

III SEMESTER

B.E. Biomedical Engineering (BM) Choice Based Credit System (CBCS) Semester - III			
ENGINEERING MATHEMATICS-III (Common to All Branches)			
Subject Code	: 15MAT31		IA Marks : 20
Number of Lecture Hours/Week	: 04		Exam Marks : 80
Total Number of Lecture Hours	: 50		Exam Hours : 03
Credits - 4			
Course Objectives: This course will enable the students to			
Revised Bloom's Taxonomy Levels: L1 – Remembering, L2 – Understanding, L3 – Applying, L4 – Analyzing, L5 – Evaluating, and L6 - Creating			
Modules		Teaching Hours	Revised Bloom's Taxonomy (RBT)Level
Module -1		10 Hours	
Module -2		10 Hours	
Module -3		10 Hours	
Module -4		10 Hours	

Module -5	10 Hours	
Course Outcomes: After studying this course, students will able to:		
Graduate Attributes (as per NBA)		
Question Paper Pattern: <ul style="list-style-type: none"> • The question paper will have TEN questions. • Each full question carry16 marks • There will be TWO full questions (with maximum of FOUR sub questions) from each module. • Each full question will have sub questions covering all the topics under a module. • The students will have to answer FIVE full questions, selecting ONE full question from each module. 		
Text Books:		
Reference Books:		

**B.E. Biomedical Engineering (BM)
Choice Based Credit System (CBCS)
Semester - III**

**ELECTRONIC INSTRUMENTATION AND MEASUREMENTS
(Common to EI, BM & ML)**

Subject Code	: 15 EI/BM/ML 32		IA Marks	: 20
Number of Lecture Hours/Week	: 04		Exam Marks	: 80
Total Number of Lecture Hours	: 50		Exam Hours	: 03

Credits - 4

Course Objectives: This course will enable the students to

- Impart with the knowledge of generalized measurement systems.
- Learn the characteristics of various types of measurement systems and errors in measuring instruments.
- Analyze the circuits for the measurement of Resistance, Capacitance, Inductance, and Frequency.
- Impart with the basic concepts of CRO and its usage for the measurement of various parameters.
- Understand the concepts of Ammeters, Voltmeter and Multimeters
- Understand the importance of Display Devices and Recorders in practical fields

Revised Bloom's Taxonomy Levels: L1 – Remembering, L2 – Understanding, L3 – Applying, L4 – Analyzing, L5 – Evaluating, and L6 - Creating

Modules	Teaching Hours	Revised Bloom's Taxonomy (RBT) Level
<p>Module -1</p> <p>A).Measurements: introduction, Significance of measurements, methods of measurements, instruments and measurement systems, Functions of instruments and measurement systems, Applications of measurement systems.</p> <p>Measurement Errors: Introduction Gross errors and systematic errors, Absolute and relative errors, basic concepts of accuracy, Precision, Resolution and Significant figures, Measurement error combinations. (relevant problems)</p>	10 Hours	L1,L2
<p>Module -2</p> <p>A). Ammeters, Voltmeter and Multimeters: Introduction, DC ammeter principle only, DC voltmeter, Multi-range voltmeter, Extending voltmeter ranges, Loading, Peak responding and True RMS voltmeters. (relevant problems)</p> <p>B). Digital Voltmeters: Introduction, Ramp type, Dual slope integrating type (V–T), integrating type (V–F) and Successive approximation type (relevant problems).</p> <p>Digital Instruments: Introduction, Block diagram of a Basic Digital Multi-meter. Digital frequency meters: Basic circuit of a Digital frequency meter, Basic circuit for frequency measurement.</p>	10 Hours	L1,L2,L3, L5
<p>Module -3</p> <p>A). Oscilloscopes : Introduction, Basic principles, CRT features, Block</p>	10 Hours	L1,L2,L3, L4

