IV SEMESTER

B.E. Biomedical Engineering (BM) **Choice Based Credit System (CBCS)** **Semester - III**				
ENGINEERING MATHEMATICS-IV **(Common to All Branches)**				
Subject Code	: 15MAT41		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:

- 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:

IV SEMESTER

B.E. Electronics and Instrumentation Engineering (EI)

Choice Based Credit System (CBCS)

Semester – IV

SIGNAL CONDITIONING AND DATA ACQUISITION CIRCUITS

(Common to EI, BM & ML) [Revised]

Subject Code	: 15 EI/BM/ML42		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

- Define and describe Op Amp, basic concepts, characteristics and specifications
- Gain knowledge about Linear and nonlinear applications op-amp.
- Design and develop circuits like, amplifiers, filters, Timers to meet industrial requirements.
- Get a firm grasp of basic principles of op-amp.

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 to Operational Amplifiers:** Introduction, Block schematic of an Op-amp, Power supply connections, Characteristics of an Ideal OP-AMP, Inverting Amplifier, Non-inverting Amplifier, Voltage follower, Differential Amplifier, CMRR. (Relevant problems). **Operational Amplifier Characteristics**: DC characteristics – Input bias current, Input offset current, Input offset voltage, Total output offset voltage, Thermal drift. AC characteristics – Frequency response, Slew rate, PSRR. **Basic op-amp applications** – Scale changer/Inverter. Summing amplifier: Inverting summing amplifier, Non-inverting Summing amplifier, Subtractor, Instrumentation Amplifier. (Relevant problems).	10 Hours	L1,L2, L3,L4
Module -2 **Operational Amplifier Applications:** V – I and I – V converter, Op-amp circuit using diodes, sample and hold circuit, Differentiator and Integrator. **Comparator and waveforms generator:** Comparator, Regenerative comparator (Schmitt Trigger), Astable mutivibrator, Monostable	10 Hours	L1,L2, L3,L4

multivibrator and Triangular waveform generator. Phase shift oscillator, Wien bridge oscillator. (Relevant problems).		
Module -3 **Voltage Regulators:** Introduction, Series Op-amp regulator, IC voltage regulators, 723 general purpose regulators, switching regulator. **Active filters:** First and Second order LPF, First and Second orders HPF, Band Pass Filters, Band Reject filters. (Design examples).	10 Hours	L1,L2, L3,L4
Module -4 **555 Timer:** Description of Functional Diagram, Monostable operation, Applications of Monostable Multivibrator: Frequency Divider & Pulse Width Modulation. Astable operation, Applications of Astable Multivibrator: FSK Generator and Pulse Position Modulation. **Phase Locked Loops:** Basic Principles, Analog phase Detector/comparator, Voltage controlled oscillator. PLL applications: Frequency Multiplication/Division, Frequency translation, FM demodulation.	10 Hours	L2,L3,L4, L5, L6
Module -5 **Data Acquisition Systems:** Types of instrumentation systems, Components of analog data acquisition system, Digital data acquisition system, Use of recorders in digital systems, Digital recording systems. **Data Converters:** **Digital to Analog Converters:** Basic DAC techniques, Weighted Resistor DAC, R – 2R Ladder DAC, DAC 0800 (Data sheet: Features and description only). **Analog to Digital Converters:** Functional diagram of ADC, Flash ADC, Counter type ADC, Successive approximation ADC, Dual slope ADC. ADC 0809 (Data sheet: Features, specifications and description only), DAC/ADC specifications.	10 Hours	L2, L3,L4, L5, L6
Course Outcomes: After studying this course, students will able to: 1. Understand the basic principles and operation of op-amp. 2. Design and develop circuits to meet the practical applications 3. Implement and integrate the op-amp circuits in electronic gadgets.		
Graduate Attributes (as per NBA) • Engineering knowledge • Problem analysis • Design & development of solutions • Investigation of Complex Problem		
Question Paper Pattern: • 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. "Linear Integrated Circuits", D. Roy Choudhury and Shail B. Jain, 4th edition, Reprint 2010, New Age International. (Module -1,2,3,4 & 5)
2. "Op - Amps and Linear Integrated Circuits", Ramakant A. Gayakwad, 4th edition, PHI (Module-3)
3. "A course in Electrical & Electronic Measurements & Instrumentation", A K Sawhney, Dhanpat Rai Publications, 19th edition, 2011.(Module-5)

