PO12

TEXT BOOKS:

1. **Reliable Design of Medical Devices**, Second Edition by Richard Fries, CRC Press, 2006.
2. **Medical Device Quality Assurance and Regulatory Compliance**, Richard C Fries, CRC Press, 1998.

REFERENCE BOOKS:

1. **Medical device regulations: global overview and guiding principles** , Michael Cheng, World Health Organization.
2. **Product Safety in the European Union** , Gábor Czitán, Attila Gutassy, Ralf Wilde, TÜV Rheinland Akadémia, 2008.

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SCHEME OF TEACHING AND EXAMINATION

B.E Medical Electronics Batch 2018-2022

Outcome Based Education (OBE) and Choice Based Credit System (CBCS)

III SEMESTER

Sl. No	Course and Course Code		Course Title	Teaching Department	Teaching Hours /Week			Examination				Credits
					Theory Lecture	Tutorial	Practical/ Drawing	Duration in hours	CIE Marks	SEE Marks	Total Marks	
					L	T	P					
1	BC	18MA31	Transforms and Applications	Mathematics	3	0	0	03	50	50	100	3
2	PC	18ML31	Analog Electronic Circuits	ML	3	0	0	03	50	50	100	3
3	PC	18ML32	Logic Design & VHDL	ML	2	2	0	03	50	50	100	3
4	PC	18ML33	Medical Science	ML	3	0	0	03	50	50	100	3
5	PC	18ML34	Network Analysis	ML	2	2	0	03	50	50	100	3
6	PC	18ML35	Sensors and Measurement	ML	3	0	0	03	50	50	100	3
7	PC	18ML36	OOPs & Data Structure	ML	3	0	0	03	50	50	100	3
8	PC	18MLL37	Analog Electronic Circuits Lab	ML	0	0	2	02	50	50	100	1
9	HS	18MLL38	Logic Design Lab	ML	0	0	2	02	50	50	100	1
10	MC	18HS31/32	CIPH/ Env.Studies	Humanities	2			02	50	-	50	1
11	MC	18HS33	Soft Skills	Humanities	2			02				-
				TOTAL	23	04	04	29	500	450	950	**24**

Course prescribed to lateral entry Diploma holders admitted to III semester of Engineering programs

12	MC	18MAD31	Advance Mathematics - I	Mathematics	02	01	--	03	50		50	-

(a) **The mandatory non - credit courses** Advance Mathematics I and II prescribed at III and IV semesters respectively, to lateral entry Diploma holders admitted to III semester of BE programs shall compulsorily be registered during respective semesters to complete all the formalities of the course and appear for SEE examination.

(b) **The mandatory non - credit courses** Advance Mathematics I and II, prescribed to lateral entrant Diploma holders admitted to III semester of BE programs, are to be completed to secure eligibility to VII semester. However, they are not considered for vertical progression from II year to III year of the programme but considered as head of passing along with credit courses of the programme to eligibility to VII semester.

Note: BC: Science Course, PC: Professional Core. HS: Humanities, MC: Mandatory Course.

Dr. Ambedkar Institute of Technology, Bengaluru-560 056

SCHEME OF TEACHING AND EXAMINATION

B.E Medical Electronics Batch 2018-2022

Outcome Based Education (OBE) and Choice Based Credit System (CBCS)

IV SEMESTER

Sl. No	Course and Course Code		Course Title	Teaching Department	Teaching Hours /Week			Examination				Credits
					Theory Lecture	Tutorial	Practical/ Drawing	Duration in hours	CIE Marks	SEE Marks	Total Marks	
					L	T	P					
1	BC	18MA41	Probability, Numerical and Optimisation Technique	Mathematics	3	0	0	03	50	50	100	3
2	PC	18ML41	Microcontrollers	ML	3	0	0	03	50	50	100	3
3	PC	18ML42	Communication System	ML	3	0	0	03	50	50	100	3
4	PC	18ML43	Signals & Systems	ML	3	2	0	03	50	50	100	4
5	PC	18ML44	Biomedical Instrumentation	ML	4	0	0	03	50	50	100	4
6	PC	18ML45	Linear IC's And Applications	ML	3	0	0	03	50	50	100	3
7	PC	18MLL46	OOPS & Data Structure Lab	ML	0	0	2	03	50	50	100	1
8	PC	18MLL47	Microcontroller Lab	ML	0	0	2	03	50	50	100	1
9	PC	18MLL48	Linear Integrated Circuits Lab	ML	0	0	2	03	50	50	100	1
10	HS	18HS41/42	CIPH/ Env. Studies	Humanities	2	0	0	02	50	-	50	1
11	MC	18HS43	Employability Skills	Humanities	2	0	0	-				-
			TOTAL		23	2	6	29	500	450	950	**24**

Course prescribed to lateral entry Diploma holders admitted to III semester of Engineering programs

12	MC	18MAD31	Advance Mathematics - I	Mathematics	02	01	--		50		50	-

(a) **The mandatory non - credit courses** Advance Mathematics I and II prescribed at III and IV semesters respectively, to lateral entry Diploma holders admitted to III semester of BE programs shall compulsorily be registered during respective semesters to complete all the formalities of the course and appear for SEE examination.

(b) **The mandatory non - credit courses** Advance Mathematics I and II, prescribed to lateral entrant Diploma holders admitted to III semester of BE programs, are to be completed to secure eligibility to VII semester. However, they are not considered for vertical progression from II year to III year of the programme but considered as head of passing along with credit courses of the programme to eligibility to VII semester.

Note: BC: Science Course, PC: Professional Core. HS: Humanities, MC: Mandatory Course.

Dr. Ambedkar Institute of Technology, Bengaluru-560 056

SCHEME OF TEACHING AND EXAMINATION

B.E Medical Electronics Batch 2018-2022

Outcome Based Education (OBE) and Choice Based Credit System (CBCS)

V SEMESTER

Sl. No	Course and Course Code		Course Title	Teaching Department	Teaching Hours /Week			Examination				Credits
					Theory Lecture	Tutorial	Practical/ Drawing	Duration in hours	CIE Marks	SEE Marks	Total Marks	
					L	T	P					
1	HS	18HS51/52	M&E/IPR	Humanities	3	0	0	03	50	50	100	3
2	PC	18ML51	Digital Image Processing	ML	3	0	0	03	50	50	100	3
3	PC	18ML52	Medical Imaging Systems	ML	3	0	0	03	50	50	100	3
4	PC	18ML53	Physiological Control Systems	ML	3	2	0	03	50	50	100	4
5	PC	18ML54	Digital Signal Processing	ML	3	0	0	03	50	50	100	3
6	PE	18ML55X	Professional Elective-1	ML	3	0	0	03	50	50	100	3
7	OE	18MLE56	Open Elective -A	ML	3	0	0	03	50	50	100	3
8	PC	18MLL57	Biomedical Instrumentation Lab	ML	0	0	2	03	50	50	100	1
9	PC	18MLL58	Digital Signal Processing Lab	ML	0	0	2	03	50	50	100	1
10	PC	18MLL59	Biomedical Digital Signal & Image Processing Lab	ML	0	0	2	03	50	50	100	1
				TOTAL	21	2	6	30	500	500	1000	**25**

Note: BC: Science Course, PC: Professional Core. HS: Humanities, MC: Mandatory Course.

Professional Elective -1	
18ML551	Embedded Systems & IOT applications
18ML552	Clinical Engineering
18ML553	ARM Processor

Open Elective :18 MLE01 Biomedical Engineering

Students can select any one of the open electives (Please refer to consolidated list of Dr AIT for open electives) offered by any Department. Selection of an open elective is not allowed provided,

- The candidate has studied the same course during the previous semesters of the programme.
- The syllabus content of open elective is similar to that of Departmental core courses or professional electives.
- A similar course, under any category, is prescribed in the higher semesters of the programme.

Registration to electives shall be documented under the guidance of Programme Coordinator

Dr. Ambedkar Institute of Technology, Bengaluru-560 056

SCHEME OF TEACHING AND EXAMINATION

B.E Medical Electronics Batch 2018-2022

Outcome Based Education (OBE) and Choice Based Credit System (CBCS)

VI SEMESTER

Sl. No	Course and Course Code		Course Title	Teaching Department	Teaching Hours /Week			Examination				Credits
					Theory Lecture	Tutorial	Practical/ Drawing	Duration in hours	CIE Marks	SEE Marks	Total Marks	
					L	T	P					
1	HS	18HS61/62	M&E/IPR	Humanities	3	0	0	03	50	50	100	3
2	PC	18ML61	Biomedical Digital Signal Processing	ML	3	0	0	03	50	50	100	3
3	PC	18ML62	Laser & Fibre Optics in Medicine	ML	3	0	0	03	50	50	100	3
4	PC	18ML63	Biomedical Equipments	ML	3	0	0	03	50	50	100	3
5	PC	18ML64	Medical Physics	ML	3	0	0	03	50	50	100	3
6	PE	18ML65X	Professional Elective -2	ML	3	0	0	03	50	50	100	3
7	OE	18MLE66	Open Elective -B	ML	3	0	0	03	50	50	100	3
8	PC	18MLL67	Operation & Testing of Medical Devices Lab	ML	0	0	2	02	50	50	100	1
9	MP	18MLMP68	Mini-project	ML	-	-	-	03	50	50	100	2
10	INT	18MLI69	Industry Internship	(To be carried out during the intervening vacations of VI & VII semester)	-	-	-	-	-	-	-	-
				TOTAL	21	0	2	26	450	450	900	**24**

Note: PC: Professional core, PE: Professional Elective, OE: Open Elective, MP: Mini-Project, INT: Internship.

Hospital Training has to be carried out for a period of 10 working days after the completion of 5th semester examination

Professional Elective-2	
18ML651	Infrared Imaging & Applications
18ML652	Medical Informatics
18ML653	VLSI Design

Open Elective - B	
18MLE02	Medical Informatics

Dr. Ambedkar Institute of Technology, Bengaluru-560 056

SCHEME OF TEACHING AND EXAMINATION

B.E Medical Electronics Batch 2018-2022

Outcome Based Education (OBE) and Choice Based Credit System (CBCS)

VII SEMESTER

Sl. No	Course and Course code		Course Title	Teaching Department	Teaching Hours /Week			Examination				Credits
					Theory Lecture	Tutorial	Practical / Drawing	Duration in hours	CIE Marks	SEE Marks	Total Marks	
					L	T	P					
1	HS	18HS71/72	CMEP / OSHA	IEM/CV	2	0	0	02	50	50	100	2
2	PC	18ML71	Neural Network & Machine Learning	ML	3	0	0	03	50	50	100	3
3	PC	18ML72	Medical Device Regulations	ML	3	0	0	03	50	50	100	3
4	PC	18ML73	Bio- Mechanics	ML	3	0	0	03	50	50	100	3
5	PE	18ML74X	Professional Elective -3	ML	3	0	0	03	50	50	100	3
6	PE	18ML75X	Professional Elective -4	ML	3	0	0	03	50	50	100	3
7	OE	18MLE76	Open Elective -B	ML	3	0	0	03	50	50	100	3
8	PC	18MLL77	Java Lab	ML	0	0	2	02	50	50	100	1
9	Project	18MLP78	Project Work Phase - 1	ML	--	--	2	-	50	-	50	2
10	INT	18MLI79	Internship	(If not completed after VI semester examinations, it has to be carried out during the intervening vacations of VII and VIII semesters)				--	--	--	--	--
				TOTAL	20	0	4	22	450	400	850	**23**

Note: PC: Professional Core, PE: Professional Elective, OE: Open Elective, INT: Internship, MC: Mandatory Course

Internship: All the students admitted to III year of BE have to undergo mandatory internship of 4 weeks during the vacations of VI and VII semesters and /or VII and VIII semesters. A SEE examination will be conducted during VIII semester and prescribed credits shall be added to VIII semester. Internship is considered as a head of passing and is considered for the award of degree. Those, who do not take-up/complete the internship will be declared as failed and have to complete during subsequent SEE examination after satisfy the internship

CMEP: Cost Management of Engg. Projects, OSHA: Occupational Safety and Health Administration

Professional Elective -3		Professional Elective - 4	
18ML741	Biosensors & BioMEMS	18ML751	Biomaterials & Artificial Organs
18ML742	Rehabilitation Engineering	18ML752	Bio-Metric Systems
18ML743	Picture Archiving & Communication Standards	18ML753	Biomedical Nanotechnology

Open Elective- C	
18MLE76	Medical Devices Safety and Regulations

Dr. Ambedkar Institute of Technology, Bengaluru-560 056

SCHEME OF TEACHING AND EXAMINATION

B.E Medical Electronics Batch 2018-2022

Outcome Based Education (OBE) and Choice Based Credit System (CBCS)

VIII SEMESTER

Sl. No	Course and Course code		Course Title	Teaching Department	Teaching Hours /Week			Examination				Credits
					Theory Lecture	Tutorial	Practical/ Drawing	Duration in hours	CIE Marks	SEE Marks	Total Marks	
					L	T	P					
1	HS	18HS81/82	CMEP / OSHA	IEM /CV	2	--	--	02	50	50	100	2
2	Project	18MLP81	Project Work Phase -2		--	--	2	03	50	50	100	10
3	Seminar	18MLS82	Technical Seminar		--	--	2	-	50	-	50	1
4	INT	18MLI83	(Completed during the intervening vacations of VI and VII semesters and /or VII and VIII semesters.)	(Completed during the intervening vacations of VI and VII semesters and /or VII and VIII semesters.)				--	50	50	100	2
				TOTAL	2	--	4	05	200	150	350	**15**

Note: PC: Professional Core, PE: Professional Elective, OE: Open Elective, INT: Internship, MC: Mandatory Course

CMEP: Cost Management of Engg. Projects, OSHA: Occupational Safety and Health Administration

Sub Title : ANALOG ELECTRONIC CIRCUITS		
Sub Code: 18ML31	**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	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: Draw equivalent circuit models for BJTs and MOSFET
CO2: Determine the cut off frequencies for practical transistor amplifiers
CO3: Classify feed back amplifiers and power amplifiers
CO4: Illustrate the procedure & working of construction of FET, MOSFET
CO5: Design biasing circuits MOSFETS
CO6: Differentiate the amplifier and switch functionality of 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
CO5	PO1,PO2,PO3,PO4
CO6	PO1,PO2,PO3,PO4

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.

Sub Title : LOGIC DESIGN and VHDL		
Sub Code: 18ML32	**No of Credits : 3=2:2:0(L-T-P)**	**No of lecture hours/week : 4**
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**	-

<u>Note 1</u>: 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,PO4,PO6,
CO5	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.