<p>diagram and working of each block, Typical CRT connections, Dual beam and dual trace CROs, Electronic switch.</p> <p>B).Special Oscilloscopes: Delayed time-base oscilloscopes: Need for a time delay & delayed-time-base system. Analog storage oscilloscopes: Need for trace storage, bistable storage CRT, Variable persistence storage CRT. Digital storage oscilloscopes: Basic DSO operation only.</p>		
<p>Module -4 A). Signal Generators : Introduction, Fixed and variable AF oscillator, Standard signal generator, Modern laboratory signal generator, AF sine and Square wave generator, Function generator, Square and Pulse generator. B). Bridge Circuits for Measurement of R, L & C: DC bridges: Introduction, Wheatstone’s bridge, Kelvin Bridge AC bridges: Capacitance Comparison Bridge, inductance Comparison Bridge, Maxwell’s bridge, Schering Bridge. (relevant problems)</p>	10 Hours	L1,L2,L3,L5 ,L6
<p>Module -5 Display Devices and Recorders: Introduction, electrical indicating instruments, digital instruments, digital display methods, digital display unit. Segmental Displays: Seven segmental display, dot matrices, LED, LCD, decade counting assemblies, display systems. Recorders: Recording requirements, analog recorders- Graphic recorders, strip chart recorders & its types, X-Y recorder, Magnetic & Digital tape recorders.</p>	10 Hours	L1,L2,L3,L5
<p>Course Outcomes: After studying this course, students will able to:</p> <ul style="list-style-type: none"> Analyze instrument characteristics, errors and generalized measurement system. Analyze and use the circuit for the measurement of R, L, C, F, I, V etc Use of Ammeters, Voltmeter and Multimeters and CRO for measurement Analyze and interpret different signal generator circuits for the generation of various waveforms Understand and use different display devices and recorders 		
<p>Graduate Attributes (as per NBA)</p> <ul style="list-style-type: none"> Engineering knowledge Problem analysis Design & Development of Solutions Modern tool usage 		
<p>Question Paper Pattern:</p> <ul style="list-style-type: none"> The question paper will have TEN questions. Each full question carry 16 marks There will be TWO full questions (with maximum of FOUR sub questions) from each module. Each full question will have sub questions covering all the topics under a module. The students will have to answer FIVE full questions, selecting ONE full question from each module. 		
<p>Text Books:</p> <ol style="list-style-type: none"> “Electronic Instrumentation”, H. S. Kalsi, TMH, 2004 (Module- 2,3 & 4) “Electronic Instrumentation and Measurements”, David A Bell, PHI / Pearson Education 2006/ Oxford Higher Education, 2013. (Module 1 & 3) 		

3. Electrical and Electronic Measurements and Instrumentation – A. K. Sawhney, 17th Edition (Reprint 2004), DhanpatRai& Co. Pvt. Ltd., 2004.(Module- 1 & 5)

Reference Books:

1. “Principles of Measurement Systems”, John P. Beatly, 3rd Edition, Pearson Education, 2000
2. “Modern Electronic Instrumentation and Measuring Techniques”, Cooper D & A D Helfrick, PHI, 1998.

B.E. Biomedical Engineering (BM) Choice Based Credit System (CBCS) Semester - III				
ANALOG ELECTRONIC CIRCUITS (Common to EI, BM & ML)				
Subject Code	: 15EI/BM/ML33		IA Marks	: 20
Number of Lecture Hours/Week	: 04		Exam Marks	: 80
Total Number of Lecture Hours	: 50		Exam Hours	: 03
Credits - 4				
Course Objectives: This course will enable the students <ul style="list-style-type: none"> • With the knowledge of Electronic devices. • To know modeling of BJT and FET for analysis and to Design of BJT Amplifier, Hybrid Equivalent and Hybrid π Models. • To know construction and characteristics of JFETs and MOSFETs. • Describe various types of FET biasing, and Demonstrate use of FET amplifiers. • Demonstrate and Generalize Frequency response of BJT and FET amplifiers at various frequencies. • Analyze Power amplifier circuits in different modes of operation. • To know the concept of Feedback and its effect on amplifier circuits and Oscillator circuits- operation and generation of low and high frequency signal using BJT/FET/Op-amp. 				
Revised Bloom's Taxonomy Levels: L1 – Remembering, L2 – Understanding, L3 – Applying, L4 – Analysing, L5 – Evaluating, and L6 - Creating				
Modules		Teaching Hours	Revised Bloom's Taxonomy (RBT) Level	
Module -1 BJT AC Analysis BJT modeling, re transistor model: Common Emitter Configuration, Voltage-Divider Bias, CE Emitter-Bias Configuration (Excluding P-spice Analysis), Emitter Follower Configuration, Determining Current Gain, Effect of R_L and R_S , Cascaded Systems, RC- Coupled BJT Amplifier, Cascade Connection, Darlington Connection. The Hybrid Equivalent model, Approximate Hybrid Equivalent Circuit, Fixed bias configuration, Voltage-Divider configuration. (Relevant problems on above topics) Complete Hybrid Equivalent Model and Hybrid π Model.		10 Hours	L1 L2	
Module -2 Field Effect Transistors Introduction, Construction and Characteristics of JFETs, Transfer Characteristics, Applying Shockley's Equation. Depletion Type MOSFET: Basic Construction, Basic Operation and Characteristics, P-Channel Depletion Type MOSFET and Symbols, Enhancement Type MOSFET: Basic Construction, Basic Operation and Characteristics, P-Channel Enhancement Type MOSFETs and Symbols. Relevant problems on above topics, CMOS-Basics. FET Biasing Introduction, Fixed-Bias Configuration, Self-Bias Configuration, Voltage-Divider Biasing. Relevant problems on above topics		10 Hours	L1 L2	