Reference Books:

1. "Operational Amplifiers and Linear Integrated Circuits", Robert. F. Coughlin &Fred. F. Driscoll, PHI/Pearson, 2006
2. "Op - Amps and Linear Integrated Circuits", James M. Fiore, Thomson Learning, 2001
3. "Design with Operational Amplifiers and Analog Integrated Circuits", Sergio Franco, TMH, 3e, 2005

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

EMBEDDED CONTROLLERS

(Common to EI, BM & ML)

Subject Code	: 15 EI/BM/ML 43		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 enables students to understand:

- Basics of Microprocessor and Microcontroller
- 8051 Microcontroller architecture and Pin description
- 8051 Addressing modes and instruction set
- Programming of on-chip peripherals in 8051
- Design and develop applications using 8051 Assembly language and C program.
- MSP 430 Microcontroller architecture
- On-chip peripherals and program using Assembly language and C.

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 **Microprocessor and Microcontrollers:** **Introduction: Microprocessor and Microcontroller**, Microprocessor survey, RISC and CISC, CPU Architecture, Harvard and Von-Neumann, CPU Architecture. 8051 Microcontroller Architecture. Pin functions organizations Input/ Output pins, ports and circuits. Internal and External memory Architecture. 8051 Reg. banks and stack, 8051 flag bits and PSW Register. Special function Registers. Timer /Counter, Serial data input/ output, Interrupts, program counter and ROM space in the 8051.	**10 Hours**	**L1,L2**
Module -2 **Addressing modes directives instruction set of 8051 Microcontroller**. Immediate and Register addressing modes. Accessing memory using various addressing modes. Bit addressing for I/o and RAM 8051 data types and directives. Jump Loop and CALL Instructions Arithmetic and Logic Instructions and programming I/o port programming. Assembly Language programs using various Instructions.	**10 Hours**	**L1,L2**

Module -3 **8051 programming in C and interfacing.** Data types and time delay in 8051 C, I/o programming, Logic operation, data conversion programs, accessing Code ROM Space, data serialization. **8051 interfacing** to LCD and key board, DAC, stepper motor, DC Motor, Parallel and serial ADC. Elevator.	**10 Hours**	**L2,L3,L4**
Module -4 **Timer/ Counter, Serial communication and Interrupts in 8051**. Programming 8051 timer/ counter, programming timer 0 and 1 in 8051 C, Basics of serial communication, 8051 connections to **RS-232.** 8051 serial port programming in assembly and C. 8051 Interrupts, Programming Timer Interrupts, External hardware Interrupts and serial communication Interrupts. Interrupts priority & Interrupt programming in C.	**10 Hours**	**L2,L3,L4,L5**
Module -5 **Introduction to Advanced Microcontrollers**. Salient Features of Advanced Microcontrollers. **MSP430F2013** Architecture and pin functions, Memory, Clock Generator, CPU Registers, Addressing modes, Instruction set and emulated Instruction set. Development Environment. Aspects of C for embedded system, Introduction to MSP 430 starter kit, parallel ports.	**10 Hours**	**L1,L2,L3**

Course Outcomes: After studying this course , Student will be able to:

- Learn architecture of 8051 and MSP 430.
- Learn programming skills using Assembly language and C
- Design and interfacing of microcontroller based embedded systems.
- Build projects

Graduate Attributes (as per NBA)

- Engineering Knowledge
- Problem Analysis
- Design and Development of solutions
- Modern Tool usage

Question Paper Pattern:

- 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. "The 8051 Microcontroller and Embedded systems-using assembly and C", Muhammad Ali Mazidi and Janice Gillespie Mazidi and Rollin D. McKinaly,PHI,2006/pearson,2006
2. "MSP430 Microcontroller Basics" John H. Davis, , Elsevier 2010.
3. "Embedded Systems Design using the TI MSP430 series", Cris Nagy, Newnes, Elsevier.

Reference Books:

1. "The 8051 Microcontroller architecture. Programming and applications", Kenneth J Alyala Thomson learning 2005.
2. "The 8051 Microcontroller: Hardware, Software and Applications" V. Udhayashankara and MallikarjunaSwamy ,TMH., 2009.