Sub Title : MEDICAL SCIENCE		
Sub Code: 18ML33	**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	**8**
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	**8**

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
CO4	PO1,PO2,PO3,PO4
CO5	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.

Sub Title : NETWORK ANALYSIS		
Sub Code: 18ML34	**No of Credits : 3=2:2:0(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. 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**

Note2: 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: Understand and apply network theorems
CO5: 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	PO1,PO2,PO3
CO5	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.

Sub Title : SENSORS AND MEASUREMENT		
Sub Code: 18ML35	**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
CO2	PO1,PO2,PO3,PO4
CO3	PO1,PO2,PO3,PO12
CO4	PO6, PO8
CO5	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.

Sub Title: OOPs AND DATA STRUCTURES		
Sub Code: 18ML36	**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: Assignments to be carried out as practical sessions and report to be submitted
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.

Sub Title : ANALOG ELECTRONIC CIRCUITS LAB		
Sub Code: 18MLL37	**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

Sub Title : LOGIC DESIGN LAB		
Sub Code: 18MLL38	**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

IV SEMESTER

Sub Title : MICROCONTROLLERS		
Sub Code: 18ML41	**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: 18ML42	**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.

Sub Title : SIGNALS & SYSTEMS		
Sub Code: 18ML43	**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.

Sub Title: BIOMEDICAL INSTRUMENTATION		
Sub Code: 18ML44	**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.	**10**

	Electric shock hazards, Leakage currents, macro shock, micro shock hazards and preventions, Electrical safety analyzer & precautions. Electrical safety codes standards.	

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.

Sub Title : LINEAR IC's AND APPLICATIONS		
Sub Code: 18ML45	**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**

<u>Note 1</u>: 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.

Sub Title: OOPs AND DATA STRUCTURE LAB		
Sub Code: 18MLL46	**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

Sub Title : MICROCONTROLLER LAB		
Sub Code: 18MLL47	**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

Sub Title: LINEAR INTEGRATED CIRCUITS LAB		
Sub Code: 18MLL48	**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

V **SEMESTER**

Sub Title: DIGITAL IMAGE PROCESSING		
Sub Code:18ML51	**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 OBJECTIVE: To enable the students to study

1. To discuss the fundamental concepts of digital image processing
2. To discuss image enhancement technique in spatial and frequency domain.
3. To discuss image segmentation and restoration technique in spatial and frequency domain

UNIT No	Syllabus Content	No of Hours
1	**DIGITAL IMAGE FUNDAMENTALS** Digital image representation, fundamental steps in digital image processing, Simple image model, basic relationships between pixels: neighborhood of a pixel, connectivity. Color models and transformations, pseudo color image processing,	8
2	**IMAGE ENHANCEMENT** Basic gray level transformations, histogram, histogram equalization, basics of spatial filtering, smoothing and sharpening spatial filters, edge detection method. Introduction to the frequency domain, smoothing and sharpening frequency domain filters, homomorphic filtering.	8
3	**IMAGE SEGMENTATION** Detection of discontinuities, edge linking & boundary detection, thresholding, region based segmentation, morphological watersheds.	8
4	**IMAGE RESTORATION** Degradation model, Noise models, restoration in the presence of noise only (Spatial and frequency domain filters), Inverse filtering, LMS filtering, Wiener filter.	8
5	**IMAGE COMPRESSION** Fundamentals, image compression models, error-free compression, lossy and lossless predictive coding, wavelet coding, JPEG 2000 coding,	7

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Note1: Assignment-1 from unit 1 and 2.

Asssignment-2 from unit 3, 4 and 5

COURSE OUTCOMES: The students will be able to

CO1: Understand the basic image processing concepts such as relationship between pixels and color models
CO2: Implement image enhancement techniques in spatial & frequency domain
CO3: Understand and apply image segmentation techniques to any given image
CO4: Understand various degradation models and apply the image restoration techniques
CO5: Perform image compression using lossy and lossless techniques

COs	Mapping with POs
CO1	PO1,PO2,PO3,PO4
CO2	PO1,PO2,PO3
CO3	PO1,PO2,PO3,PO4,PO5,PO7,PO11,PO12
CO4	PO1,PO2,PO3,PO4,PO5,PO7,PO11,PO12
CO5	PO1,PO2,PO3,PO4,PO5,PO7,PO11,PO12

Text Books:

1. **Digital Image Processing** , R C Gonzalez & R E Woods, Pearson Education, 3 edition.
2. **Digital Image Processing and Computer Vision** , Milan Sonka, Cengage learning, First edition.

Reference Books:

1. **Digital Image Processing** , S.Jayaraman, S.Esakkirajan, T.Veerakumar, Tata Mcgraw Hill, 2009.
2. **Fundamentals of Digital Image processing** , A K Jain, PHI / Pearson Education, 1989.
3. **Digital Image Processing** , Sid Ahmed, McGraw Hill.

Sub Title: MEDICAL IMAGING SYSTEMS		
Sub Code: 18ML52	**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:

1. To understand x-ray generation and biological effects.
2. To study different x-ray diagnostic methods.
3. To study CT imaging concepts, fundamental of Magnetic resonance imaging..
4. To study Generation and detection of ultrasound and its techniques.
5. To study the principles of Radionuclide imaging.

UNIT No	Syllabus Content	No of Hours
1	**X-RAY IMAGING:** Generation and Detection of X-rays – X-ray generation, X-ray generators, Filters, Beam restrictors and grids, Intensifying screens, fluorescent screens, and image intensifiers, X-ray detectors, X-ray image characteristics – Spatial resolution, Image noise, Image contrast, Receiver operating curve (ROC), Biological effects of ionizing radiation.	**7**
2	**X-RAY DIAGNOSTIC METHODS:** Conventional X-ray radiography, Fluoroscopy, Angiography, Mammography and Xeroradiography, Image subtraction. **COMPUTED TOMOGRAPHY:** Conventional tomography, Computed tomography – Radon Transform (Projections) and Fourier Slice theorem, Algorithms for image reconstruction: parallel and Fan beam data, Spiral CT. Recent developments – Digital radiography.	**8**
3	**ULTRASOUND IMAGING:** Generation and detection of Ultrasound-Piezoelectric effect, Ultrasonic transducers, **ULTRASONIC DIAGNOSTIC METHODS :**Pulse echo systems-Amplitude mode (A-mode), Brightness mode (B-mode), Motion mode (M-mode), Constant depth mode (C-mode), Doppler methods, Duplex imaging, Tissue characterization, Colour Doppler flow imaging, Image characteristics – Ultrasonic texture or speckle, Speckle reduction, Compensation of phase aberration, Biological effects of ultrasound.	**8**

4	**RADIONUCLIDE IMAGING:** Generation & Detection of Nuclear Emission – Radionuclide generators, nuclear radiation detectors, Collimators, Radionuclide imaging systems- Gamma Camera, SPECT, PET. **BASICS OF MAGNETIC RESONANCE IMAGING:** fundamentals of nuclear magnetic resonance- Angular momentum, magnetic dipole moment, magnetization, Larmor frequency, Rotating frame of reference and RF magnetic field, Free induction decay (FID), Fourier spectrum of the NMR signal, Spin density, Relaxation times, Pulse sequences.	**8**
5	**MRI SYSTEM & IMAGING METHODS : M**agnetic field gradients, NMR Coil/Probe, Transmitter, Receiver, Data acquisition. Imaging Methods- Introduction, slice selection, frequency encoding, phase encoding, Spin-Echo imaging- Characteristics of MRI images- spatial resolution, image contrast. Functional MRI.DICOM Standards **Mandatory** assignments/seminars on latest developments in each of the modalities.	**8**

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

COURSE OUTCOMES: On the completion of the course the students will be able to
CO1: Understand the different imaging modalities such as x-ray, CT, Ultrasound & MRI
CO2: Understand the reconstruction of images from above imaging modalities using different transforms.
CO3: Understand the properties of radio nuclides and its applications
CO4: Understand the medical image communication standard.
CO5: Explore the latest trends & happenings in the subject

COs	Mapping with POs
CO1	PO1,PO6,PO7, PO12
CO2	PO1,PO6,PO12
CO3	PO5,PO12
CO4	PO6,PO8,PO12
CO5	PO10,PO11, PO12

.

TEXT BOOKS:

1. **Principles of Medical Imaging**, Kirk Shung, Michael B. Smith and Banjamin Tsui, Academic Press, 1992.
2. **Handbook of Biomedical Instrumentation**, R.S.Khandpur, Tata McGraw Hill, 2nd Edition, 2003.

REFERENCE BOOK:

1. **Fundamentals of Medical Imaging**, Paul Suetens, Cambridge University Press, 2002.

Sub Title : PHYSIOLOGICAL CONTROL SYSTEMS		
Sub Code:18ML53	**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:

1. To discuss the mathematical modeling of systems.
2. To distinguish physiological and engineering control system.
3. Learn the time response of feedback control systems.
4. Learn the different methods of stability analysis (in time domain and frequency domain).

UNIT No	Syllabus Content	No of Lecture Hours	No of Tutorial Hours
1	**Modeling of Systems:** The control system, Mathematical models of physical systems – Introduction, Differential equations of physical systems – Mechanical systems, Friction, Translational systems (Mechanical accelerometer, Levered systems excluded),	**7**	**5**
2	**Introduction To Physiological Control Systems:** Preliminary considerations, Historical Background, System analysis, Physiological systems-A simple example, Differences between engineering & physiological control systems. **Mathematical Modeling:** Generalized system properties, Models with combination of system elements, Linear models of physiological systems-respiratory and muscle mechanics.	**7**	**1**
3	**Time Response of feedback control systems**: Standard test signals, Unit step response of First and second order systems, Time response specifications, Time response specifications of second order systems, steady – state errors and error constants. **Static Analysis Of Physiological Systems:** regulation of cardiac output, regulation of glucose, chemical regulation of ventilation.	**8**	**5**
4	**Stability analysis:** Concepts of stability, Necessary conditions for Stability, Routh- stability criterion, Relative stability analysis; More on the Routh stability criterion. frequency response model of a circulatory control, frequency response of glucose-insulin regulation. stability analysis of pupillary light reflexes. **Root–Locus Techniques**: Introduction, The root locus concepts, Construction of root loci.	**9**	**7**

5	**Stability in the frequency domain:** Mathematical preliminaries, Nyquist Stability criterion, Assessment of relative stability using Nyquist criterion, **Frequency domain analysis:** Introduction, Correlation between time and frequency response, Bode plots, frequency response model of a circulatory control, frequency response of glucose-insulin regulation. **MATLAB Exercise (Practice only) :**	**9**	**7**

Note1: Assignment-1 from unit 1 and 2.
Asssignment-2 from unit 3, 4 and 5 and simulation experiments using MATLAB

COURSE OUTCOMES: The students will be able to

CO1: Understand and develop mathematical modeling of mechanical & electrical systems.
CO2: Mathematically model the physiological systems & relate it to the engineering control system
CO3: Understand and determine the time domain parameters of first and second order system.
CO4: Apply the different methods of stability analysis in time domain & frequency domain
CO5: Verify the systems using simulation tools such as MATLAB.

Cos	Mapping with Pos
CO1	PO1,PO3
CO2	PO1,PO3
CO3	PO3,PO4, PO6,
CO4	PO3,PO4, PO6,
CO5	PO5, PO12

TEXT BOOK :

1. **Control Systems Engineering**, J. Nagarath and M.Gopal, New Age International (P) Limited, Fourth edition ,2005.
2. **Physiological Control Systems – Analysis, Simulation & Estimation**, Michael C Khoo, Wiley IEEE press.

REFERENCE BOOKS:

1. **Modern Control Engineering ,** K. Ogata, Pearson Education Asia/ PHI, 4th Edition, 2002.
2. **Concepts of Control Systems,** P. S. Satyanarayana; Dynaram publishers, 2001.
3. **Control Systems Principles and Design,** M. Gopal, TMH, 1999.
4. **Feedback control system analysis and synthesis,** J. J. D'Azzo and C. H. Houpis, McGraw Hill, International student Edition.
5. **Biological Control System Analysis** by Milsum John, McGraw Hill
6. **Control Theory and Physiological Feedback Mechanism** by William Baltimore

Sub Title: DIGITAL SIGNAL PROCESSING		
Sub Code: 18ML54	**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 :Is to make the student understand

1. The Discrete Fourier Transform
2. The Fast Fourier Transform
3. FIR and IIR Filters
4. Drawing Digital filter structure

Unit No	Syllabus Content	No of Hours
1	**DISCRETE FOURIER TRANSFORM: INTRODUCTION**, definition of DFT, properties of DFT, circular convolution, linear convolution using DFT.	**8**
2	**FAST FOURIER TRANSFORM: INTRODUCTION**, decimation in time FFT algorithm, computational efficiency, decimation in frequency algorithm.	**8**
3	**FIR FILTER DESIGN:** Introduction, different types of windows- rectangular, Bartlett, Hanning, Hamming, design of FIR filters using above windows, **ANALOG FILTER DESIGN:** Introduction, Butterworth filters, Chebyshev filters, general filter forms	**8**
4	**DESIGN OF IIR DIGITAL FILTER:** Introduction, design of IIR digital filter through analog filters, impulse invariant transformations, bilinear transformations, design of digital Butter worth frequency transformation. comparison of IIR & FIR digital filters.	**8**
5	**REALISATION OF DIGITAL SYSTEMS:** Introduction, Block diagram and signal flow graph, basic IIR filter structures (Direct forms I & II), cascade and parallel realisations, basic FIR filter structures (Direct forms I & II), and linear phase FIR structures	**7**

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

COURSE OUTCOMES: The student will be able to

CO1: Understand the properties of DFT and interpret the frequency analysis of the sequences
CO2: Understand the FFT algorithm and derive the representation in the frequency domain.
CO3: Design Butterworth IIR filter
CO4: Design FIR filters using different windowing techniques .
CO5: Understand the practical realization of filters and the hardware resources

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

TEXT BOOKS:

1. **Digital Signal Processing,** Proakis and Manolakis, Prentice Hall of India , 3rd Edition.
2. **Time frequency and wavelet applications in biomedical signal processing,** Metin Akay, IEEE Wiley Press.

REFERENCE BOOKS:

1. Digital Signal Processing, S K Mitra, Mc Graw-Hill, 4th Edition.
2. Theory and Application of DSP, Rabinar L R and Gold B, Prentice Hall of India, 1999.
3. Introduction to digital signal processing, Johnson, Prentice Hall of India ,1999.
4. Digital Signal Processing,Alan V Oppenheim, Prentice Hall of India.
5. DSP using Matlab, Prokis & Ingle , Cengage Learning, 1st edition.