<p>Module -3 FET Amplifiers Introduction, JFET Small Signal Model, JFET AC equivalent Circuit, Fixed-Bias Configuration, Self-Bias Configuration, Voltage-Divider Configuration, Source Follower Configuration. Relevant problems on above topics. BJT and JFET Frequency Response: Introduction, General Frequency Considerations, Low Frequency Response of BJT Amplifier, Low Frequency Response of FET Amplifier, Miller Effect Capacitance, High Frequency Response of FET Amplifier, Multistage frequency effects. Relevant problems on above topics .(Excluding P-spice Analysis)</p>	10 Hours	L1, L2, L3
<p>Module -4 Power Amplifiers Introduction: Definitions and Amplifier Types, Series Fed Class A Amplifier, Transformer Coupled Class A Amplifier, Class B Amplifier operation. Class B amplifier circuits: Transformer-Coupled Push-Pull Circuits, Complementary –Symmetry Circuits only, Amplifier Distortion, Class C and Class D Amplifier. Relevant Problems on above topics.</p>	10 Hours	L1,L2, L3,L4
<p>Module -5 Feedback and Oscillator Circuits Feedback Concepts, Feedback Connection Types, Effects of negative feedback, Oscillator operation, Phase Shift Oscillator: FET Phase Shift Oscillator, Transistor Phase Shift Oscillator, Wien Bridge Oscillator, Tuned oscillator Circuit: FET and Transistor Colpitts Oscillator, FET and Transistor Hartley Oscillator, Crystal oscillator. Relevant Problems on above topics Unijunction transistor oscillator.</p>	10 Hours	L2, L3
<p>Course Outcomes: After studying this course, students will able to:</p> <ul style="list-style-type: none"> • Explain the Working principles, characteristics and basic applications of BJT and FET. • Modeling of BJT/FET for analysis • Design Single stage, Multistage amplifier, with and without feedback • Analyze Frequency response of BJT and FET. • Acquire the knowledge of classifications of Power amplifier, operation, and able to design power amplifier. • Apply the knowledge gained in the design of BJT/FET circuits in Oscillators to generate different frequency signals. 		
<p>Graduate Attributes (as per NBA)</p> <ul style="list-style-type: none"> • Engineering Knowledge • Problem Analysis • Design / development of solutions (partly) • Interpretation of data 		
<p>Question Paper Pattern:</p> <ul style="list-style-type: none"> • The question paper will have TEN questions. • Each full question carry 16 marks • There will be TWO full questions (with maximum of FOUR sub questions) from each module. • Each full question will have sub questions covering all the topics under a module. 		

- The students will have to answer FIVE full questions, selecting ONE full question from each module.