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

CONTROL SYSTEMS
(Common to EI & BM)

Subject Code	: 15 EI/BM 44		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

- Understand the basic concepts & mathematical modeling of systems
- Draw block diagram & reduction for a given system
- Obtain Transfer functions by reduction and Signal Flow graph techniques.
- Analyze the system response in time and frequency domain
- Understand and Design of control systems using state space analysis

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 **Modeling of Systems and Block diagram**: Introduction to Control Systems, Types of Control Systems, with examples. Concept of mathematical modeling of physical systems- Mechanical, Translational (Mechanical accelerometer, systems excluded), and Rotational systems, Analogous systems based on force voltage analogy and force current analogy. Introduction to Block diagram algebra. Numerical problems on all topics.	10 Hours	L_1, L_2, L_3, L_4
Module -2 **Signal Flow graph**: Introduction to Signal Flow graph, Mason's gain formula. Obtaining Transfer functions for the given SFG using Mason's gain formula. **Time response analysis**: Introduction. Standard test signals, response of first order & second order systems for unit step input. Steady state errors & Error constants. Numerical problems on all topics.	10 Hours	L_1, L_2, L_3, L_4
Module -3 **Concepts of stability**: The Concept of stability. Necessary conditions for stability. Hurwitz stability criterion. Routh stability criterion. Relative stability analysis using RH Criterion. **The Root Locus Technique**: Introduction. Root locus concepts.	10 Hours	L2, L3, L4, L5

Construction of root loci. Stability analysis using Root locus Technique Numerical problems on all topics.		
Module -4 **Frequency domain Analysis**: Introduction to frequency domain analysis, Correlation between time & frequency response, Bode plots. **Polar Plot**: Introduction to Polar plot and Nyquist plots, Nyquist stability criterion. Stability analysis using Polar plot. Numerical problems on all topics	10 Hours	L2, L3, L4, L5
Module -5 **State space Analysis:** Concept of state, state variables and state model. State diagrams and State models for Linear continuous-time systems (Electrical systems): State space representation using Physical and Phase variables. Derivation of transfer functions from the state model. Numerical problems on all topics. **Solution of state equations**: Solutions of homogeneous and Non-homogeneous state equations. Properties of state transition matrix, computation of state transition matrix by matrix exponential and Laplace transform method. Numerical problems	10 Hours	L2, L3, L4, L5

Course Outcomes: After studying this course, students will able to:

- Apply modeling knowledge in implementation physical systems.
- Understand the reduction of block diagram & analyze using Signal flow graph.
- Comment on performance of a system by evaluating various parameters.
- Model a system by applying the concept of State Space analysis
- Design and develop portable control systems

Graduate Attributes (as per NBA)

- Engineering knowledge
- Problem analysis
- Design & Development of Solutions
- Investigation of Complex Problem

Question Paper Pattern:

- 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:

1. "Control Systems Engineering", I.J. Nagarath and M. Gopal ,New Age International (P) Limited, Publishers, Fifth edition – 2012.
2. "Modern Control Engineering ", K. Ogata, Pearson Education Asia/ PHI, 4th Edition, 2002.

Reference Books:

1. "Automatic Control Systems", Benjamin C. Kuo, John Wiley India Pvt. Ltd., 8th Edition, 2008.
2. "Feedback and Control System", Joseph J Distefano III et al., Schaum's Outlines, TMH, 2nd Edition 2007.

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

BIOMEDICAL TRANSDUCERS AND MEASUREMENTS

Subject Code	: 15BM45		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

- Gain the knowledge of working principle and construction details of Biomedical Transducers.
- Acquire the knowledge of transducer applications to access the biological signals.
- Access the performance of various Biomedical Transducers.