PROFESSIONAL ELECTIVE 1

Sub Title: EMBEDDED SYSTEMS & IOT APPLICATIONS		
Sub Code: 18ML551	**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 learn

1.The concepts of embedded programming in the context of 8051
2 .Design constraints of 8051 for embedded applications
3. Embedded C
4. TI Processor- MSP 430

Unit No	Syllabus Content	No of Hours
1	**Introduction to Embedded Systems** Embedded system, Choice of processor, programming language and operating system, Conclusions **Reading Switches:** Introduction, Basic techniques for reading from port pins, Example: Reading and writing bytes, Example: Reading and writing bits (simple version), Example: Reading and writing bits (generic version), The need for pull-up resistors, Dealing with switch bounce, Example: Reading switch inputs (basic code), Example: Counting goats, Conclusions**.**	**7**
2	**Adding Structure to the Code** Introduction, Object-oriented programming with C, The Project Header (MAIN.H), The Port Header (PORT.H), Examples	**8**
3	**MSP430G2553:** Block diagram and study. **MSP EXP 430 G2 Launch Pad –** components. **Examples**- LED control using a switch, serial communication	**8**
4	**Interfacing**: seven segment displays and Liquid Crystal displays with MSP430, Introduction to MSP 430 timer modules and its modes of operation, generating Pulse Width Modulation using Timer Capture Mode. ADC operation in MSP430	**8**
5	**Internet of Things** Embedded Systems-an overview, features. Networked Embedded System- types and overview, wireless communication standards-zigbee, Bluetooth & Wi-Fi. OSI & TCP/IP model in a nutshell. Introduction to the Internet and understand how internet works. Introduction to Smart Objects or Things. **IOT applications** IOT- understand what IOT is and discuss its application in health-care systems- Patient Monitoring & diagnostics, Home healthcare & Personal care & Fitness. Case Study: Wireless Patient Monitor system. Application Design: Design of IOT based pulse oximeter, block diagram, concepts of analog front end, signal process and Wi-Fi integration.	**8**

Note 1: No questions on Review portions from Unit 1

Note 2: Assignment-1 from unit 1 and 2.

Asssignment-2 Reports based on Training on MSP 430 & IOT Applications

COURSE OUTCOMES: The student will be able to

CO1: Design and development of embedded system using microcontroller 8051
CO2: Apply the programming skills of embedded C for any microcontroller
CO3: Understand TI -MSP430 processor and develop coding using the launch pad
CO4: Design & Develop interfacing applications using MSP 430
CO5: Understand the fundamentals of IOT protocols & IOT applications

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

TEXT BOOKS:

1. Embedded C - Michael J. Pont, 2nd Ed., Pearson Education, 2008
2. TI- MSP430 Launch Pad Manual

REFERENCE BOOKS:

1. PICmicro MCU C-An introduction to programming, The Microchip PIC in CCS C - Nigel Gardner
2. Getting Started with Internet of Things- CunoPfister, 2011
3. Interconnecting Smart Objects with IP- J. P Vasseur, Adam Dunkels, 2010

Sub Title: CLINICAL ENGINEERING		
Sub Code: 18ML552	**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 student

1. To understand the role of clinical engineer and importance of clinical engineering.
2. To learn the hospital managerial skills in all aspects.
3. The routine maintenance safety and other issues of medical devices.

Unit No	Syllabus Content	No. of Hours
1	Definition, role of clinical engineering within the hospital organization, major functions of a clinical engineering department, flowchart and model of a clinical engineering department, computerized maintenance and management system, clinical information systems, picture archiving and communication systems (PACS).	**08**
2	Duties and responsibilities, clinical engineer as consultant, clinical engineer as investigator and expert witness. patient safety and clinical engineers, accident investigation, electromagnetic interference, WMTS interference issues.	**08**
3	Technology evaluation, strategic technology planning, technology and alternatives, risks, hazards, and clinical efficacy, conceptual needs analysis.	**07**
4	Management engineering in health care, cost effectiveness and productivity, personnel management, medical technology assessment process, planning strategies.	**08**
5	Medical technology management practices, health care strategic planning utilizing technology assessment, medical device research and design, maintenance and repair of medical devices, medical device troubleshooting, safety standards and regulations.	**08**

Note1: Assignment-1 from unit 1 and 2.
Asssignment-2 Quiz based on talks by clinical engineers

COURSE OUTCOMES: The student will be able to

CO1: Understand the role and functions of clinical engineer in health care management.
CO2:Understand the importance of clinical engineer in maintaining safety standards in a clinical environment
CO3: Apply management Principles in Health care
CO4: Prepare the framework for the maintenance & repair of medical devices
CO5: Understand the general approach for troubleshooting

COs	Mapping with POs
CO1	PO2,PO6,
CO2	PO6,PO7,PO8,
CO3	PO2,PO3,PO4,PO6,
CO4	PO2,PO3,PO4, PO12
CO5	PO2,PO3,PO4, PO12

Text Book:

1. Joseph Dyro B.S. Clinical Engineering Handbook, Elsevier Academic Press, 2004.

Reference Books:

1. Yadin David, Clinical Engineering, Principles and Applications in Engineering Series, CRC Press, 2003.
2. Michael Nowicki, The Financial Management of Hospitals and Healthcare Organizations, Blackwell Publishing Ltd, 2004.

Sub Title: ARM PROCESSOR		
Sub Code:18ML553	**No. of Credits : 03**	**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 Study

1. The architecture of ARM Processor
2. The different Instruction Set
3. Interrupt Handling
4. C Programming for ARM Processor
5. Memory Organisation

UNIT No	Syllabus Content	No. of Hours
1	**ARM Processor Fundamentals** Embedded system introduction, ARM bus technology, Embedded system application ARM core dataflow model, registers, current program status register, Pipeline, Exceptions, Interrupts and Vector Table, Core extensions.	**08**
2	**Introduction to the ARM Instruction set:** Introduction, Data processing instructions, Load - Store instruction, Software interrupt instructions, Program status register instructions, Loading constants, ARMv5E extensions, Conditional Execution.	**08**
3	**Introduction to the THUMB instruction set:** Introduction, THUMB register usage, ARM – THUMB interworking, Other branch instructions, Data processing instructions, Stack instructions, Software interrupt instructions.	**07**
4	**Exception and Interrupt Handling:** Exception Handling-ARM Processor Exceptions and Modes, Vector Table, Exception Priorities, Link Register Offset. Interrupts- Interrupt Latency, Basic Interrupt Stack design and implementation, Interrupt Handling Scheme- Non nested Interrupt Handler, Nested Interrupt Handler, Reentrant Interrupt Handler, Prioritized Simple Interrupt Handler.	**08**
5	**CACHES:** The memory Hierarchy and caches memory-caches and memory management units, Cache Architecture-basic architecture of caches memory, basic operation of cache controller, the relationship between cache and main memory.	**08**

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

COURSE OUTCOME : The students would have learnt to

1. Depict the organization, architecture, memory and operation of the ARM microprocessors
2. Employ the knowledge of Instruction set of ARM processors to develop basic Assembly Language Programs
3. Recognize the importance of the Thumb mode of operation of ARM processors
4. Describe the techniques involved in Exception and Interrupt handling in ARM Processors.
5. Develop embedded C programs to interact with Built in Peripherals and employ the knowledge of operation of cache controller.

COs	**Mapping with POs**
CO1	PO2, PO3,PO5
CO2	PO2, PO5, PO12
CO3	PO3, PO5, PO12
CO4	PO3, PO5, PO12
CO5	PO3, PO5, PO12

Text Books:

1. Andrew N Sloss, Dominic System and Chris Wright," ARM System Developers Guide", Elsevier, Morgan Kaufman publisher, 1st Edition, 2008/,ISBN:1558608745.

Reference Books:

1. David Seal, "ARM Architecture Reference Manual", Addison- Wesley, 2nd Edition, 2009
2. Furber S, "ARM System on chip Architecture", Addison Wiley, 2nd Edition 2008
3. Rajkam, "Embedded System", Tata McGraw-Hill Publishers, 2nd Edition, 2008

Sub Title: BIOMEDICAL INSTRUMENTATION LAB		
Sub Code: 18MLL57	**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 understand

1. The transducer principle, type,measurement of physiological parameter
2. The bio signal measurement
3. Analytical instruments such as colorimeter, pH meter
4. Medical Instrumentation such as X- ray, Ultrasound, Recorders

UNIT	Syllabus Content
1	Plotting the characteristics & Determination of parameters of: a) Resistive strain gage (b) Photoelectric transducer (c) Temperature transducers: RTD / thermocouple / thermistor.
2	Determination of characteristics of: (a) Polarized electrode; (b) Non-polarized electrode (c) Multipoint electrode.
3	Design & Testing of: (a) DC amplifier (b) Isolation amplifier.
4	Design & Testing of: (a) Instrumentation amplifier; (b) Transducer bridge with amplifier.
5	Recording of ECG: (a) Determination of time & amplitude of QRS complex, (b) Calculation of Heart Rate, (c) Determination of Cardiac Vector.
6	Recording of EEG.
7	Measurement of Hearing threshold using Audiometer and plot its characteristics.
8	Measurement of pH of a given solution using pH meter.
9	Determination of solution concentration using Colorimeter/Spectrophotometer.
10	Measurement of Blood Pressure using Sphygmomanometer & Digital meter.
11	Study of (a) Ultrasound transducers & Ultrasonic blood flow meters, (b) X-ray

COURSE OUTCOMES: The student will be able to

CO1: Measure the parameters, temperature, PH, Blood pressure using the transducers
CO2: Design & test instrumentation amplifier for physiological parameters
CO3: Record EEG, ECG signal & measure hearing threshold using the recorders available in the lab
CO4: Understand the working concepts of ultrasound transducers
CO5: Document the observations & time management & to work in a team

COs	Mapping with Pos
CO1	PO6, PO12
CO2	PO6, PO12
CO3	PO5,PO6, PO12
CO4	PO6, PO12
CO5	PO9, PO10, PO11

Sub Title: DIGITAL SIGNAL PROCESSING LAB		
Sub Code: 18MLL58	**No of Credits:1= 0:0:1(L-T-P)**	**No of lecture hours/week :02**
Exam Duration : 3	**Exam Marks : 50**	

COURSE OBJECTIVES: To make the students

1. To compute linear ,circular convolution, and correlation
2. To implement and verify FFT algorithm
3. Implementing DSP concepts using LABVIEW.

UNIT No	Syllabus Content
	MATLAB
1	Generation of standard signals
2	Verification of the Sampling theorem.
3	Determine linear convolution, Circular convolution and Correlation of two given sequences. Verify the result using theoretical computations.
4	Determine the linear convolution and correlation of two given point sequences, using FFT algorithm.
5	Implementation of IIR filters & FIR filters
	LABVIEW
6	To perform arithmetic and logical operations.
7	To realize code converters, adders.
8	To illustrate the use of control and flow statements.
9	To create vi for array and matrix manipulation.
10	To display step, ramp, exponential, sine, cosine, square signal.
11	To perform linear convolution, correlation.
12	To compute the FFT of a signal.
	Open End Project

COURSE OUTCOMES: The students would have learnt

CO1: To Implement & verify the theoretical concepts of convolution, correlation and sampling theorem using the software tools MATLAB/ LABVIEW

CO2: To generate any given signal using MATLAB & LABVIEW

CO3: To design digital filters for a given specification using MATLAB & LABVIEW

CO4: Develop and demonstrate a simple application through Open end project

CO5: Document the observations & time management & to work in a team

Cos	**Mapping with Pos**
CO1	PO1,PO2,PO3,PO4,PO5,PO9,PO12
CO2	PO1,PO2,PO3,PO4,PO5,PO9,PO12
CO3	PO1,PO2,PO3,PO4,
CO4	PO10,PO11,PO12
CO5	PO10,PO11,PO12

Sub Title : BIO-MEDICAL DIGITAL SIGNAL & IMAGE PROCESSING LAB		
Sub Code: 18MLL59	**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:
To familiarize the student with the signal conditioning of Biomedical signals using FIR and IIR filters and to plot and observe the nature of these signals using MATLAB. And also familiarize the student with the basic concepts of image processing such as enhancement and segmentation using MATLAB.

UNIT No	Syllabus Content
	Biomedical Signal Processing using MATLAB
1	Analysis of ECG data: Original signal, Noise signal and filtered signal
2	Realization of IIR and FIR filters for ECG
3	PSD estimation for ECG, EEG, and EMG
4	R-R interval sequence interpretation
5	Analysis of Real time ECG signals acquired through Power Lab data acquisition system
	Image Processing using MATLAB
6	Basic operations on an image: Logical operations, Resizing, Rotation, Translation, Negative of an image
7	Plotting Histogram and histogram equalization
8	Image Segmentation: Threshold, multiple threshold
9	Implementation of spatial domain filters: LP, Median, HP
10	Implementation of edge detection using gradient filters.
11	Display of bit planes of an image
Open End Experiment	

COURSE OUTCOME: The student will be able
CO1: To implement digital filters using acquired signals
CO2: To Compute frequency spectrum of ECG & EEG signals
CO3: To Implement image enhancement techniques
CO4: To implement image segmentation techniques
CO5: Design and develop any biomedical signal & image processing application using MATLAB
CO6: To maintain the document and finish the work in stipulated time

Cos	**Mapping with Pos**
CO1	PO3,PO4,PO5,PO12
CO2	PO3,PO4,PO5,PO12
CO3	PO3,PO4,PO5,PO12
CO4	PO3,PO4,PO5,PO12
CO5	PO3,PO4,PO5,PO12
CO6	PO10, PO11

OPEN ELECTIVE – GROUP A

Sub. Title : BIOMEDICAL ENGINEERING		
Sub Code: 18MLE56	**No of Credits : 03:00:00**	**No of lecture hours/week :03**
Exam Duration : 3 hours	**Exam Marks : 100**	**Total No. of Contact Hrs: 39**

COURSE OBJECTIVES : To enable the student to learn

1. The nature of various physiological signals.
2. The measurement of blood pressure, pulse rate etc. and cardiac pacemakers & defibrillators
3. The basics of auditory mechanisms and the hearing aids & surgical systems.