Text Books:

1. Robert L. Boylestad and Louis Nashelsky, “Electronics devices and Circuit theory”, Pearson, 10th Edition, 2009, ISBN:9788131727003

Reference Books:

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

B.E. Biomedical Engineering (BM) Choice Based Credit System (CBCS) Semester - III				
DIGITAL DESIGN AND HDL (Common to EI, BM & ML)				
Subject Code	: 15 EI/BM/ML 34		IA Marks	: 20
Number of Lecture Hours/Week	: 04		Exam Marks	: 80
Total Number of Lecture Hours	: 50		Exam Hours	: 03
Credits - 4				
Course Objectives: This course will enable the students to <ul style="list-style-type: none"> To impart the concepts of simplifying Boolean expression using K-map techniques and provide an understanding of logic families To impart the concepts of designing and analyzing combinational logic circuits To provide an understanding for the concepts of HDL-Verilog, data flow and behavioral models for the design of digital systems. To impart design methods and analysis of sequential logic circuits 				
Revised Bloom's Taxonomy Levels: L1 – Remembering, L2 – Understanding, L3 – Applying, L4 – Analysing, L5 – Evaluating, and L6 - Creating				
Modules		Teaching Hours	Revised Bloom's Taxonomy (RBT)Level	
Module -1 Principles of combinational logic: Definition of combinational logic, Canonical forms, Generation of switching equations from truth tables, Karnaugh maps- up to 4 variables, Quine-McCluskey minimization technique Introduction to Verilog: Structure of Verilog module, Operators, data types, Styles of description- Data flow description, Behavioral description, Implement logic gates, half adder and full adder using Verilog data flow description.		10 Hours	L2,L3,L4	
Module -2 Combinational Functions: Arithmetic Operations: Adders and subtractors-cascading full adders, Look ahead carry, Binary Comparators – 2bit and 4 bit, two bit Multiplier, Verilog Description of for above circuits. Multiplexers- Realization of 2:1, 4:1 and 8:1 using gates & Applications. Demultiplexers: - Realization of 1:2 1:4 and 1:8 using basic gates & Applications Verilog Behavioral description: Structure, variable assignment statement, sequential statements, loop statements, Verilog behavioral description of Multiplexers (2:1,4:1,8:1) and De-multiplexers (1:2,1:4,1:8)		10 Hours	L1,L2,L3	
Module -3 Analysis and design of combinational logic: Encoders: Binary coded decimal codes, Binary – Gray vice versa, BCD – Excess 3 Encoders: Realization and Priority Encoders, Decoders: BCD – Decimal, BCD – Seven segment, Seven segment display. Verilog behavioral description of Encoders (8 to 3 with priority and without		10 Hours	L1,L2	

priority), Decoders (2 to 4).		
Module -4 Sequential Logic Circuits-1: Latches and Flip-Flops: SR-latch, D-latch, D flip-flop, JK flip-flop, T flip- flop Master slave FF, Edge trigger and Pulse trigger FF , Registers and Shift Registers: PISO, PIPO, SISO,SIPO, Right shift and left shift, Universal Shift register. Verilog behavioral description of latches (D-latch, SR latch) and flip-flops (D, T, JK, SR flip-flops).	10 Hours	L2,L3,L6
Module -5 Counters, design and their applications: Counters-Binary ripple counters, Synchronous binary counters, Modulo N counters – Synchronous and Asynchronous counters. Verilog behavioral description of Synchronous and Asynchronous counters, sequential counters. Synthesis of Verilog: Mapping process in the hardware domain- Mapping of signal assignment, variable assignment, if statements, else-if statements, loop statements	10 Hours	L2,L3,L4,L6
Course Outcomes: After studying this course, students will able to: <ul style="list-style-type: none"> • Simplify Boolean functions using K-map and Quine-McCluskey minimization technique • Analyze, design and write verilog code for combinational logic circuits. (MUX, De-MUX, adder and subtractor, and comparator circuits) • Analyze and design code converters, encoders and decoders. • Analyze and design of synchronous sequential circuits • Analyze sequential circuits, Moore/Mealy machines 		
Graduate Attributes (as per NBA) <ul style="list-style-type: none"> • Engineering knowledge • Problem analysis • Design & Development of Solutions • Modern tool usage 		
Question Paper Pattern: <ul style="list-style-type: none"> • The question paper will have TEN questions. • Each full question consists of 16 marks. • There will be 2 full questions (with maximum of FOUR sub questions) from each module. • Each full question will have sub questions covering all the topics under a module. • The students will have to answer 5 full questions, selecting one full question from each module. 		
Text Books: <ol style="list-style-type: none"> 1. Digital Logic Applications and Design by John M Yarbrough, Thomson Learning,2001 (Modules 1,2,3,4,5 –Logic design) 2. HDL Programming VHDL and Verilog by Nazeih M. Botros, 2009 reprint, Dreamtech press.(Modules 1,2,3,4,5 Verilog description) 		
Reference Books: <ol style="list-style-type: none"> 1. Charles H Roth, Jr., “Fundamentals of logic design”, Cengage Learning 2. Digital Principals and Design – Donald D Givone,12th reprint, TMH,2008 3. Logic Design, Sudhakar Samuel, Pearson/ Saguine, 2007 4. Fundamentals of HDL- Cyril P R Pearson/Sanguin 2010 		

