MANGALORE INSTITUTE OF TECHNOLOGY AND ENGINEERING
(An ISO 9001:2015 Certified Institution)

1.3.2. Average percentage of courses that include experiential learning through project work/field work/internship during last five years

ACADEMIC YEAR 2018-19

MECHATRONICS ENGINEERING

Document contains list and syllabus of courses that includes experiential learning through project works, internships and field work for the department.

Documents Enclosed

Sl. No	Particulars	Page Nos
1.	List of course that include experiential learning	1-2
2.	Syllabus of mapped Courses	3-194

LIST OF COURSE THAT INCLUDE EXPERIENTIAL LEARNING		
Total mapped course : 52		
1	15MAT11	Engineering maths-I
2	15PHY12	Engineering physics
3	15EME14	Elements of mechanical engg
4	15ELE15	Basic electrical engg
5	15PHYL17	Engg. Physics lab
6	15MAT21	Engineering maths-II
7	15CHE22	Engineering chemistry
8	15PCD23	Programming in c & data structures
9	15CED24	Computer aided engineering drawing
10	15ELN25	Basic electronics
11	15CPL26	Computer programming lab
12	15CHEL27	Engg. Chemistry lab
13	15MAT31	Engineering Mathematics – III
14	15MT32	Material Science& Technology
15	15MT33	Mechanics of Materials
16	15MT34	Control System
17	15MT35	Analog and Digital Electronics
18	15MT36	Computer Organization
19	15MTL37	Mechanical Lab – I
20	15MTL38	Analog And Digital Electronics Lab
21	15MAT 41	Engineering Mathematics – IV
22	15MT 42	Fluid Mechanics and Machines
23	15MT43	Micro Controller
24	15MT 44	Manufacturing Technology
25	15MT45	Theory of Machines
26	15MT46	Instrumentation and Measurement
27	15MTL47	Mechanical Lab – II
28	15MTL48	Micro Controller Lab
29	15MT51	Design Of Machine Elements
30	15MT52	Virtual Instrumentation
31	15MT53	Hydraulics and Pneumatics
32	15MT54	Micro and Smart Systems Technology
33	15MT552	Operations Research
34	15MT562	Automation in Manufacturing
35	15MTL57	Virtual Instrumentation Lab
36	15MTL58	Micro and Smart Systems Technology Lab
37	15MT61	PLC & SCADA

38	15MT62	Embedded Systems (ARM)
39	15MT63	Power Electronics
40	15MT64	Computer Aided Machine Drawing
41	15MT654	Satellite Communication /18-19
42	15MT661	Robotics and Automation
43	15MTL67	PLC & SCADA Lab
44	15MTL68	Power Electronics Lab
45	15MT71	Industrial Robotics
46	15MT72	Thermal Engineering
47	15MT73	Signal Process
48	15MT743	Real Time Systems
49	15MT754	Digital Image Processing
50	15MT81	Automotive Electronics & Hybrid Vehicles
51	15MT82	Communication System
52	15MT831	Product Design and Development

Syllabus of mapped course

VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELGAUM

SYLLABUS FOR 2015 -2019

ENGINEERING MATHEMATICS-III

(Common to all Branches)

Course Title: Engineering Mathematics - III	**Course Code : 15MAT31**
Credits: 04	**L-T-P : 4-0-0**
Contact Hours/Week : 04	**Total Hours: 50**
Exam. Marks : 80	**IA Marks : 20**
Exam. Hours : 03	

Course Objectives:

The objectives of this course is to introduce students to the mostly used analytical and numerical methods in the different engineering fields by making them to learn Fourier series, Fourier transforms and Z-transforms, statistical methods, numerical methods to solve algebraic and transcendental equations, vector integration and calculus of variations.