The medical imaging modalities such as ultrasonic and MRI

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 and EGG.	**08**
2	**BIOMEDICAL RECORDERS:** Electrocardiograph-block diagram description, ECG leads, Artefacts. blood pressure measurement: korotkoff's method respiratory measurements: Impedance Pneumograpy. Oximeters: Principle, pulse oximeter. **CARDIAC PACEMAKERS AND DEFIBRILLATORS**: Need for cardiac pacemaker, types of pacemaker, need for defibrillators. AC and DC defibrillators.	**08**
3	**AUDIOMETER AND HEARING AIDS:** Mechanism of hearing, measurement of sound, basic audiometer, pure-tone audiometer, speech audiometer, hearing aids- conventional, digital hearing aid, cochlear implants. **VENTILATORS:** Mechanics of respiration, artificial ventilation, ventilators.	**08**
4	**INSTRUMENTS OF SURGERY:** Principles of surgical diathermy, surgical diathermy machine, automated electro-surgical systems, electrodes used with surgical diathermy. **HAEMODIALYSIS MACHINE:** Function of kidney, artificial kidney, dialyzer, membranes for hemodialysis, portable kidney machine.	**08**
5	**ULTRASOUND IMAGING:** Fundamentals of acoustic propagation - stress strain relationship, characteristic impedance, intensity, reflection and refraction, attenuation, absorption & scattering, Doppler effect, generation	**07**

	and detection of ultrasound-piezoelectric effect, ultrasonic transducers. **ULTRASONIC DIAGNOSTIC METHODS :** Pulse echo systems- Amplitude mode (A-mode), Brightness mode (B-mode), Motion mode (M-mode), Constant depth mode (C-mode), Colour Doppler flow imaging. **BASICS OF MAGNETIC RESONANCE IMAGING:** Fundamentals of nuclear magnetic resonance- angular momentum, magnetic dipole moment, magnetization, Larmor frequency, rotating frame of reference and RF magnetic field, Free Induction Decay (FID), Fourier spectrum of the NMR signal, spin density, relaxation times, pulse sequences.	

Assignment Question from unit 1, 2 &3
Assignment 2 Question from unit 4 & 5

After the successful completion of the course, the students will be able to :
CO1: Interpret a typical biomedical measuring system, its constraints & precautions
CO2: Understand the principle of the origin of biomedical signals and devise systems for measurement
CO3: Understand the use of electrical & heat energy in surgical processes & apply the safety aspects in improving the design
CO4: Apply the principles of audiometers, ventilators, haemodialysis to evolve new devices
CO5: Understand the fundamentals of Ultrasound Imaging & Magnetic Resonance Imaging

COs	Mapping with POs
CO1	PO1,PO2,PO4, PO6
CO2	PO1,PO2,PO3,PO4,PO6
CO3	PO1,PO2,PO3,PO4,PO6
CO4	PO1,PO4, PO12
CO5	PO1,PO2,PO4,PO6,

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
3. **Principles of Medical Imaging**, Kirk Shung, Michael B. Smith and Banjamin Tsui, Academic Press, 1992

REFERENCE BOOK:

1. **Biomedical Instrumentation and Measurement** – by Leslie Cromwell, Fred J Weibell and Erich A. Pfeiffer, Prentice-Hall India Pvt. Ltd.
2. **BIO MEDICAL TRANSDUCERS AND INSTRUMENTS**, Tatsuo Togawa, Toshiyo Tamura and P. Ake Oberg, CRC Press, 1997.
3. **Introduction to Biomedical Equipment Technology,** Joseph J Carr and John M Brown , Pearson Education ,4th Edition , 2001.

VI **SEMESTER**

Sub Title: BIOMEDICAL DIGITAL SIGNAL PROCESSING		
Sub Code: 18ML61	**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:

1. To learn the nature of various biomedical signals and its analysis.
2. To know about neurological signal generation.
3. To study sleep EEG types and their features.
4. To study adaptive filters and their applications in biomedical signal processing.
5. To gain knowledge about various artefacts and methods to eliminate it.
6. To study cardiological signal processing

UNIT No	**Syllabus Content**	**No of Hours**
1	**INTRODUCTION TO BIOMEDICAL SIGNALS:** The nature of biomedical signals, the action potential, objectives of biomedical signal analysis, Difficulties in biomedical signal analysis, computer aided diagnosis. Neurological signal processing: The brain and its potentials, The electrophysiological origin of brain waves, The EEG signal and its characteristics, EEG analysis. EMG signal characteristic and analysis	**7**
2	**SLEEP EEG:** Data acquisition and classification of sleep stages, The Markov model and Markov chains, Dynamics of sleep-wake transitions, Hypnogram model parameters, and Event history analysis for modeling sleep.	**8**
3	**ADAPTIVE FILTERS:** Principle of an adaptive filter, the steepest descent algorithm, adaptive noise canceller, cancellation of 60 Hz interference in electrocardiography, applications of adaptive filters. Canceling donor - heart interference in heart-transplant electrocardiography, Cancellation of ECG signal from the electrical activity of the chest muscles, canceling of maternal ECG in fetal ECG, Cancellation of High frequency noise in Electro - surgery.	**8**
4	**SIGNAL AVERAGING:** Basics of signal averaging, a typical signal averager, signal averaging as a digital filter, Removal of artifacts by averaging. Filtering for removal of artifacts**:** Introduction, Random noise, structured noise and physiological interference, stationary versus non stationary process, high frequency noise in ECG, motion artifact in ECG, power line interference in ECG signals, Maternal interference in Fetal ECG, muscle contraction interference in VAG signals.	**8**

5	**CARDIOLOGICAL SIGNAL PROCESSING:** Pre-processing. ECG QRS Detection techniques. Rhythm analysis. Arrhythmia detection Algorithms. Automated ECG Analysis. ECG Pattern Recognition. Heart rate variability analysis, ST–segment analyzer, portable, arrhythmia monitors.	**8**

Note 1 : Assignment-1 from unit 1 and 2.
Asssignment- Quiz & Report based on visit to one of the sleep EEG labs

COURSE OUTCOMES: The students would have learnt to

CO1: Analyze and interpret EEG & EMG
CO2: Acquire EEG & interpret the models of sleep EEG
CO3: Design and develop Adaptive filters.
CO4: Identify noise sources in ECG signal & apply filtering
CO5: Classify & detect abnormality in ECG signals.

COs	Mapping with POs
CO1	PO1,PO2,PO4
CO2	PO1,PO2,PO3,PO4, PO12
CO3	PO1,PO2,PO3,PO4
CO4	PO2,PO3,PO4
CO5	PO2,PO3,PO4

TEXT BOOKS:

1. **Biomedical Digital Signal Processing**,Willis J.Tompkins, PHI.
2. **Biomedical Signal Processing- Principles and Techniques**, Tata McGraw-Hill, D.C.Reddy, 2005.
3. **Biomedical Signal Analysis**, Rangaraj M. Rangayyan, IEEE Press, 2001.
4. **Wavelet Transforms** , Raghuveer M. Rao and Ajit S. Bopardikar, Pearson, 1998.

REFERENCE BOOKS:

1. **Biomedical Signal Processing ,** Akay M, Academic Press ,1994
2. **Biomedical Signal Processing ,** Cohen.A, Vol. I , CRC Press, 1986.

Sub Title: LASERS AND FIBER OPTICS IN MEDICINE		
Sub Code: 18ML62	**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:

1. To study the production of lasers, its properties and types.
2. To study the effects of laser-tissue interaction.
3. To know the need for optic fibers and its applications in Medicine.
4. To gain knowledge regarding fiber fabrication and fiber bundles.
5. To study the basic principle of endoscopy, its uses in diagnosis and therapeutic field.

UNIT No	Syllabus Content	No of Hours
1	**INTRODUCTION:** Historical background. Medical Lasers: Introduction, Laser physics-fundamentals, principles, advances, Medical Lasers-fundamentals, principles(co2, Nd-YAG, eximer, dye - lasers), advances(semiconductor laser, free electron laser, Miscellaneous laser techniques). Medical Laser Systems-fundamentals, principles. Laser safety-fundamentals. Introduction, historical background ,Introduction to OFC**,** block diagram of OFC, analog link and digital link	**08**
2	**APPLICATIONS OF LASERS IN THERAPY & DIAGNOSIS:** Introduction, laser assisted diagnosis and therapy-fundamentals, interaction of laser beams and materials-principles Laser interaction with tissue-principles; laser assisted diagnostics-principles, applications of lasers in diagnosis and imaging-advances, laser surgery and therapy-principles-photo thermal & photomechanical mechanisms, thermal interaction between laser and tissue-advances.	**08**
3	**SINGLE OPTICAL FIBERS :** optical fibers-fundamentals, light transmission in optical fibers-principles, optical properties of optical fibers-advances, fabrication of optical fibers-principles, optical fibers for UV, visible, IR light-principles, power transmission through optical fibers-principles, modified fiber ends and tips-principles, fiber lasers-advances.	**07**
4	**OPTICAL FIBER BUNDLES:** Introduction, non-ordered fiber optic bundles for light guides-fundamentals & principles, ordered fiber optic bundles for imaging devices-fundamentals & principles, fiber scopes and endoscopes-fundamentals, fiber optic imaging systems-advances.	**08**

5	**CLINICAL APPLICATIONS OF FIBER OPTIC LASER SYSTEMS:** Endoscopy: Introduction, endoscopic imaging systems-fundamentals, principles, advances, endoscopic diagnostics-advances, endoscopic therapy-fundamentals, endoscopic ultrasound imaging-principles. Introduction, fiber optic laser systems in cardiovascular disease, flow diagram for laser angioplasty & photodynamic therapy.	**08**

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

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

CO1: Identify different lasers and its applications in diagnosis & therapy.
CO2: Understand the fundamentals & principles of optical fibers
CO3: Understand the application of optical fibers in communication
CO4: Understand the principle of transmission of UV & IR through Optical fibers in clinical environment
CO5: Understand the clinical applications of fiber optic

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

TEXT BOOK:

1. **Lasers and Optical Fibers in Medicine** , Abraham Katzir, Academic Press, 1998.

REFERENCE BOOKS:

1. **Therapeutic Lasers – Theory and practice** , G.David Baxter, Churchill Livingstone Publications.
2. **Medical Lasers and their safe use,**David H Shiney, Stephen and L.Trokel, Springer, Springer Verlag publications.
3. **Elements of fiber optics**, S.L.Wymer, Regents PHI.
4. **Biomedical Electronics and Instrumentation**, S.K.Venkata Ram Galgotia publications.

Sub Title: BIOMEDICAL EQUIPMENTS		
Sub Code: 18ML63	**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:

1. To study spectrophotometer, clinical flame photometer.
2. To study different blood gas analyzers
3. To study different types of Audiometers
4. To understand the working principle of surgical diathermy.
5. To study haemodialysis and different ventilators

Note1: Assignment-1 from unit 1 and 2.

UNIT No	Syllabus Content	No of Hours
1	**CLINICAL LABORATORY INSTRUMENTS:** Medical diagnosis with clinical tests, spectrophotometry-components, clinical flame photometer, ion-selective electrode based analyzers.	**7**
2	**BLOOD GAS ANALYZERS:** Acid-base balance, blood pH measurement, measurement of blood pCO2, measurement of blood pO2, intra-arterial blood gas monitoring, complete blood gas analyzer. **BLOOD CELL COUNTERS**: Types of blood cells, Coulter counter, automatic recognition and differential counting of cells.	**8**
3	**AUDIOMETER AND HEARING AIDS:** Mechanism of hearing, measurement of sound, basic audiometer, pure-tone audiometer, speech audiometer, audiometer system Bekesy, evoked response audiometer system, hearing aids-digital hearing aid, cochlear implants.	**8**
4	**INSTRUMENTS OF SURGERY:** Principles of surgical diathermy, surgical diathermy machine, automated electro-surgical systems, electrodes used with surgical diathermy, safety aspects in electro- surgical units, surgical diathermy analyzer. **PHYSIOTHERAPY AND ELECTROTHERAPY EQUIPMENTS:** High frequency ,heat therapy, short wave diathermy, microwave diathermy, ultrasound therapy unit, electro diagnostic therapeutic apparatus, pain relief through electrical stimulation ,bladder and cerebral stimulators.	**8**
5	**HAEMODIALYSIS MACHINE:** Function of kidney, artificial kidney, dialyzer, membranes for hemodialysis, portable kidney machine. **VENTILATORS:** Mechanics of respiration, artificial ventilation, ventilators, types of ventilators, ventilator terms, classification of ventilators, pressure volume flow diagrams, modern ventilators, high frequency ventilators, humidifiers, nebulizers and aspirators	**8**

Asssignment-2 from unit 3,4 and 5

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

CO1: Understand the working & application of clinical lab equipments such as blood gas analyzers, blood cell counters and surgical equipments.
CO2: Understand the human hearing mechanism, identify the defects in hearing mechanism
CO3: Understand the functioning of breathing mechanism, ventilators
CO4: Understand the functioning of kidney and working of artificial kidney
CO5: Design & develop artificial organs such as ventilators & kidney and hearing aids

COs	Mapping with POs
CO1	PO1,PO2,PO3,PO4
CO2	PO1, PO2, PO3, PO4
CO3	PO1, PO2, PO3, PO4, PO12
CO4	PO1, PO2, PO3, PO4, PO12
CO5	PO1, PO2, PO3, PO4, PO12

TEXT BOOK:

1. **Handbook of Biomedical Instrumentation** – by R.S.Khandpur, 2nd Edition, Tata McGraw Hill, 2003

REFERENCE BOOK:

1. **Biomedical Instrumentation and Measurement** – by Leslie Cromwell, Fred J Weibell and Erich A. Pfeiffer, Prentice-Hall India Pvt. Ltd.

Sub Title: MEDICAL PHYSICS		
Sub Code:18ML64	**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: This course analyzes the human body from the basic principles of physics. Principles derived in physics are applied directly to the human body.

1. To describe effects of heat and cold in medicine.
2. To describe effects of physics of lung and breathing mechanism.
3. To discuss the pumping action of the heart and how the blood pressure changes occur.
4. To discuss the electrical conduction system of the nerves in the brain, the heart and the eyes, application of low and high frequency electricity in medicine, magnetism in medicine.
5. To discuss how the ultrasound is helpful in Medicine, physics of ear and hearing to know about how light is helpful in Medicine.