B.E. Biomedical Engineering (BM) Choice Based Credit System (CBCS) Semester - III			
HUMAN ANATOMY AND PHYSIOLOGY (Common to BM and ML)			
Subject Code	: 15 BM/ML 35		IA Marks : 20
Number of Lecture Hours/Week	: 04		Exam Marks : 80
Total Number of Lecture Hours	: 50		Exam Hours : 03
Credits - 4			
Course Objectives: <ul style="list-style-type: none"> To understand the internal environment of human body and homeostasis mechanism To provide the basic knowledge of different types of tissues. To provide the knowledge of structure and functioning of nervous system, cardiovascular system, respiratory system, digestive system and musculoskeletal system To provide the knowledge of physiological parameters of normal health and factors affecting various physiological processes in the body. 			
Revised Bloom's Taxonomy Levels: L1 – Remembering, L2 – Understanding, L3 – Applying, L4 – Analyzing, L5 – Evaluating, and L6 - Creating			
Modules		Teaching Hours	Revised Bloom's Taxonomy (RBT) Level
Module -1 Introduction: Homeostasis, Tissue, Cartilage: The internal environment and homeostasis, survival needs of the body, movement of substances within the body, body fluids, action potential, propagation of action potential, cell-structure and functions. 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.		10 Hours	L1, L2
Module -2 Nervous System: Functional Components of nervous system, Neurons: Properties of neurons, Cell bodies, Axon and Dendrites, Types of nerves, Synapse and neurotransmitters, neuromuscular junction. Central nervous system: 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, spinal reflex, Spinal nerves (in brief list & functions), Cranial nerves (in brief list & functions), Autonomic nervous system (in brief)- functions and effects. Pituitary gland and hypothalamus.		10 Hours	L1, L2, L3, L4
Module -3 Cardiovascular System: Introduction, Blood vessels- Arteries and Arterioles, Veins and Venules, capillaries, control of blood vessel diameter, blood supply- internal respiration, cell nutrition. Heart- position, structure- pericardium, myocardium, endocardium, interior of the heart, flow of blood		10 Hours	L1, L2, L3, L4

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 (different parts of aorta & their blood supply, in brief). Summary of the main blood vessels (arteries & veins, explanation with flow diagram only)		
<p>Module -4</p> <p>Respiratory System: Organs of respiration, 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</p> <p>Digestive System: 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. Pancreas and Liver.</p>	10 Hours	L1, L2, L3, L4
<p>Module -5</p> <p>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.</p> <p>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, Hip joint, Knee joint, ankle joint.</p>	10 Hours	L1, L2
<p>Course Outcomes: After studying this course, students will able to:</p> <ul style="list-style-type: none"> • Describe internal environment of human body and explain the fundamental concept of homeostasis. • Explain the structure and functioning of various types of tissues. • Describe the structure and explain the functioning of various nervous system, cardiovascular system, respiratory system, digestive system and musculoskeletal system. • Demonstrate and analyze various physiological parameters in normal and abnormal conditions. 		
<p>Graduate Attributes (as per NBA)</p> <ul style="list-style-type: none"> • Engineering knowledge • Problem analysis • Investigation of Complex Problem • Lifelong learning 		
<p>Question Paper Pattern:</p> <ul style="list-style-type: none"> • The question paper will have TEN questions. • Each full question carry 16 marks • There will be TWO full questions (with maximum of FOUR sub questions) from each module. 		

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

Text Books:

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

Reference Books:

1. Concise Medical Physiology- by Sujit K. Chaudhuri, 5thEdition, New Central Book Agency Pvt. Ltd.
2. Essentials of Medical Physiology - by K. Sembulingam and Prema Sembulingam, 3rdEdition, Jaypee Publications
3. Human Physiology: From Cells to Systems – by Lauralee Sherwood, 6th Edition, Thomson India Edition, 2007.