MODULE	RBT Levels	No. of Hrs
MODULE-I **Fourier Series:** Periodic functions, Dirichlet's condition, Fourier Series of periodic functions with period 2π and with arbitrary period $2c$. Fourier series of even and odd functions. Half range Fourier Series, practical harmonic analysis-Illustrative examples from engineering field.	L1, L2 & L4	10
MODULE-II **Fourier Transforms:** Infinite Fourier transforms, Fourier sine and cosine transforms. Inverse Fourier transform. **Z-transform:** Difference equations, basic definition, z-transform-definition, Standard z-transforms, Damping rule, Shifting rule, Initial value and final value theorems (without proof) and problems, Inverse z-transform. Applications of z-transforms to solve difference equations.	L2, L3 & L4	10
MODULE- III **Statistical Methods:** Review of measures of central tendency and dispersion. Correlation-Karl Pearson's coefficient of correlation-problems. Regression analysis- lines of regression (without proof) –problems **Curve Fitting:** Curve fitting by the method of least squares- fitting of the curves of the form, $y = ax + b$, $y = ax^2 + bx + c$ *and* $y = ae^{bx}$. **Numerical Methods:** Numerical solution of algebraic and transcendental equations by Regula- Falsi Method and Newton-Raphson method.	L3	10
MODULE-IV **Finite differences:** Forward and backward differences, Newton's forward and backward interpolation formulae. Divided differences- Newton's divided difference formula. Lagrange's interpolation formula and inverse interpolation formula (all formulae without proof)-Problems. **Numerical integration:** : Simpson's $(1/3)^{rd}$ and $(3/8)^{th}$ rules, Weddle's rule (without proof) –Problems.	L3	10
MODULE-V **Vector integration:** Line integrals-definition and problems, surface and volume integrals-definition, Green's theorem in a plane, Stokes and Gauss-divergence theorem(without proof) and problems. **Calculus of Variations:** Variation of function and Functional, variational problems. Euler's equation, Geodesics, hanging chain, problems.	L3 & L4 L2 & L4	10

Course Outcomes: On completion of this course, students are able to:

1. Know the use of periodic signals and Fourier series to analyze circuits and system communications.
2. Explain the general linear system theory for continuous-time signals and digital signal processing using the Fourier Transform and z-transform.
3. Employ appropriate numerical methods to solve algebraic and transcendental equations.
4. Apply Green's Theorem, Divergence Theorem and Stokes' theorem in various applications in the field of electro-magnetic and gravitational fields and fluid flow problems.
5. Determine the extremals of functionals and solve the simple problems of the calculus of variations.

Question paper pattern:

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

Graduate Attributes (as per NBA)

1. Engineering Knowledge
2. Problem Analysis
3. Life-Long Learning
4. Accomplishment of Complex Problems

Text Books:

1. *B.S. Grewal: Higher Engineering Mathematics, Khanna Publishers, 43rd Ed., 2015.*
2. *E. Kreyszig: Advanced Engineering Mathematics, John Wiley & Sons, 10th Ed., 2015.*

Reference books:

1. *N.P.Bali and Manish Goyal: A Text Book of Engineering Mathematics, Laxmi Publishers, 7th Ed., 2010.*
2. *B.V.Ramana: "Higher Engineering Mathematics" Tata McGraw-Hill, 2006.*
3. *H. K. Dass and Er. RajnishVerma: "Higher Engineering Mathematics", S. Chand publishing, 1st edition, 2011.*

Web links and Video Lectures:

1. *http://nptel.ac.in/courses.php?disciplineID=111*
2. *http://www.khanacademy.org/*
3. *http://www.class-central.com/subject/math*

MATERIAL SCIENCE AND TECHNOLOGY

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

Subject Code	15MT32	IA Marks	20
Number of Lecture Hours/Week	04	Exam Marks	80
Total Number of Lecture Hours	50	Exam Hours	03

CREDITS – 04

Course objectives:

To gain an understanding of the relationships between the structures, properties, processing and applications of various engineering materials.

Modules	**Hours Teaching**	**Revised Bloom's Taxonomy (RBT) Level**
Module -1		
Mechanical Behavior : Stress- Strain diagram showing ductile and brittle behavior of materials, Liner and non-linear elastic behavior and properties, mechanical Properties in plastic range, Yield strength offset yield strength, ductility, ultimate tensile strength, toughness plastic deformation of single crystal by slip and twinning. Atomic diffusion, flick's laws of Diffusion, Factors attaching the Diffusion **Fracture:** Types, creep: Description of the phenomenon with examples, 3 stages of creep properties, stress relaxation fatigue: types of fatigue lauding with examples, Mechanism of fatigue, Fatigue properties, Fatigue testing and S-N diagram.	**10 Hours**	
Module -2		
Heat Treating of metals: TTT curves, Continuous cooling curves, Annealing and its types, Normalizing, Hardening, Tempering, Martempering, Austemparing, hardenability, Surface hardening methods like Carburizing, Cyaniding Nitriding, flame hardening and induction hardening, age hardening of aluminum and copper	**10 Hours**	