UNIT No	Syllabus Content	No of Hours
1	**Heat and cold in medicine:** Introduction, physics basis of heat and temperature, thermography and temperature scales, mapping of body's temperature, heat therapy, use of cold in medicine, cryosurgery and safety aspects.	**7**
2	**Physics of lung and breathing:** Introduction, the air ways, blood & lung interaction, measurement of lung volumes, pressure air flow volume relationship of the lungs .Physics of alveoli, breathing mechanism, air-way resistance, work of breathing, physics of some common lung diseases.	**8**
3	**Physics of cardiovascular system:** Introduction to cardiovascular system, major components of cardiovascular system, oxygen and carbon-di-oxide exchange in the capillary system, work done by the heart, blood pressure and its measurements, transmural pressure, Bernoulli's principle applied to cardiovascular system, blood flow laminar & turbulent ,heart sounds, physics of some cardiovascular diseases.	**8**
4	**Electricity within the body: E**lectromyogram, electrocardiogram, electroencephalogram,electroretionogram,electrooculogram,magneto cardiogram & magnet encephalogram, electric shock ,high frequency and low frequency electricity in medicine, magnetism in medicine.	**8**

5	**Sounds in medicine**: Ultrasound picture of the body, ultrasound to measure motion, physiological effects of ultrasound in therapy, the production of sound. **Physics of ear and hearing:** The outer ear, middle ear and the inner ear, sensitivity of ears, testing hearing, deafness & hearing aids. **Light in medicine:** Measurement of light and its units, application of visible light in medicine, application of UV and IR in medicine**.**	**8**

<u>Note 1</u>: Assignment-1 from unit 1 and 2.
Asssignment-2 from unit 3, 4 and 5

COURSE OUTCOMES: On the completion of the course the students would have learnt

CO1: Understand the applications of heat and cold for diagnostic & therapeutic purpose.
CO2: Understand the origin of electric signals within the body & therapeutic applications of electricity and magnetism
CO3: Understand the mechanisms of vital systems of human body by relating it to the fundamental concepts of physics.
CO4: Understand the application of sound and light for diagnostic & therapeutic purpose.
CO5: Suggest/device a suitable system depending upon the body condition.

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

TEXT BOOK:

1. **Medical Physics**, John R. Cameron and James G. Skofronick, John Wiley & Sons 1978.

REFERENCE BOOK:

1. **Physics of the Human Body,** Herman I.P., Springer.

PROFESSIONAL ELECTIVE -2

Sub Title: INFRARED IMAGING & APPLICATIONS		
Sub Code: 18ML651	**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 enable the student learn

1. To Understand the scope and practice of the field of infrared imaging system
2. To Understand the basic techniques used in thermography
3. To Examine and grasp the principle of camera and image acquisition techniques
4. To identify and Demonstrate proficiency in developing applications

UNIT No	**Syllabus Content**	**No of Hours**
1	**Introduction to thermography:** Principles of black body radiation laws: Blackbody, Plank's law, Wien's displacement law, Stefan Boltzmann Law, Emissivity, IR absorption characteristics, Radiometric measurements.	**08**
2	**Heat Transfer Mechanisms and measurements:** Heat and Temperature, Heat Transfer Mechanism, Principle of Conduction, Convection and Radiation, Temperature measurements: Contact and Non contact.	**07**
3	**Principle of Infrared Camera:** Detector performance parameters: Responsivity, Noise Equivalent Power, Specific detectivity, System performance parameters: Temperature range, Accuracy, Thermal sensitivity,Minimum Resolvable Temperature Difference (MRTD), Calibration of IR camera.	**08**
4	**Passive and Active Techniques:** Passive Thermography, Active Thermography: Pulsed Thermography, Pulsed Phase Thermography, Vibro Thermography, Frequency Modulated Thermal Wave Imaging	**08**
5	**Applications:** Diagnosis and Monitoring of Pain-Acupuncture-Breast Thermography and Detection of Breast Cancer-Other Medical Applications-Raynaud's Phenomenon- Pressure Ulcers.	**08**

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

CO1: Identify the objectives and background of infrared imaging

CO2: Apply the temperature measurements for various applications

CO3: Demonstrate the working operation of IR Camera

CO4: Analyze the various thermography calibration procedure.

CO5: Design of basic thermography imaging procedure for various clinical applications

COs	Mapping with Pos
CO1	PO1,PO6,PO7,PO8
CO2	PO2,PO3,PO5
CO3	PO1,PO2,PO7
CO4	PO7,PO11, PO12
CO5	PO10,PO11, PO12

TEXT BOOKS:

1. **Infrared Thermal Imaging: Fundamentals,** Michael Vollmer, Klaus-Peter Mollmann ,Research and Applications, John Wiley, 2010.
2. **Common sense approach to thermal imaging,** Holst, Gerald C. Washington, DC, USA: SPIE Optical Engineering Press, 2000.
3. **Infrared Imaging: A casebook in clinical medicine**, Francis Ring , Anna Jung , Janusz uber, IOP Publishing, Temple Circus, Temple Way, Bristol, BS1 6HG, UK 2015.

REFERENCE BOOKS:

1. **Medical Infrared Imaging**, Nicholas A. Diakides, Joseph D. Bronzino, CRC Press,2007
2. **Nondestructive Evaluation of Materials by Infrared Thermography**, Xavier P.V. Maldague, Springer Science & Business Media

Sub Title: MEDICAL INFORMATICS		
Sub Code: 18ML652	**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 student learn

5. Identify the fundamentals medical informatics
6. Develop practical health care applications using suitable database management system
7. Utilise knowledge, skills and concepts on health information technology
8. Apply principles of information security, ethics and policy information
9. Assesses existing information exchange system standards
10. Analyse and develop project, manage strategies health information technology

UNIT No	Syllabus Content	No of Hours
1	**Medical Informatics:** Introduction - Structure of Medical Informatics –Internet and Medicine -Security issues, Computer based medical information retrieval, Functional capabilities of a computerized HIS, e-health services, **Cloud computing:** Introduction, Cloud Computing Architecture and Management, Security in Cloud Computing, Cloud computing in Medical Applications,	**08**
2	**Computerised Patient Record** : Introduction - History taking by computer, Dialogue with the computer, Components and functionality of CPR, Development tools, CPR in Radiology- Application server provider, Clinical information system, Computerized prescriptions for patients.	**07**
3	**Computers in Clinical Laboratory Medical Imaging**: Automated clinical laboratories-Automated methods in hematology, cytology and histology, Intelligent Laboratory Information System - Computerized ECG, EEG and EMG, **Computers in Medical Imaging** Computer assisted medical imaging- nuclear medicine, ultrasound imaging ultrasonography-computed X-ray tomography, Radiation therapy and planning, Nuclear Magnetic Resonance	**08**
4	**Computer Assisted Medical Decision-Making:** Neuro computers and Artificial Neural Networks application, Expert system – General model of CMD, Computer – assisted decision support system-production rule system, cognitive model, semester networks , decisions analysis in clinical medicine-computers in the care of critically patients-computer assisted surgery-designing	**08**
5	**Recent Trends in Medical Informatics**: Virtual reality applications in medicine, Computer assisted surgery, Surgical simulation, Telemedicine - Tele surgery, computer aids for the handicapped, computer assisted instrumentation in Medical Informatics - Computer assisted patient education and health - Medical education and health care information	**08**

Note 1: Assignment-1 from unit 1 and 2.

Asssignment-2 Based on industry expert talk on cloud computing, recent trends in medical informatics

COURSE OUTCOMES: On the completion of the course the students will be able to
CO1: Understand the concepts of medical information systems.
CO2: Develop Computerized Patient Record (CPR)System
CO3: Application of computers for data storage in clinical laboratory, medical imaging, education & decision making.
CO4: Develop assistive aids for physically challenged
CO5: Understand the concepts of tele-surgery

COs	**Mapping with Pos**
CO1	PO1,PO6,PO7,PO8
CO2	PO2,PO3,PO5
CO3	PO1,PO2,PO7,PO12
CO4	PO10, PO12
CO5	PO1,PO2,PO7,PO12

TEXT BOOKS:

4. **Medical Informatics**, Mohan Bansal, T M H, 2003.
5. **Computers in Medicine Progress in Medical Informatics**, R. D. Lele, TMH, 2005.

References:

1. **Introduction to Bioinformatics** , T. K. Attwood & D. J. Parry-Smith, Pearson Education Low Price Edition, 2004.

2. **Essentials of CLOUD COMPUTING**, K. Chandrasekaran, Taylor & Francis Group, CRC Press is an imprint of Taylor & Francis Group, an Informa business, 2015.

3. **Medical Informatics**, Dinesh Bhatia, PHI Leaning, India, 2015

Sub Title : VLSI DESIGN		
Sub Code: 18ML653	**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 : The objectives of the course is to enable students to:

1. Impart knowledge of MOS transistor theory and CMOS technologies
2. Learn the operation principles and analysis of inverter circuits.
3. Design Combinational, sequential and dynamic logic circuits as per the requirements
4. Infer the operation of Semiconductors Memory circuits.
5. Demonstrate the concepts of CMOS testing

Unit No	Syllabus Content	No. Of Hours
1	**Introduction**: A Brief History, MOS Transistors, CMOS Logic **MOS Transistor Theory:** Introduction, Long-channel I-V Characteristics, Non-ideal I-V Effects, DC Transfer Characteristics.	08
2	**Fabrication:** CMOS Fabrication and Layout, VLSI Design Flow, Introduction, CMOS Technologies, Layout Design Rules, MOSFET Scaling and Small-Geometry Effects, MOSFET Capacitances	08
3	**Delay:** Introduction, Transient Response, RC Delay Model, Linear Delay Model, Logical Efforts of Paths. **Combinational Circuit Design:** Introduction, Circuit families	08
4	**Sequential Circuit Design**: Introduction, Circuit Design for Latches and Flip-Flops Dynamic Logic Circuits: Introduction, Basic Principles of Pass Transistor Circuits, Synchronous Dynamic Circuit Techniques, Dynamic CMOS Circuit Techniques	08
5	**Semiconductor Memories:** Introduction, Dynamic Random Access Memory (DRAM) and Static Random Access Memory (SRAM) **Testing and Verification:** Introduction, Logic Verification Principles, Manufacturing Test Principles, Design for testability	07

Assignment -1 from units 1 and 2
Assignment – 2 from units 3, 4 and 5.

Course Outcomes : On completion of the course the student will be able to

CO1: Demonstrate understanding of MOS transistor theory, CMOS fabrication flow and technology scaling.

CO2: Draw the basic gates using the stick and layout diagrams with the knowledge of physical design aspects.

CO3: Demonstrate ability to design Combinational, sequential and dynamic logic circuits as per the requirements

CO4:Interpret Memory elements along with timing considerations

CO5: Interpret testing and testability issues in VLSI Design

TEXT BOOKS:

1. "CMOS Digital Integrated Circuits: Analysis and Design" - Sung Mo Kang & Yosuf Leblebici, Third Edition, Tata McGraw-Hill.
2. "CMOS VLSI Design- A Circuits and Systems Perspective"- Neil H. E. Weste, and David Money Harris4th Edition, Pearson Education.

REFERENCE BOOKS:

1. Adel Sedra and K. C. Smith, "Microelectronics Circuits Theory and Applications", 6th or 7th Edition, Oxford University Press, International Version, 2009.
2. Douglas A Pucknell & Kamran Eshragian, "Basic VLSI Design", PHI 3rd Edition, (original Edition – 1994).
3. Behzad Razavi, "Design of Analog CMOS Integrated Circuits", TMH, 2007.

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

Sub Title : OPERATION & TESTING OF MEDICAL DEVICES LAB		
Sub Code: 18MLL67	**No. of Credits:1=0: 0:1(L-T-P)**	**No of lecture hours/week :03**
Exam Duration : 3 hours	**Exam Marks : 50**	

Course Objectives:To enable the students to

- understand the usage of state of art equipments in the hospital
- To make the students learn troubleshooting
- Operation and Testing of Medical Devices Lab

1	Hospital visit for a minimum period 10 days to be carried out either in the beginning of the sixth semester or phased out during the semester. The report submitted should include the detailed study of equipments with respect to specification, cost & make apart from the operation and testing procedure in the following labs in the hospital: • Biochemistry lab, Pathology Lab • Opthalmology lab • Radiology lab • Dialysis lab • OT • ICU, NICU • Physiotherapy • Ventilator • Safety standards & medical ethics
2	Need for Calibration of Medical Devices. Calibrating Devices
3	Troubleshooting of X Ray machine, ECG machine
4	DC power supply, different types grounding & shielding mechanisms
5	Hands-on Workshop on Calibration & Testing of Medical Devices

Course Outcome:
On completion of the course the student will be able to
CO1: Understand the Practical use of equipments & its operating Procedures
CO2: Apply the latest trend in the technology and the state of the art technology
CO3: Develop an understanding of the global companies in the market their device specification & idea of cost of the products
CO4: Understand the safety standards and medical ethics
CO5: Understand and perform the procedures of trouble shooting & Calibration
CO6: Make effective presentation & documentation

Cos	**Mapping with Pos**
CO1	PO1,PO2,PO3
CO2	PO3, PO4, PO12
CO3	PO11, PO12
CO4	PO8, PO12
CO5	PO9,PO10, PO12
CO6	PO9,PO10, PO11, PO12

Sub Title: MINIPROJECT		
Sub Code: 18MLP68	**No of Credits : 00:00:2**	**No of lecture hours/week : 2**
Exam Duration : 3 hours	**Exam Marks : 50**	

COURSE OBJECTIVES: To enable the students to come up with their own innovative ideas and realize it.

1. PCB soldering and Testing: Learning any of the Open source PCB software
2. Practice the skills of Soldering and Testing simple circuits
3. Develop a working hardware model for any of the biomedical applications

Note:

- Mini project should be carried by a group of 3 or 4 and not more than 4 in a group.
- Evaluation should be based on the demonstration, viva-voce and final report.