B.E. Biomedical Engineering (BM) Choice Based Credit System (CBCS) Semester - III			
NETWORK ANALYSIS (Common to EI, BM & ML)			
Subject Code	: 15EI/BM/ML 36		IA Marks : 20
Number of Lecture Hours/Week	: 04		Exam Marks : 80
Total Number of Lecture Hours	: 50		Exam Hours : 03
Credits - 4			
<p>Course Objectives: This course will enable the students to</p> <ul style="list-style-type: none"> • To introduce the Basic circuit laws, Network theorems and Analyze the networks. • To analyze the networks by using optimized methods • To analyze the network behavior during switching states. • To realize the network parameters. 			
<p>Revised Bloom's Taxonomy Levels: L1 – Remembering, L2 – Understanding, L3 – Applying, L4 – Analysing, L5 – Evaluating, and L6 - Creating</p>			
Modules		Teaching Hours	Revised Bloom's Taxonomy (RBT) Level
<p>Module -1 Basic concepts: Sources of electrical energy, Source transformation & Source shifting, Network reduction using star-delta transformation, loop and node analysis with dependent & independent sources for DC networks, concept of super node and super mesh analysis for only independent sources for DC networks.</p>		10 Hours	L ₁ =Remembering, L ₂ =Understanding, L ₃ =Applying, L ₄ =Analysis.
<p>Module -2 Network theorems: Super position, reciprocity, Millman's theorem (for DC networks), Thevenin's & Norton's theorem (for DC networks), and Maximum power transfer theorems (for AC & DC networks)</p>		10 Hours	L ₁ =Remembering L ₂ =Understanding L ₃ =Applying L ₄ =Analysis
<p>Module -3 Transient behavior and initial conditions: Behavior of circuit elements under switching condition and their representation, evaluation of initial & final conditions in RL, RC & RLC circuits for DC excitations. Two port network parameters: Definitions and modeling of Z, Y, H & transmission parameters.</p>		10 Hours	L ₁ = Understanding L ₂ = Analyzing L ₃ =Applying L ₄ =Synthesis
<p>Module -4 Resonant Circuits: Series resonance: Variation of current and voltage with frequency, Selectivity & Bandwidth, Q-factor Parallel resonance: General case-resistance present in both branches, Selectivity & Bandwidth, Maximum impedance conditions with Capacitor, Inductor or frequency as variable.</p>		10 Hours	L ₁ = Understanding L ₂ = Analyzing L ₃ =Applying L ₄ =Realizing
<p>Module -5 Network topology: Graph of a network, concepts of: tree & co-tree, incidence matrix, tie-set & cut-set schedules, Solution of resistive networks using equilibrium equations in matrix form, Principle of duality.</p>		10 Hours	L ₁ = Understanding L ₂ = Analyzing L ₃ =Applying L ₄ =Evaluation
<p>Course Outcomes: After studying this course, students will able to:</p>			

- Apply the basic concepts (Laws, theorems) of networks to obtain solution.
- Choose the Appropriate/specific technique to analyze the networks.
- Realize and Analyze the network behavior

Graduate Attributes (as per NBA)

- Applying the Engineering concepts to analyze the networks
- Realizing and solving the complex circuits

Question Paper Pattern:

- The question paper will have TEN questions.
- Each full question carry 16 marks
- In each full question, preferably 40% should be related to theoretical concepts/derivations and 60% should be related problems/solutions.
- There will be TWO full questions (with maximum of FOUR sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer FIVE full questions, selecting ONE full question from each module.

Text Books:

1. Engineering Circuit Analysis, William H Hayt et al, McGraw Hill, 8th Edition.
2. Networks And Systems, D Roy Choudhury, New Age International Publishers, 3rd Edition.
3. Network Analysis, M.E. Van Valkenburg, Prentice-Hall, 3rd Edition.