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 **FUNDAMENTAL CONCEPTS & BASIC TRANSDUCERS:** Introduction, Classification of Transducers**,** Measurement, Signals and Noise in the measurement-Measurement, signals and noise, signal to noise ratio, different types of noise. Characteristics of Measurement system-Transducer and measurement system, static characteristics, dynamic characteristics, standard and calibration, accuracy and error. Displacement, Position and Motion Transducers.	10 Hours	L1, L2, L3
Module -2 **BIOELECTRIC SIGNALS AND ELECTRODES**: Sources of Biomedical Signals, Origin of Bioelectric Signals, Electrocardiogram (ECG), Electroencephalogram (EEG), Electromyogram (EMG), Electrooculogram (EOG), Electroretinogram (ERG), Recording Electrodes–Electrode-tissue interface, Electrolyte-Skin interface, polarization, skin contact impedance, motion artifacts, Silver-Silver Chloride electrodes, Electrodes for ECG, Electrodes for EEG, Electrodes of EMG, Electrical conductivity of electrode jellies and creams, microelectrodes.	10 Hours	L1, L2, L3
Module -3 **PRESSURE MEASUREMENT:** Pressure Transducers-LVDT pressure transducers and Strain gauge pressure transducers. Physiological pressure ranges and measurement sites, Direct	10 Hours	L1, L2, L3

pressure measurement-catheters for pressure measurement, diaphragm displacement transducers, catheter tip pressure transducers, implantable pressure transducers and pressure telemetering capsules. Indirect pressure measurement-Indirect measurement of systolic, diastolic, and mean blood pressure, Detection of Kortokoff sounds.		
Module -4 **TRANSDUCERS AND SENSORS:** Requirements for measurement ranges, Temperature transducers – Thermistors, thermocouples, wire and thin film thermo-resistive elements, P-N junction diodes and transistors, infrared radiation thermometers, infrared thermography. Clinical thermometer probes, tympanic thermometers, telemetering capsules. Photoelectric Transducers: photovoltaic cells and photoemissive cells. Biosensors and Smart Sensors	10 Hours	L1, L2, L3
Module -5 **FLOW MEASUREMENT:** Requirements for measurement ranges – blood flow in a single vessel, tissue blood flow, and respiratory gas flow. Electromagnetic flowmeters – principle, methods of magnetic field excitation, perivascular probes, intravascular probes. Ultrasonic blood flowmeters– propagation of ultrasound in the tissue, ultrasonic Doppler flowmeters, blood flow measurement through Doppler imaging. Indicator dilution method – principle and working, thermodilution method, Fick method, thermistor velocity probe, impedance cardiography.	10 Hours	L1, L2, L3
Course Outcomes: After studying this course, students will able to: 1. Understand the working principle and construction details of Transducers. 2. Improve the measurement techniques through different approach. 3. Practically can implement the technology in measurement field.		
Graduate Attributes (as per NBA) • Engineering knowledge • Modern tool usage • Engineer and society • Environment& sustainability • Lifelong learning		
Question Paper Pattern: • 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. **Biomedical Transducers and Instruments –** Tatsuo Togawa, Toshiyo Tamura and P. Ake Oberg, CRC Press, 1997.
2. **Handbook of Biomedical Instrumentation**- R S Khandpur, 2nd edition, Tata McGraw Hill, 2003.

Reference Books:

1. **Biomedical Instrumentation and Measurement** – Leslie Cromwell, Fred J Weibell and Erich A. Pfeiffer, 2nd Edition, Prentice-Hall India Pvt. Ltd., 2004.
2. **Transducers and Instrumentation** -D. V. S. Murty Prentice Hall India Pvt ltd. 2nd Edition

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

SCIENTIFIC AND ANALYTICAL INSTRUMENTATION

(Common to EI, BM & ML)

Subject Code	: 15 EI/BM/ML 46		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:

- To introduce the basic concept of qualitative and quantitative analysis of a given sample.
- To Impart various spectroscopic techniques and its instrumentation.
- To Impart the concept of separation science and its application.
- To impart methods of Industrial analyzers and its application.

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 An introduction to instrumental methods: Terms associated with Chemical analysis, Classification of instrumental techniques, A review of important consideration in analytical methods, Basic functions of instrumentation, Nature of EM radiation, EM spectrum. Atomic energy levels, Molecular electronic energy levels, vibrational energy levels, Fundamental Levels of photometry, IR Spectroscopy: Basic Components of IR Spectrophotometers, Fourier Transform IR Spectroscopy	**10 Hours**	**L1, L2**
Module -2 UV and visible Spectrometers –instrumentation : Radiation Sources, Wavelength selection, Detector, Readout modules, Instruments for absorption photometry	**10 Hours**	**L1, L2**
Module -3 Flame emission and atomic absorption spectroscopy: Introduction, Instrumentation for flame spectrometric methods, Flame emission spectrometry, atomic absorption spectrometry, Atomic fluorescence spectrometry, Interferences associated with Flames & furnaces, applications, comparison of FES and AAS	**10 Hours**	**L1, L2**
Module -4	**10 Hours**	**L1, L2, L3**