COURSE OUTCOME: The students would have learnt

CO1: To build working prototype models based on their innovative ideas in the field biomedical applications
CO2: PCB designing software tools
CO3: The skills of soldering & testing
CO4: The ability to work in a group
CO5: To prepare documentation and convey their ideas through presentation

COs	Mapping with POs
CO1	PO1,PO2,PO3, PO5, PO11, PO12
CO2	PO5, PO12
CO3	PO2,PO3, PO12
CO4	PO9,PO10
CO5	PO9,PO10

OPEN ELECTIVE –B

Sub Title: MEDICAL INFORMATICS		
Sub Code: 18MLE66	**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 student learn

1. Identify the fundamentals medical informatics
2. Develop practical health care applications using suitable database management system
3. Utilise knowledge, skills and concepts on health information technology
4. Apply principles of information security, ethics and policy information
5. Assesses existing information exchange system standards
6. Analyse and develop project, manage strategies health information technology

UNIT No	Syllabus Content	No of Hours
1	**Medical Informatics:** Introduction - Structure of Medical Informatics –Internet and Medicine -Security issues, Computer based medical information retrieval, Functional capabilities of a computerized HIS, e-health services, **Cloud computing:** Introduction, Cloud Computing Architecture and Management, Security in Cloud Computing, Cloud computing in Medical Applications,	**08**
2	**Computerised Patient Record** : Introduction - History taking by computer, Dialogue with the computer, Components and functionality of CPR, Development tools, CPR in Radiology- Application server provider, Clinical information system, Computerized prescriptions for patients.	**07**
3	**Computers in Clinical Laboratory Medical Imaging**: Automated clinical laboratories-Automated methods in hematology, cytology and histology, Intelligent Laboratory Information System - Computerized ECG, EEG and EMG, **Computers in Medical Imaging** Computer assisted medical imaging- nuclear medicine, ultrasound imaging ultrasonography-computed X-ray tomography, Radiation therapy and planning, Nuclear Magnetic Resonance	**08**
4	**Computer Assisted Medical Decision-Making:** Neuro computers and Artificial Neural Networks application, Expert system – General model of CMD, Computer – assisted decision support system-production rule system, cognitive model, semester networks , decisions analysis in clinical medicine-computers in the care of critically patients-computer assisted surgery-designing	**08**
5	**Recent Trends in Medical Informatics**: Virtual reality applications in medicine, Computer assisted surgery, Surgical simulation, Telemedicine - Tele surgery, computer aids for the handicapped, computer assisted instrumentation in Medical Informatics - Computer assisted patient education and health - Medical education and health care information	**08**

Note 1: **Assignment-1 from unit 1 and 2.**

Asssignment-2 Based on industry expert talk on cloud computing, recent trends in medical informatics

COURSE OUTCOMES: On the completion of the course the students will be able to
CO1: Understand the concepts of medical information systems.
CO2: Develop Computerized Patient Record (CPR)System
CO3: Application of computers for data storage in clinical laboratory, medical imaging, education & decision making.
CO4: Develop assistive aids for physically challenged
CO5: Understand the concepts of tele-surgery

COs	Mapping with Pos
CO1	PO1,PO6,PO7,PO8
CO2	PO2,PO3,PO5
CO3	PO1,PO2,PO7,PO12
CO4	PO10, PO12
CO5	PO1,PO2,PO7,PO12

TEXT BOOKS:

6. **Medical Informatics**, Mohan Bansal, T M H, 2003.
7. **Computers in Medicine Progress in Medical Informatics**, R. D. Lele, TMH, 2005.

References:

1. **Introduction to Bioinformatics** , T. K. Attwood & D. J. Parry-Smith, Pearson Education Low Price Edition, 2004.

2. **Essentials of CLOUD COMPUTING**, K. Chandrasekaran, Taylor & Francis Group, CRC Press is an imprint of Taylor & Francis Group, an Informa business, 2015.

3. **Medical Informatics**, Dinesh Bhatia, PHI Leaning, India, 2015

VII **SEMESTER**

NEURAL NETWORK & MACHINE LEARNING		
Sub Code: 18ML71	**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: The enable the students to learn

1. The concepts of biological neuron and analogy to the artificial neuron model
2. Different neural network architecture
3. Various learning paradigms and comparisons

UNIT No	Syllabus Content	No of Hours
1	**ARTIFICIAL NEURAL NETWORK:** introduction to artificial neural network, model of a neuron, Types of activation function, neural networks viewed as directed graphs, architectural graph of a neuron with feedback, Network Architectures, Artificial intelligence and Neural Networks. **SINGLE LAYER PERCEPTION:** Introduction, Adaptive filtering problem, Unconstrained optimization techniques, Newton's method, Gauss-Newton method, Linear least square filter, Least mean square algorithm, Learning curves, Learning Rate, Annealing techniques, Perceptron, convergence theorem	7
2	**MULTILAYER PERCETRON**: Introduction, Some Preliminaries, Back propagation algorithm, XOR Problem, Heuristics for making the back propagation algorithm perform better, Feature detection, Hessian matrix, generalization, Cross validation, Virtues and limitations of back propagation algorithm	8
3	**Random Variables-**Binomial distribution, Poission distribution Continuous Random variables uniform density, exponential density, normal density **Introduction to pattern Recognition** **Statistical Decision Making:** Introduction, Bayes' theorem, multiple features, conditionally independent features, Decision boundaries: Two Dimensional decision boundaries **Clustering:** Introduction, Hierarchical clustering-agglomerative, single linkage, average linkage, ward's method. Partitional clustering-Forgy's, k-means.	8
4	Introduction to Deep Learning, Bayesian Learning, Decision Surfaces Linear Classifiers, Linear Machines with Hinge Loss Unsupervised Learning with Deep Network, Autoencoders Convolutional Neural Network, Building blocks of CNN, Transfer Learning Revisiting Gradient Descent, Momentum Optimizer, Effective training in Deep Net- early stopping, Dropout, Batch Normalization, Instance Normalization, Group Normalization	8

5	Recent Trends in Deep Learning Architectures, Residual Network, Skip Connection Network, Fully Connected CNN etc. Classical Supervised Tasks with Deep Learning, Image Denoising, Semantic Segmentation, Object Detection etc. LSTM Networks Generative Modeling with DL, Variational Autoencoder, Generative Adversarial Network Revisiting Gradient Descent, Momentum Optimizer, RMSProp, Adam	**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 the concepts neural network and different learning algorithms.
CO2: Apply perceptron and multiple perceptron for classification.
CO3: Apply the probabilistic models for data classification.
CO4: Understand the concepts of CNN
CO5: Apply Deep Learning for classification through case studies

Cos	Mapping with Pos
CO1	PO1,PO2,PO4, PO6, PO7,PO12
CO2	PO2,PO3,PO4,PO6, PO7, PO12
CO3	PO2,PO3,PO4, PO6, PO7, PO12
CO4	PO2,PO3,PO4, PO6, PO7, PO12
CO5	PO2,PO3,PO4,PO6, PO7, PO12

TEXT BOOKS:

1. **An Introduction To Neural Networks,** James A. Anderson, PHI, 2nd edition ,1995.
2. **Neural Networks**, Simon Haykin Pearson Education/PHI, 2001.
3. **Neural Networks** , Satish Kumar, Tata Mcgraw-hill 2009
4. **Pattern Recognition & Image Analysis**, Earl Gose, Richard Johnsonbaugh Steve Jost, Prentice Hall of India,

REFERENCE BOOKS:

1. Deep Learning- Ian Good felllow, Yoshua Benjio, Aaron Courville, The MIT Press
2. Pattern Classification- Richard O. Duda, Peter E. Hart, David G. Stork, John Wiley & Sons Inc.

Sub Title: MEDICAL DEVICES & REGULATIONS		
Sub Code: 18ML72	**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 enable the students to study

1. Device types, Regulations and Standards and approval process of Medical Devices
2. Knowledge of FDA terminologies
3. Validation process for medical device hardware and software

Unit No.	Syllabus Contents	No of Hours
1	**Medical Device**: Definition, product definition process, overview of quality function deployment(QFD), QFD process, business proposal. **Reliability**: Concept of failure, various methods of CAPA. **Safety and Risk Management**: Personnel safety and hygiene, medical device safety and risk management, effectiveness/performance of medical devices, Phases in the life span of a medical device, risk management processes, shared responsibility for medical device safety and performance.	**7**
2	**The Food and Drug Administration:** Device classification, 510 (k) Process, Declaration of conformance, PMA application, Investigational Device Exemptions (IDEs), Good Laboratory Practices (GLPs), Good Manufacturing Practices (GMPs), Human Factors, Design Control. ***The European Union:*** European Directives, Conformity Assessment and Testing, European Organization for Testing and Certification, Benefits of the GHTF, Final documents from the GHTF, Global Medical Device Nomenclature (GMDN)	**8**
3	**Standards and Regulations Background** ***Standards:*** Voluntary and mandatory standards, Standards development process, Conformity assessment with standards, National and international standards systems, Identification of standards, Current trends in the use of standards in medical device regulations. The ISO 9000 Series of Standards, ISO 14000 Series of Standards. **The Medical Devices Directives:** Medical Devices Directives process, Choosing the appropriate directive, Essential requirements, Classification of the device based on conformity, Medical Devices Directives, Active Implantable Medical Devices Directives, *In-vitro* Diagnostic Medical Devices Directives. NABH, NABL, JCI, AERB , WHO guidelines on medical devices.	**8**
4	**Software and Quality System Regulation** Software as a Technology, Domestic Software Regulations, Domestic Software Standards, International Software Regulations, International Software Standards, Design controls, Document controls, Purchasing controls, Identification and traceability, Production and process controls, Acceptance activities, Non-conforming product, corrective and preventive action.	**8**

5	**Medical Device Testing** The basis and types of testing, Parsing test requirements, Test protocol, Test methodology, Purpose of the test, Failure definition, Determining sample size and test length, Types of testing. **Validation:** Hardware verification and validation, Software verification and validation,	**8**

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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: Define the medical device, its processes encompassing safety and risk management.
CO2: Identify the objectives and functions of FDA and EU.
CO3: Analyze various medical device standards and regulations
CO4: Document the procedure in software quality system regulations
CO5: Implement test protocol for medical device testing.

COs	Mapping with POs
CO1	PO1,PO4,PO6
CO2	PO1,PO6,PO7,PO8
CO3	PO1,PO5,PO6,PO7,PO8
CO4	PO1,PO5,PO12
CO5	PO1,PO2,PO11,PO12

TEXT BOOKS

1. **Reliable Design of Medical Devices**, Second Edition by Richard Fries, CRC Press, 2006.
2. **Medical Device Quality Assurance and Regulatory Compliance** , Richard C Fries, CRC Press, 1998.

REFERENCE BOOKS

1. **Medical device regulations: global overview and guiding principles** , Michael Cheng, World Health Organization.
2. **Product Safety in the European Union** , Gabor Czitan, Attila Gutassy, Ralf Wilde, TUV Rheinland Academia, 2008.

Sub Title : BIO MECHANICS		
Sub Code: 18ML73	**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: Understand the mechanical aspects of human motion:

1. Quantitative and qualitative analysis of human motion and performance.
2. Use physical laws of motion to solve problems of human motion.
3. Understand the relationship between mechanical properties and anatomical functions.
4. Understand how biomechanical principles can be applied to examine human activities such as sport and orthopaedic rehabilitation.

UNIT No	Syllabus Content	No of Hours
1	**BIO-FLUID MECHANICS:** Newton's laws, stress, strain, elasticity, Hook's-law, viscosity, Newtonian Fluid, Non-Newtonian fluid, viscoelastic fluids. Vascular tree. Relationship between diameters, velocity and pressure of blood flow, Resistance against flow	08
2	**VISCOELASTIC FLUID:** Viscoelasticity, Viscoelastic Models: Maxwell, Voigt and Kelvin Models Response to harmonic variation. Use of viscoelastic models.	08
3	**RESPIRATORY MECHANICS:** Alveoli mechanics, Interaction of blood and lung P-V curve of lung. Breathing mechanism. Airway resistance. Physics of lung diseases.	08
4	**ORTHOPEDIC MECHANICS:** Mechanical properties of cartilage. Diffusion properties of articular, cartilage, Mechanical properties of bone. Kinetics and Kinematics of joints, Lubrication of joints. Fundamental concepts of Gait analysis.	08
5	Measuring principles of Cutometer, Durometer. Electrodynamometer, Microindentometer & Ballistometer.	07

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

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

CO1: Understand the concepts of bio-fluids.

CO2: Understand the various viscoelastic models.

CO3: Understand the concepts of respiratory mechanics

CO4: Understand the concept of orthopaedic mechanics.

CO5: Understand the principles of various biomechanic measuring equipments.

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

TEXT BOOKS:

1. **Biomechanics, Mechanical Properties of Living Tissues,**Y.C Fung,Springer Verlag, Edition2, 1993.
2. **Introduction to Biomechanics of Joints & Joint Replacement Mechanical Engg,** D.Dowson, V Wright publication, 1987.
3. **The Biomedical Hand Book**,Joseph.D.Bronzino ,CRC Press, 2nd Edition,2000.

ELECTIVE 3 (GROUP C)

Sub Title: BIOSENSORS AND BIOMEMS		
Sub Code:18ML741	**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. The components used for various biosensors and biosensor family.
2. The principles of different types of transducers.
3. The applications of biosensor in different fields.
4. Different types of photometric assay techniques.

UNIT No	Syllabus Content	No of Hours
1	**Transducers in Biosensors:** Various types of transducers; principles and applications - Calorimetric, optical, potentiometric / amperometric conductrometric/resistormetric, piezoelectric, semiconductor, impedimetric, mechanical and molecular electronics based transducers. Chemiluminescences - based biosensors.	**7**
2	**Applications and Uses of Biosensors:** Bio-Sensors in Clinical Chemistry, Medicine and Health Care, biosensors for personal diabetes management, application of biosensors to environmental samples. Biochips and their application to genomics	**8**
3	**Introduction to Biomems and Biomaterilals:** BIOMEMS, The driving force behind biomedical applications, bio-compatiability, Silicon fabrication: Hard fabrication considerations, lithography, etching techniques, Thin film deposition process, ion implantation, substrate bonding. Biomaterials: Soft lithography, micro molding, smart polymers & hydrogels, nanomedicine, thick film technologies, polymers, physical properties, copolymers. **Microfluidic Principles**: Introduction, transport process, electrokinetic	**8**
4	**Microactuators & Drug Delivery:** Introduction, activation methods, microactuators for microfluids, equivalent circuit representation, drug delivery, Clinical laboratory medicine: introduction, chemistry, hematology, immunology, urine analysis. **Micro-Total-Analysis Systems:** Lab-On A-Chip, capillary electrophoresis arrays, cell, molecule & particle handling, surface modification, Microspheres**.**	**8**
5	**Emerging Bio-MEMS Technology:** introduction, Minimal invasive surgery, cardiovascular, neurosciences, diabetics, point-of-care diagnosis, cell-based biosensors, Oncology.	**8**

<u>Note 1</u>: 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 characteristics of types of bio transducer

CO2: Understand the general applications of biosensors in medicine & health

CO3: Understand the biomaterials and fabrication of Bio-MEMS

CO4: Understand the principle of micro drug delivery system

CO5: Apply the Bio materials for major health issues

COs	**Mapping with POs**
CO1	PO3,PO4,PO6,PO7
CO2	PO1, PO2, PO3,PO4,PO6,PO7,
CO3	PO1,PO2, PO3,PO4,PO6,PO7,
CO4	PO1,PO2, PO3,PO4,PO6,PO7,PO12
CO5	PO1,PO2,PO7, PO11,PO12

TEXT BOOKS:

1. **Biosensors**, Elizabeth A. H Hall - Open University press, Milton Keynes.
2. **Commercial Biosensors,** Graham Ramsay, John Wiley and son, 1998.