Reference Books:

1. Introduction to Electric circuits, Richard C Dorf & James A Svoboda, Wiley, 9th Edition.
2. Electric Circuits, Mahmood Nahvi, McGraw Hill, 9th Edition

**B.E. Biomedical Engineering (BM)
Choice Based Credit System (CBCS)
Semester - III**

**ANALOG ELECTRONIC CIRCUITS LAB
(Common to EI, BM & ML)**

Subject Code	: 15EI/BM/ML L37		IA Marks	: 20
Number of Practical Hours/Week	: 03		Exam Marks	: 80
Total Number of Practical Hours	: 42		Exam Hours	: 03

Credits - 2

Course Objectives:

This laboratory course enables students to get practical knowledge & experience in design, assembly and evaluation/testing of

- Rectifier circuits without and with filter
- BJT as Amplifier without and with feedback
- JFET Characteristics and as Amplifier.
- MOSFET Characteristics
- BJT as Power Amplifiers
- Oscillators using BJT and FET for frequency generation
- UJT characteristics
- Verification of Theorems and applications in practical fields

Revised Bloom's Taxonomy Levels: L1 – Remembering, L2 – Understanding, L3 – Applying, L4 – Analyzing, L5 – Evaluating, and L6 - Creating

Laboratory Experiments	Revised Bloom's Taxonomy (RBT) Level
NOTE: The experiments are to be carried using discrete components only	
1. To design and testing of the following rectifiers with and without filters: (a) Full Wave Rectifier (center tap) (b) Bridge Rectifier.	L3, l4, L5, L6
2. To plot characteristics of UJT and to determine its intrinsic stand-off ratio.	L1, L2, L3, L4
3. To design and test the common emitter amplifier (voltage divider bias) without feedback and determine input, output impedance, gain and bandwidth.	L3, l4, L5, L6
4. To design and test the Emitter follower amplifier (BJT) using voltage divider bias and determine input, output impedance, gain and bandwidth.	L3, l4, L5, L6
5. To plot the Drain and Transfer characteristic for the given FET and to find the Drain Resistance and Trans-conductance.	L1, L2, L3, L4
6. To design, test and to plot the frequency response of Common Source JFET/MOSFET amplifier, and to determine its bandwidth.	L3, l4, L5, L6
7. To plot the input and output characteristics of n-channel MOSFET and calculate its parameters, namely; drain resistance, mutual conductance and amplification factor.	L1, L2, L3, L4
8. Wiring and testing of Complimentary symmetry class B push pull power amplifier and calculation of efficiency.	L1, L2, L3, L4

9. To design and test the RC-Phase shift Oscillator using BJT for the given frequency.	L3, L4, L5, L6
10. To design and test the following tuned oscillator circuits for the given frequency. (a) Hartley Oscillator using BJT (b) Colpitts Oscillator using FET.	L3, L4, L5, L6
11. Testing of crystal oscillator and to determine its frequency of oscillation.	L1, L2, L3, L4
12. Verification of Thevenin's theorem and Maximum Power Transform theorem for the given DC circuits.	L1, L2, L3, L4
<p>Course Outcomes: After studying this course, students will able to:</p> <ul style="list-style-type: none"> • Acquire the Working principles, characteristics and basic applications of BJT and FET. • Modeling of BJT/FET for analysis • Able to design Single stage, Multistage amplifier, with and without feedback • Able to analyze Frequency response of BJT and FET. • Acquire the knowledge of Power amplifiers, operation, and able to design power amplifier. • Apply the knowledge gained in the design of BJT/FET circuits in Oscillators to generate different frequencies and their applications. • Knowledge of UJT characteristics and its application. • Applications of theorems in various practical fields. 	
<p>Graduate Attributes (as per NBA)</p> <ul style="list-style-type: none"> • Engineering Knowledge. • Problem Analysis. • Design / development of solutions (partly) 	
<p>Conduct of Practical Examination:</p> <ol style="list-style-type: none"> 1. All laboratory experiments are to be included for practical examination. 2. Students are allowed to pick one experiment from the lot. 3. Strictly follow the instructions as printed on the cover page of answer script for breakup of marks. 4. Change of experiment is allowed only once and 15% Marks allotted to the procedure part to be made zero. 	
<p>Reference Books:</p> <ol style="list-style-type: none"> 1. Electronics Lab Manual by K. A. Navas, Volume I, PHI, 5th Edition, 2015, ISBN:9788120351424. 2. Electronics Laboratory Primer - A Design Approach by S.Poorna Chandra, B.Sasikala, S Chand Pub. 	