Gas Chromatography : Chromatograph , Basics parts of a chromatograph, Methods of measurements of peak areas, HPLC : HPLC Instrumentation, Mobile –phase delivery system sample introduction, separation of columns, Detectors – Ultraviolet Photometers & Spectrophotometers, electro chemicals detector (amperometric detector), Differential refractometers		
Module -5 Blood analyzer: Introduction, Blood pH measurements, measurement of blood Pco_2, Po_2, A Complete blood gas analyzer. Air pollution monitoring instruments Carbon monoxide, Sulphur dioxide, Nitrogen oxides, Hydrocarbons Ozone, automated wet chemical air analysis, water pollution monitoring instruments.	**10 Hours**	**L1, L2, L3, L4**

Course Outcomes:

1. The students get well versed with the principle, construction and working of various analytical instrumentation.
2. Students get detailed information about the application of analytical techniques in medicine, Industry, etc.

Graduate Attributes (as per NBA)

- Engineering Knowledge
- Problem Analysis
- Life-long Learning

Question Paper Pattern:

- The question paper will have TEN questions.
- Each full question 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:

1. Instrumental Methods of Analysis, 7^{th} edition. – 2. H.H. Willard, L.L. Merritt, J.A. Dean, F.A. Settle, CBS Publishing & Distribution (Module 1, Module 2, Module 3, Module 4 HPLC)
2. Handbook of Instruments – R.S. Khandpur, Tata McGraw Hill (Module 1-IR Spectroscopy, Module 4, Module 5)

Reference Books:

1. Braun R.D., Introduction to Instrumental Analysis, Mc Graw –Hill Singapore, 2006.
2. Frank G. Kerry Industrial Gas Handbook: Gas Separation and Purification, Taylor and francis group, 2007.
3. Principles of Instrumental Analysis 5^{th} Edition – Douglas A. Skoog, F. James Holler, Timothy A. Niemen, Thomason Brooks/ Cole

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

EMBEDDED CONTROLLERS LAB
(Common to EI, BM & ML)

Subject Code	: 15 EI/BM/ML L47		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 :

- Write 8051 Assembly language and C programs for 8051 and MSP430.
- Interface hardware modules to Microcontroller board.
- Develop applications based on Microcontroller 8051 and MSP430.

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

Laboratory Experiments Note: Software and Hardware program using KEIL software and MSP 430 IDE.	**Revised Bloom's Taxonomy (RBT)Level**
Software program using 8051 µc Simple Assembly Language; 1. Program using 8051 in Block, Move, Exchange. 2. Program in sorting, finding largest and smallest element in an array. 3. Counters ---> For Hex and BCD up/ down count. 4. Boolean and Logical Instructions. (Bit Manipulation). 5. Subroutines using CALL and RETURN instructions. 6. Code Conversions ---> ASCII to Decimal, Decimal to ASCII, BCD to ASCII 7. Programs to generate delay, programs using serial port and on chip timer/ counter.	**L2, L3, L4**
Software program using MSP 430 IDE 8. Assembly program using MSP 430 for data transfer, Block Move in an array.	**L2, L3, L4**
Hardware programming (using 8051) 9. Stepper motor Interface to 8051 Microcontroller with C Program. 10. DC Motor Interface to 8051 Microcontroller with C Program 11. DAC Interface for to generate sine wave, square wave, triangular wave, Ramp wave through 8051Microcontroller with C Program. 12. Keyboard Interfacing. 13. ADC Interfacing	**L3, L4, L5**

Course Outcomes: After the completion of this Laboratory course, students will be able to:

- Get hands-on exposure in 8051 and MSB 430 platform.
- Enhance programming skills using Assembly language and C.