REFERENCE BOOKS:

1. **Biosensors,** Eggins.
2. **Biosensors** , AEG CASS , OIRL press, Oxford University.
3. **Transducers and Instrumentation**, Murthy D V S. ,Prentice Hall, 1995

Sub Title: REHABILITATION ENGINEERING		
Sub Code: 18ML742	**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 enable the students to Study

1. Concept of Rehabilitation, Diagnosis of disability.
2. Rehabilitation team role of physiatrist.
3. Therapeutic exercise technique.
4. Principle in Management of communication.
5. Orthotic devices in Rehabilitation Engg. and to know about level of amputation.
6. Prosthetic device and mobility aids.

UNIT No	Syllabus Content	No of Hour
1	**INTRODUCTION TO REHABILITATION & REHABILITATION TEAM:** What is Rehabilitation, Epidemiology of Rehabilitation, Health, Levels of Prevention, Preventive Rehabilitation, Diagnosis of Disability, Functional Diagnosis, Importance of Physiatry in Functional diagnosis, Impairment disability handicap, Primary & secondary Disabilities, Effects of prolonged inactivity & Bed rest on body system. REHABILITATION TEAM**:** Classification of members, The Role of Physiatrist, Occupational therapist, Physical therapist, Recreation therapist, Prosthetist - Orthotist, Speech pathologist, Rehabilitation nurse, Social worker, Corrective therapist, Psychologist, Music therapist, Dance therapist & Biomedical engineer.	**12**
2	**THERAPEUTIC EXERCISE TECHNIQUE :** Co-ordination exercises, Frenkels exercises, Gait analyses-Pathological Gaits, Gait Training, Relaxation exercises-Methods for training Relaxation, Strengthening exercises-Strength training, Types of Contraction, Mobilisation exercises, Endurance exercises.	**7**
3	**PRINCIPLES IN MANAGEMENT OF COMMUNICATION:** Impairment-introduction to communication, Aphasia, Types of aphasia, Treatment of aphasic patient, Augmentative communication-general form of communication, types of visual aids, Hearing aids, Types of conventional hearing aid, Writing aids.	**7**
4	**ORTHOTIC DEVICES IN REHABILITATION ENGINEERING:** General orthotics, Classification of orthotics-functional & regional, General principles of Orthosis, Biomechanics of orthoses, merits & demerits of orthotics, Material design consideration in orthotics, Calipers-FO, AFO, KAFO, HKAFO. Spinal Orthosis, Cervical, Head cervical thoracic orthosis, Thoraco lumbar sacral orthosis, Lumbo sacro orthosis, Splints-its functions & types. **AMPUTATION:** Levels of Amputation – Surgical process, Expected Outcomes, Post operative dressings – Rigid dressings, Semi rigid dressings, Soft	**13**

	dressings, Examination- Range of Motion, Muscle Strength, Status of Residual Limb, Status of the un involved limb, Functional status, emotional status.	
5	**PROSTHETIC DEVICES:** Introduction, Partial Foot Prostheses- Foot-ankle assembly, Trans femoral Prostheses – Knee unit, Axis system, Friction Mechanisms, Extension aid, Stabilizers, Socket. Disarticulation Prostheses-Knee Disarticulation Prostheses, Hip Disarticulation Prostheses **MOBILITY AIDS:** Walking frames, Parallel bars, Rollators, Quadripods, Tripods & walking sticks, Crutches, Wheel chairs. Post cardiac operation rehab	**13**

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

COURSE OUTCOMES: The student will be able to

CO1: Understand the concept of rehabilitation and the role of rehabilitation team.

CO2: Implement and suggest therapeutic exercise techniques.

CO3: Understand aphasia and suggest different visual aids,hearing aids and writing aids.

CO4: Design and develop orthotic and prosthetic devices.

CO5: Differentiate between the different mobility aids.

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

TEXT BOOKS:

1. **Rehabilitation Medicine,** Dr. S. Sunder, Jaypee Medical Publications, New Delhi.

REFERENCE:

1. **Physical Rehabilitation**, Susan B O'Sullivan, Thomas J Schmitz. 5th edition

Sub Title: PICTURE ARCHIVING AND COMMUNICATION STANDARDS		
Sub Code: 18ML743	**No. of Credits : 3**	**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 enable the students to study

1. Technical requirements & financial implication to maintain PACS
2. Image processing fundamentals and medical imaging
3. Medical data storage & recovery

UNIT No	Syllabus Content	No. of Hours
1	**Introduction to PACS:** Interpretation Workstations, Strategic Plan, PACS Impact Analysis, Financial Analysis, Technical Requirements, Project Planning and Evaluation, Contract Negotiations .DICOM Standard, Queuing Perspective, Quality Assurance, HL7, IHE.	**7**
2	**Computer Fundamentals:** Digital Imaging Fundamentals, Image Acquisition, Image Processing Algorithms, Quality Assurance, Future trends, Image Compression, Compression Applications to medical imaging.	**8**
3	**PACS Architecture**: Centralized model, Medical-legal Archive, Networking Fundamentals, Factors to consider in building a network**.** **Servers and Operating Systems:** Disaster recovery, Storage and enterprise archiving, RAID, Direct attached storage, Storage area network, Hierarchical storage.	**8**
4	**Image Displays:** Digital Mammography, Web distribution. **PACS Workstation Software**: Role of Workstation, User Interface, Future of Workstations, Breast Imaging, CAD, CASS.	**8**
5	**3 Dimensional Imaging In Radiology**: Voice recognition, Order entry in Radiology. **Tele Radiology:** Image Acquisition and Image Digitization, Image Transmission, Applications of Tele Radiology, Legal and Socioeconomic Issues ACR Standards.	**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 students would have learnt to
1. Explain the fundamental concepts of PACS and DICOM standards.
2. Apply the various operations performed on digital image
3. Understand the architecture of a typical PACS and requirements for implementations
4. Apply display techniques for medical images.
5. Apply the PACS in different domains of medical imaging and radiology

COs	Mapping with POs
CO1	PO2, PO3, PO4, PO6
CO2	PO2, PO3, PO4, PO12
CO3	PO2, PO3, PO4,
CO4	PO2, PO3, PO4,
CO5	PO2, PO3, PO4, PO6, PO12

TEXT BOOKS:
1. PACS – A guide to the Digital Revolution- Keith Dreyer – Springer, 2006.
REFERENCE BOOKS:
1. PACS in Medicine by H.K.Huang, Wiley-IEEE, 2004.

ELECTIVE 4 (GROUP D)

Sub Title: BIOMATERIALS & ARTIFICIAL ORGANS		
Sub Code:18ML751	**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 enable the students to study

1. To know about various synthetic biomaterials.
2. To know about composite biodegradable polymeric and tissue derived material.
3. To understand the various artificial organs such as artificial heart, artificial kidney artificial lung.

UNIT No	Syllabus Content	No of Hour
1	**BIOMATERIALS:** Introduction to biomaterials, uses of biomaterials, biomaterials in organs & body systems, materials for use in the body, performance of biomaterials. **METALLIC BIOMATERIALS:** Introduction, Stainless steel, Cobalt-Chromium alloy, Titanium alloys, Titanium-Nickel alloys, Dental metals, Corrosion of metallic implants, Manufacturing of implants. **CERAMIC BIOMATERIALS:** Introduction, nonabsorbable /relatively bioinert bioceramics, biodegradable/resorbable ceramics, bioreactive ceramics, deterioration of ceramics, bioceramic-manufacturing techniques. **POLYMERIC BIOMATERIALS:** Introduction, polymerization and basic structure, polymers used as biomaterials, sterilization, surface modifications to for improving biocompatibility.	**8**
2	**COMPOSITE BIOMATERIALS:** Structure, bounds on properties, anisotropy of composites, particulate composites, fibrous composites, porous materials, biocompatibility. **BIODEGRADABLE POLYMERIC BIOMATERIALS:** Introduction, Glycolide based biodegradable homopolymers polyesters, non-glycolide linear aliphatic polyesters, aliphatic and aromatic polycarbonates, and biodegradation properties of synthetic biodegradable polymers. **TISSUE DERIVED BIOMATERIALS:** Structure and properties of collagen and collagen-rich tissues, biotechnology of collagen, design of resorbable collagen-based medical implant. 3D Printing	**8**
3	**ARTIFICIAL ORGANS INTRODUCTION:** Substitutive medicine, outlook for organ replacement, design consideration, evaluation process. **ARTIFICIAL HEART AND CIRCULATORY ASSIST DEVICES:** Engineering design, Engg design of artificial heart and circulatory assist devices, blood interfacing implants – introduction, total artificial hearts & ventricular assist devices, vascular prostheses, Non-blood interfacing implants for soft tissues- sutures and allied augmentation devices, percutaneous and skin implants, maxillofacial implants, eye and ear implants. Cardiac Valve	**8**

	Prostheses: Mechanical valves, tissue valves, current types of prostheses, tissue versus mechanical, engineering concerns and hemodynamic assessment of prosthetic heart valves, implications for thrombus deposition, durability, current trends in valve design, vascular grafts-history, synthetic grafts, regional patency, thrombosis, neointimal hyperplasia, graft infections.	
4	**ARTIFICIAL KIDNEY:** Functions of the kidneys, kidney disease, renal failure, renal transplantation, artificial kidney, dialyzers, membranes for haemodialysis, haemodialysis machine, peritoneal dialysis equipment-therapy format, fluid and solute removal.	**8**
5	**ARTIFICIAL LUNGS:** Gas exchange systems, Cardiopulmonary bypass (heart-lung machine)-principle, block diagram and working, artificial lung versus natural lung. Liver functions, hepatic failure, liver support systems, general replacement of liver functions.	**7**

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

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

CO1: Understand the different biocompatible materials such as metallic, ceramic and polymers.
CO2: Understand the biodegradable biomaterials
CO3: Identify different artificial implants and assistive devices for cardio-vascular system
CO4:Design of artificial organs such as heart, kidney and lung.

COs	Mapping with POs
CO1	PO1,PO3,PO6,PO7
CO2	PO1,PO2,PO3,PO4,PO6,PO7,PO8
CO3	PO1,PO2,PO3,PO4,PO6,PO7,PO8,PO12
CO4	PO10,PO11,PO12

.

TEXT BOOK:

1. **Biomedical Engineering Handbook**, J.D.Bronzino ,CRC Press ,Volume1 ,2nd Edition, 2000.
2. **Biomedical Engineering Handbook,** J.D.Bronzino ,CRC Press ,Volume2 ,2nd Edition, 2000.
3. **Handbook of Biomedical Instrumentation ,** R.S.Khandpur **,**Tata McGraw Hill, 2nd Edition , 2003.

Sub Title: BIOMETRIC SYSTEMS		
Sub Code: 18ML752	**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 enable the students to Study

1. To understand the technologies of fingerprint, iris, face and speech recognition
2. To understand the general principles of design of biometric systems and the underlying trade-offs.
3. To recognize personal privacy and security implications of biometrics based identification technology.
4. To identify issues in the realistic evaluation of biometrics based systems.

UNIT No	Syllabus Content	No of Hours
1	**Introduction to Biometrics** Introduction and back ground biometric technologies passive biometrics active biometrics - Biometrics Vs traditional techniques Benefits of biometrics - Operation of a biometric system Key biometric processes: verification, identification and biometric matching. Development of biometric authentication. Basic terms, biometric data, biometric characteristics, biometric features, biometric templates and references. Performance measures in biometric systems: False Accept Rate (FAR), False Reject Rate (FRR), Failure To Enroll (FTE) Rate, Failure To Acquire (FTA) rate and- Need for strong authentication Protecting privacy and biometrics and policy Biometric applications	**10**
2	**Fingerprint Identification Technology** Fingerprint capture, sensor types, latent fingerprints. Fingerprint image preprocessing, segmentation, binary and skeletal images. Fingerprint Patterns, Fingerprint Features, Fingerprint Image, width between two ridges - Fingerprint Image Processing - Minutiae Determination - Fingerprint singularities, detection of loops, deltas, whirls and cores. Fingerprint Matching: Fingerprint Classification, Matching policies. Galton's details, base and complex minutiae, detection of minutiae. Fingerprint recognition, minutiae- and correlation-based methods. Fingerprints in forensics and biometrics, similarities and differences.	**12**
3	**Face Recognition:** Introduction to the face processing pipeline: acquisition, face detection, alignment, feature extraction, matching. Classic subspace methods. Hand-tuned feature descriptors. Distance, similarity and learning-based matching. components, Facial Scan Technologies, Face Detection, Face	**12**

	Recognition, Representation and Classification, Kernel- based Methods and 3D Models, Learning the Face Spare, Facial Scan Strengths and Weaknesses, Methods for assessing progress in Face Recognition.	
4	**Voice Scan:** Introduction, Components, Features and Models, Addition Method for managing Variability, Measuring Performance, Alternative Approaches, Voice Scan Strengths and Weaknesses, NIST Speaker Recognition Evaluation Program, Biometric System Integration.	**10**
5	**Fusion in Biometrics:** Introduction to Multibiometric - Information Fusion in Biometrics - Issues in Designing a Multibiometric System - Sources of Multiple Evidence - Levels of Fusion in Biometrics - Sensor level, Feature level, Rank level, Decision level fusion - Score level Fusion. Examples biopotential and gait based biometric systems.	**08**

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: Identify the objectives and background of biometrics
CO2: Determine fingerprint identification techniques.
CO3: Demonstrate knowledge engineering principles underlying face recognition.
CO4: Analyze various speech features and models for speaker recognition system
CO5: Design of basic biometric system applications.

COs	**Mapping with POs**
CO1	PO1,PO3,PO4, PO6, PO7,
CO2	PO1,PO2,PO3,PO4, PO6, PO7, PO12
CO3	PO1,PO2,PO3,PO4,PO12
CO4	PO1,PO2,PO3,PO4,PO12
CO5	PO1,PO2,PO3,PO4,PO12

Text Books:

1. **Fundamentals of BioMEMS & Medical Microdevices**, Steven Salitreman, Cengage Learning India, 2006.
2. **Lab-On-A-Chip: Miniaturized systems for chemical analysis & synthesis**, Edwin ooterrbroek, Alert Berg, Elsevier, 2003.