**B.E. Biomedical Engineering (BM)
Choice Based Credit System (CBCS)
Semester - III**

**DIGITAL DESIGN AND HDL LAB
(Common to EI, BM & ML)**

Subject Code	: 15 EI/BM/ML L38	IA Marks	: 20
Number of Practical Hours/Week	: 03	Exam Marks	: 80
Total Number of Practical Hours	: 42	Exam Hours	: 03

Credits - 2

Course Objectives: This course will enable the students to

- The operation of various logic gates and digital circuits and write the Verilog code.
- Design of logic circuits for combinational and sequential circuits and write Verilog code.
- Synthesis of digital circuits, FFs, shift registers and counters using ICs.
- To use FPGA/CPLD kits for downloading the Verilog code and test the output.

Revised Bloom's Taxonomy Levels: L1 – Remembering, L2 – Understanding, L3 – Applying, L4 – Analyzing, L5 – Evaluating, and L6 - Creating

Laboratory Experiments:

Note: (1) Use discrete components to test and verify the logic gates.
(2) Use FPGA/CPLD kits for down loading the Verilog code and test the output.

**Revised
Bloom's
Taxonomy
(RBT) Level**

1. Simplification, realization of Boolean expressions using logic gates/Universal gates	L1,L2,L3
2. To design and implement a) Adder/Subtractor – Full/half using logic gates. b) 4-bit Parallel Adder/ subtractor using IC 7483.	L3, L4, L5,L6
3. To realize a) BCD to Excess-3 code conversion and vice versa b) Binary to Gray code conversion and vice versa	L2,L3, L4
4. To realize a) 4:1 Multiplexer using gates b) 1:8 Demux c) Priority encoder and 3:8 Decoder using IC74138 d) One / Two bit comparator	L2, L3, L4
5. To realize the following flip-flops using NAND Gates (a) T type (b) JK Master slave (c) D type	L2, L3, L4
6. To realize the 3-bit counters as a sequential circuit and Mod-N Counter design (7476, 7490, 74192, 74193)	L2, L3, L4
7. Adder/Subtractor – Full/half using Verilog data flow description	L2, L3, L4
8. Code converters using Verilog Behavioral description a) Gray to binary and vice versa b) Binary to excess3 and vice versa	L2, L3, L4
9. Multiplexers/decoders/encoder using Verilog Behavioral description - 8:1 mux, 3:8 decoder, 8:3 encoder, Priority encoder - 1:8 Demux and verify using test bench - 2-bit Comparator using behavioral description	L2, L3, L4
10. Flip-flops using Verilog Behavioral description a) JK type b) SR type c) T type and d) D type	L2, L3, L4

11. Counter up/down (BCD and binary) , sequential counters using Verilog Behavioral description	L2,L3, L4
12. Interface experiments: (a) Stepper motor (b) Relay (c) Waveform generation using DAC	L2,L3, L4
<p>Course Outcomes: After studying this course, students will able to:</p> <ul style="list-style-type: none"> • Realize Boolean expression using Universal gates / basic gates using ICs and Verilog • Demonstrate the function of adder/subtractor circuits using gates/ICs & Verilog. • Design and analyze the Comparator, Multiplexers Decoders, Encoders circuits using ICs and Verilog. • Design and analysis of different Flip-flops and counters using gates and FFs • Able to use FPGA/CPLD kits for down loading Verilog codes for shift registers and counters and check output. 	
<p>Graduate Attributes (as per NBA)</p> <ul style="list-style-type: none"> • Engineering Knowledge. • Problem Analysis. • Design/Development of solutions 	
<p>Conduct of Practical Examination:</p> <ol style="list-style-type: none"> 1. All laboratory experiments are to be included for practical examination. 2. Students are allowed to pick one experiment from the lot. 3. Strictly follow the instructions as printed on the cover page of answer script for breakup of marks. 4. Change of experiment is allowed only once and 15% Marks allotted to the procedure part to be made zero 	
<p>Text Books:</p> <ol style="list-style-type: none"> 1. Digital Principals and Design – Donald D Givone,12th reprint, TMH,2008 2. HDL Programming VHDLAnd Verilog ByNazeih M. Botros, 2009 reprint, Dreamtech press. 	
<p>Reference Books:</p> <ol style="list-style-type: none"> 1. Digital Logic Applications and Design by John M Yarbrough, Thomson Learning,2001 2. Fundamentals of HDL- Cyril P R Pearson/Sanguin 2010 	