- Design and interfacing of microcontroller based embedded systems.
- Build projects

Graduate Attributes (as per NBA)

- Engineering Knowledge
- Problem Analysis
- Design and Development of solutions
- Modern Tool usage
- Individual and Team work

Conduct of Practical Examination:

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

Reference Books:

1. "The 8051 Microcontroller and Embedded systems-using assembly and C", Muhammad AliMazidi and Janice Gillespie Mazidi and Rollin D. McKinaly,PHI,2006/pearson,2006
2. "MSP430 Microcontroller Basics" John H. Davis, Elsevier 2010.
3. "Embedded Systems Design using the TI MSP430 series", Cris Nagy, Newnes, Elsevier.
4. "The 8051 Microcontroller architecture. Programming and applications", Kenneth J Alyala Thomson learning 2005.

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

BIOMEDICAL TRANSDUCERS AND MEASUREMENTS LAB

Subject Code	: 15BML48		IA Marks	: 20
Number of practical Hours/Week	: 03		Exam Marks	: 50
Total Number of practical Hours	:42		Exam Hours	: 03

Credits - 2

Course Objectives: This Lab course will enable the students to

- Impart the working principle of sensors and transducer
- Testing the response and plot the characteristics of different transducers
- Interpret and analyze experimental results with theoretical concepts.
- Calibrate the sensors/transducers
- Study and interpret data sheets of different transducers to select the suitable transducer for particular application and safe operation.
- Understand the basic concepts and procedure for the measurement of BP, solution concentration, pH and conductivity.

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

LIST OF EXPERIMENTS	Revised Bloom's Taxonomy (RBT) Level
1. Measurement of displacement using LVDT& determine its sensitivity and resolution.	**L1, L2, L3,L4**
2. Temperature measurement using RTD, Thermistor and Thermocouple, and to find their sensitivity.	**L1, L2, L3,L4**
3. Temperature measurement using AD590 / LM34.	**L1, L2, L3,L4**
4. Characteristics of LDR, Photodiode & Phototransistor by variable illumination & variable distance.	**L1, L2, L3,L4**
5. Measurement of unknown resistance by Wheatstone bridge & finding the sensitivity of the bridge.	**L1, L2, L3,L4**
6. Measurement of self-inductance using Maxwell's bridge.	**L1, L2, L3**
7. Measurement of inductance and internal resistance of a choke by three voltmeter method.	**L1, L2, L3**
8. Measurement of unknown capacitance using Schering's bridge.	**L1, L2, L3**
9. Characteristics of Load cell and Cantilever beam using Strain gauge (Quarter, Half and Full bridge configuration)	**L1, L2, L3,L4**
10. Measurement of blood pressure using sphygmomanometer and automatic digital BP instrument. Finding the systolic and diastolic values and calculate Mean Arterial Pressure (MAP).	**L1, L2, L3,L4**
11. Measurement of unknown concentration of given solution/body fluid using Spectrophotometer and Colorimeter	**L1, L2, L3,L4**
12. (a) Measurement of pH of a given solution/ body fluid using pH meter. (b) Determination of Conductivity of a given unknown solution/ body fluid using conductivity meter	**L1, L2, L3,L4**

Course Outcomes: After studying this course, students will able to:

- Analyze the response and plot the characteristics of temperature measurement transducers such as RTD, Thermistor, and Thermocouple & AD590.
- Analyze the response and plot the characteristics of displacement measuring transducers such as LVDT and Potentiometric transducer.
- Analyze the response and plot the characteristics of strain gauge type load cell.
- Analyze the response and plot the characteristics of pressure transducer.
- Measure unknown values of resistance, capacitance and Inductance using different bridges.
- Design , build and test the circuits for practical applications using transducers
- Measure BP, solution concentration, pH and conductivity for different biomedical applications.

Graduate Attributes (as per NBA)

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

Conduct of Practical Examination:

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

Reference Books:

1. Electronic Instrumentation by H. S. Kalsi, TMH, 2004 (Module-2,3 & 4)
2. Electronic Instrumentation and Measurements by David A Bell, PHI / Pearson Education2006/ Oxford Higher Education, 2013. (Module 1& 3)
3. Measurement systems application and design by E.O. Doebline 4th Edition, TMH.
4. Instrumentation for Process Measurement by Norman. A. Anderson, 3rd Edition, CRC
5. Principle of Measurement System by John. P. Bentley, 3rd Edition, Pearson, 2007
6. Handbook of Biomedical Instrumentation- R S Khandpur, 2nd edition, Tata McGraw Hill, 2003.