Sub Title : JAVA LAB		
Sub Code: 18MLL77	**No. of Credits:2=0: 0:2(L-T-P)**	**No of lecture hours/week :04**
Exam Duration : 3 hours	**Exam Marks : 50**	

COURSE OBJECTIVES

To enable the students learn the fundamentals of programming language Java and also develop programming skills in Java

1	Simple Java Programs to illustrate the data operators
2	Program for string reversal
3	Program for demonstration of control statements
4	Program for demonstrating constructors
5	Program for demonstrating Overloading and overriding
6	Program for demonstrating multilevel Inheritance
7	Program for exception handling (try & catch methods and nested try statement and)
8	Program for demonstration of multi threading : Implementing runnable & extends, producer-consumer problem synchronization
9	Program for demonstrating event handling
10	Developing Applet program

COURSE OUTCOME: The students would have

CO1: Acquired programming skills in Java and will be able to develop applications using Java

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

Sub Title: Project Phase I		
Sub Code: 18MLP78	**No of Credits 2:00:00**	
	Exam Marks :	

COURSE OBJECTIVES: To enable the students to learn

1. Develop their own ideas
2. Interact with outside world
3. Work in a group in a collaborative and productive manner

The project topics and batch mates are decided in Project Phase 1. The project work is carried out in group of 3 or 4. Industry projects are encouraged and promoted. The Project topic and the design presented in the phase I. The students will make a presentation of the abstract and synopsis and also submit a report showing the design & implementation along with the literature survey.

COURSE OUTCOME: The students will be able to

CO1: Carry out the literature survey
CO2: Convert the ideas of their interest into a conceptual model
CO3: Interact with outside world in identifying a suitable problem
CO4: Prepare proposals and approach funding agencies

COs	**Mapping with POs**
CO1	PO2,PO3,PO4,PO5, PO6, PO7, PO12
CO2	PO3, PO6, PO12
CO3	PO9,PO10, PO12
CO4	PO10, PO11,

VIII **SEMESTER**

Sub Title: Project Phase II		
Sub Code: 18MLP81	**No of Credits 10:00:00**	
	Exam Marks : 100	

COURSE OBJECTIVES: To enable the students to Study

1. Realise their technical ideas into a working mode
2. Interact with outside world
3. Work in a group in a collaborative and productive manner

The project topics and batch mates are decided in Project Phase 1. The project work is carried out in group of 3 or 4. Industry projects are encouraged and promoted. The Project topic and the design presented in the phase I has to be implemented with the guidance of a teacher assigned to the batch. The students will finally make an oral presentation and also submit a technical report.

Course Outcome: The students will be able to
CO1: Realise innovative ideas into working models
CO2: Discuss ideas, plan and work in a peer team to develop a system
CO3: Design a cost effective model within the time
CO4: Interact with industry experts
CO5: Document and present the technical project report

Cos	**Mapping with Pos**
CO1	PO1,PO2,PO3,PO4,PO5,PO6,PO7, PO12
CO2	PO9,PO10, PO11,
CO3	PO4, PO5, PO11, PO12,
CO4	PO9, PO10,PO11, PO12
CO5	PO10, PO12

SUB TITLE: TECHNICAL SEMINAR		
Sub Code: 18MLS82	**No of Credits 01:00:00**	
	Exam Marks : 50	

Course Objectives: To enable the students to learn

1. Read and disseminate technical papers
2. Prepare and present a document before the peers
3. Understand the latest happenings in their field of interest

The seminar topics must relate to the current trend in technology depending on the students interest in the field of medical electronics. And the students must carry out an elaborate literature survey on the related field referring standard international journals/conferences. The students will finally make a oral presentation and also submit a technical report.

Course Outcome: To enable the students to learn
CO1: Read and interpret technical papers
CO2: Express the ideas and communicate clearly
CO3: Prepare Technical documentation

COs	**Mapping with POs**
CO1	PO2,PO3,PO4,PO6
CO2	PO10
CO3	PO10,PO12

Sub Title: INTERNSHIP		
Sub Code: 18MLI83	**No of Credits 02:00:00**	
	Exam Marks : 100	

Course Objectives: To enable the students to

1. Understand the latest technology trends
2. Develop and refine skills
3. Explore the career path

The students must carry out the internship in the field related to medical electronics. The students will finally make an oral presentation and also submit a report.

Course Outcome: The student will be able to
CO1: Develop communication, interpersonal & problem solving skills
CO2: Integrate theory and implementation
CO3: Prepare Technical documentation

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

Dr. Ambedkar Institute of Technology, Bengaluru-560 056

SCHEME OF TEACHING AND EXAMINATION from Academic Year 2021-22

B.E Medical Electronics Engineering Batch 2020-21

Outcome Based Education (OBE) and Choice Based Credit System (CBCS)

III SEMESTER

Sl. No	Course and Course Code		Course Title	Teaching Department	Teaching Hours /Week			Examination				Credits
					Theory Lecture	Tutorial	Practical/ Drawing	Duration in hours	CIE Marks	SEE Marks	Total Marks	
					L	T	P					
1	BC	18MA31	Transforms and Applications	Mathematics	3	0	0	03	50	50	100	3
2	PC	18MD31	Analog Electronic Circuits		3	0	0	03	50	50	100	3
3	PC	18MD32	Logic Design and VHDL		2	2	0	03	50	50	100	3
4	PC	18MD33	Medical Science		3	0	0	03	50	50	100	3
5	PC	18MD34	Network Analysis		2	2	0	03	50	50	100	3
6	PC	18MD35	Sensors and Measurement		3	0	0	03	50	50	100	3
7	PC	18MD36	OOPs and Data Structures		3	0	0	03	50	50	100	3
8	PC	18MDL37	Analog Electronic Circuits Lab		0	0	2	02	50	50	100	1
9	HS	18MDL38	Logic Design Lab		0	0	2	02	50	50	100	1
10	MC	18HS31/32	CIPH/ Env. Studies	Humanities	2			02	50	-	50	1
11	MC	18HS33	Soft Skills	Humanities	2			02				-
				TOTAL	**23**	**04**	**04**	**29**	500	500	950	**24**

Course prescribed to lateral entry Diploma holders admitted to III semester of Engineering programs

12	MC	18MAD31	Advance Mathematics - I	Mathematics	02	01	--	03	50		50	-

(a)**The mandatory non – credit courses** Advance Mathematics I and II prescribed at III and IV semesters respectively, to lateral entry Diploma holders admitted to III semester of BE programs shall compulsorily be registered during respective semesters to complete all the formalities of the course and appear for SEE examination.

(b) **The mandatory non – credit courses** Advance Mathematics I and II, prescribed to lateral entrant Diploma holders admitted to III semester of BE programs, are to be completed to secure eligibility to VII semester. However, they are not considered for vertical progression from II year to III year of the programme but considered as head of passing along with credit courses of the programme to eligibility to VII semester.

Note: BC: Science Course, PC: Professional Core. HS: Humanities, MC: Mandatory Course.

Dr. Ambedkar Institute of Technology, Bengaluru-560 056

SCHEME OF TEACHING AND EXAMINATION from Academic Year 2021-22

B.E Medical Electronics and Engineering Batch 20-21

Outcome Based Education (OBE) and Choice Based Credit System (CBCS)

IV SEMESTER

Sl. No	Course and Course Code		Course Title	Teaching Department	Teaching Hours /Week			Examination				Credits
					Theory Lecture	Tutorial	Practical/ Drawing	Duration in hours	CIE Marks	SEE Marks	Total Marks	
					L	T	P					
1	BC	18MA41	Probability, Numerical and Optimisation Technique	Mathematics	3	0	0	03	50	50	100	3
2	PC	18MD41	Microcontrollers		3	0	0	03	50	50	100	3
3	PC	18MD42	Communication Systems		3	0	0	03	50	50	100	3
4	PC	18MD43	Signals and Systems		3	2	0	03	50	50	100	4
5	PC	18MD44	Biomedical Instrumentation		4	0	0	03	50	50	100	4
6	PC	18MD45	Linear IC's and Applications		3	0	0	03	50	50	100	3
7	PC	18MDL46	OOPS and Data Structure Lab		0	0	2	03	50	50	100	1
8	PC	18MDL47	Microcontroller Lab		0	0	2	03	50	50	100	1
9	PC	18MDL48	Linear Integrated Circuits Lab		0	0	2	03	50	50	100	1
10	HS	18HS41/42	CIPH/ Env. Studies	Humanities	2	0	0	02	50	-	50	1
11	MC	18HS43	Employability Skills	Humanities	3	0	0	-				-
				TOTAL	24	2	6	**29**	500	450	950	**24**

Course prescribed to lateral entry Diploma holders admitted to III semester of Engineering programs

12	MC	18MAD31	Advance Mathematics - I	Mathematics	02	01	--		50		50	-

(a)**The mandatory non – credit courses** Advance Mathematics I and II prescribed at III and IV semesters respectively, to lateral entry Diploma holders admitted to III semester of BE programs shall compulsorily be registered during respective semesters to complete all the formalities of the course and appear for SEE examination.

(b) **The mandatory non – credit courses** Advance Mathematics I and II, prescribed to lateral entrant Diploma holders admitted to III semester of BE programs, are to be completed to secure eligibility to VII semester. However, they are not considered for vertical progression from II year to III year of the programme but considered as head of passing along with credit courses of the programme to eligibility to VII semester.

Note: BC: Science Course, PC: Professional Core. HS: Humanities, MC: Mandatory Course.

Sub Title : ANALOG ELECTRONIC CIRCUITS		
Sub Code: 18MD31	**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 transistor hybrid equivalent model and frequency analysis of voltage divider configuration based on the hybrid equivalent model.
2. The frequency response of the amplifier
3. Feedback concepts and Power amplifier classification.
4. FET & MOSFET construction and characteristics.
5. MOSFET Biasing circuits

UNIT No	Syllabus Content	No of Hours
1	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 Hybrid equivalent model of voltage divider circuit
CO2: Determine the cut off frequencies for practical transistor amplifiers
CO3: Classify feed back amplifiers and power amplifiers
CO4: Understand the construction of FET, MOSFET
CO5: Understand the Characteristics and analyse the behaviour of MOSFET under varied voltage conditions
CO6: Design different MOSFET Biasing circuits

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

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.

Sub Title : LOGIC DESIGN and VHDL		
Sub Code: 18MD32	**No of Credits : 3=2:2:0(L-T-P)**	**No of lecture hours/week : 4**
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,PO4,PO6,
CO5	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.

Sub Title : MEDICAL SCIENCE		
Sub Code: 18MD33	**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	**8**
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	**8**

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.

Sub Title : NETWORK ANALYSIS		
Sub Code: 18MD34	**No of Credits : 3=2:2:0(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. 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**

Note2: 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: Understand and apply network theorems
CO5: 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	PO1,PO2,PO3
CO5	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.

Sub Title : Sensors and Measurement		
Sub Code: 18MD35	**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.

Sub Title: OOPs AND DATA STRUCTURES		
Sub Code: 18MD36	**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: Assignments to be carried out as practical sessions and report to be submitted
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.

Sub Title : ANALOG ELECTRONIC CIRCUITS LAB		
Sub Code: 18MDL37	**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

Sub Title : LOGIC DESIGN LAB		
Sub Code: 18MDL38	**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

IV SEMESTER

Sub Title : MICROCONTROLLERS		
Sub Code: 18MD41	**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. 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	**MSP430 :** Architecture**,** Addressing modes**,** Constant generator**,** Instruction set, Resets, Clock System, Functions & Subroutines , Interrupts, ISR, Low Power modes**,**	**8**
4	Digital IO- Parallel Ports**,** Programing-Input & Output Registers, Function Select Register, Port Interrupts, Pull Up/Down Registers, GPIO Control Timers- Basic Timer, Timer A, Timer registers, Capture & Compare , Timer Modes, Timer Interrupts, Watch Dog Timer, Real Time Clock, Pulse Width Modulation ADC 10 in MSP430 – Architecture, Interrupts,	**8**

5	**Communication protocols and Interfacing:** Serial communication basics, Synchronous/Asynchronous interfaces (like UART, USB, SPI, I2C,), Implementing and programming UART, I2C, SPI interface using **MSP430,** **IoT Fundamentals -** overview and architecture, wireless communication standards- Zigbee, Bluetooth & Wi-Fi. OSI & TCP/IP model in a nutshell.	**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 & MSP430
CO3: Write software programs for 8051 and MSP430
CO4: Incorporate the Timer, Interrupts and Serial Communication in developing application programs.
CO5: understand the concepts of IOT and the related wireless protocols

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. **MSP430 Microcontrollers Basics, John H Devis, 1st Edition, Reed Elsevier India Pvt. Ltd 2017**
3. **Analog and Digital Circuits for Electronic Control System Applications**: **Using the TI MSP430 Microcontroller**, Jerry Luecke, 1st Edition, Elsevier Science, 2005

Reference Books:

1. **The 8051 Microcontroller and Embedded Systems,** Kenneth J. Ayala and Dhananjay V.Gadre , Cenegage learning.
2. **8051 Micrcontroller-Hardware, Software and Applications,** V.Udayashankara and M.S. Mallikarjunaswamy,Tata McGraw-Hill, 2009**3.**
3. **Microcontrollers- Theory and Applications**, Ajay V.Deshmukh ,TMH,2005.
4. **Texas Instruments Manual**

Sub Title: COMMUNICATION SYSTEMS		
Sub Code: 18MD42	**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 . **Simulation study using MATLAB Simulink (only for practice)**	**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 **Simulation study using MATLAB Simulink (only for practice)**	**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	**7**

	temperature.	

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.

Sub Title : SIGNALS and SYSTEMS		
Sub Code: 18MD43	**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.

Sub Title: BIOMEDICAL INSTRUMENTATION		
Sub Code: 18MD44	**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.	**10**

	Electric shock hazards, Leakage currents, macro shock, micro shock hazards and preventions, Electrical safety analyzer & precautions. Electrical safety codes standards.	

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.

Sub Title : LINEAR IC's and APPLICATIONS		
Sub Code: 18MD45	**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**

<u>Note 1</u>: 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.

Sub Title: OOPs AND DATA STRUCTURE LAB		
Sub Code: 18MDL46	**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

Sub Title : MICROCONTROLLER LAB		
Sub Code: 18MDL47	**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

Sub Title: LINEAR INTEGRATED CIRCUITS LAB		
Sub Code: 18MDL48	**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