alloys. **Ferrous and non ferrous materials:** Properties composition and use of grey cush iron, malleable iron, SG iron and steel. Copper alloys- brasses and bronzes, aluminum alloys Al-Cu, Al-Si, Al-Zn alloys.		
Module -3		
Solidification and phase diagram: Mechanism of solidification, Homogenous and Heterogeneous nucleation. Cristal Growth, Cast metal strictures, Phase diagram. Solid solutions Substitution and Interstitial solid solution, Hume rothary rule, Intermediate phase, construction of equilibrium diagram involving complete and partial solubility, lever rule, Gibb's phase rule.	**10 Hours**	
Module -4		
Composite materials: Definition, classification, type of matrix materials and reinforcements, advantages and application of composites**.** **Processing of FRP Composites:** Layup and curing, fabricating process, open and closed mould process, hand layup technique; structural laminate bag molding, production procedures for bag molding; filament winding, pultrusion, pulforming, thermo-forming, injection molding, blow molding. **Metal Matrix Composites:** Reinforcement materials, types, characteristics and selection, base metals selection. Need for MMC's and its application.	**10 Hours**	
Module -5		
Smart Materials: Piezoelectric Materials, Electrostrictive Materials, Magnetostrictive Materials, Magnetoelectric Materials. Magnetorheological Fluids, Electrorheological Fluids, Shape Memory Materials, Fiber-Optic Sensors. Smart Sensor, Actuator and Transducer Technologies: Smart Sensors: Accelerometers; Force Sensors; Load Cells; Torque Sensors; Pressure Sensors; Microphones; Impact Hammers	**10 Hours**	
Course outcomes: At the end of the course, the students will be able to: · Appreciate the necessity of engineering materials, Smart Sensors and its applications in various fields. · Identify possible cause of failure due to fatigue and Creep. · Demonstrate the knowledge of nucleation, Crystal growth, Solid solution and Phase diagrams. . Appreciate the significance and applications of Various heat treatment processes. · Explain the definition and classification and fabrication processes of composite materials.		
Graduate Attributes (as per NBA):		

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. Materials Science and Engineering,William D. Callister Jr., John Wiley & Sons. Inc, 5th Edition, 2001.
2. Mechanics of Composite Materials, Second Edition, Autar K. Kaw, CRC Press, 2005.
3. Smart Materials and Structures - M. V. Gandhi and B. So Thompson - Chapman & Hall, London; New York - 1992 (ISBN: 0412370107).
4. Materials Science and Engineering,William D. Callister Jr., John Wiley & Sons. Inc, 5th Edition, 2001
5. Materials Science, Shackleford.,& M. K. Muralidhara, Pearson Publication – 2007.
6. "Material Science & Metallurgy For Engineers", Dr. V.D. Kodgire& S. V. Kodgire, Everest Publication.
7. "Mechanical Behavior & Testing Of Materials", A. K. Bhargava, C.P. Sharma.P H I Learning Private Ltd.

Reference Books:

1. An Introduction to Metallurgy; Alan Cottrell, Universities Press India Oriental Longman Pvt. Ltd., 1974.
2. Engineering Materials Science, W.C.Richards, PHI, 1965
3. Physical Metallurgy; Lakhtin, Mir Publications
4. Materials Science and Engineering, V.Raghavan,PHI, 2002
5. Elements of Materials Science and Engineering, H. VanVlack, Addison- Wesley Edn., 1998
6. Materials Science and Engineering,William D. Callister Jr., John Wiley & Sons. Inc, 5th Edition, 2001.
7. The Science and Engineering of Materials, Donald R. Askland and Pradeep.P. Phule, Cengage Learning, 4th Ed., 2003

MECHANICS OF MATERIALS

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

Subject Code	15MT33	IA Marks	20
Number of Lecture Hours/Week	04	Exam Marks	80
Total Number of Lecture Hours	50	Exam Hours	03

CREDITS – 04

Course objectives:

This course is designed to introduce basic principles of statics for deformable bodies. The main objective is to help the students develop an intuition for equilibrium, properly constrained systems, and deformation under external loadings. It is also anticipated that the theory and design approach for the mechanics of deformable bodies will help prepare the students for complex systems that will be encountered in advanced design courses.

Modules	**Hours Teaching**	**Revised Bloom's Taxonomy (RBT) Level**
Module -1		
Simple Stress and Strain: Introduction, Concept of Stress and Strain, Linear elasticity, Hooke's Law and Poisson's ratio. Extension / Shortening of a bar, bars with varying cross sections (step and tapering circular and rectangular), Elongation due to self weight, Principle of super position, St. Venant's Principle. **Simple shear stress and Shear strain. Volumetric strain**: expression for volumetric strain, Elastic Constants and relations. Stresses in Composite Section and temperature stresses (No numerical).	**10 Hours**	

Module -2		
Compound Stresses: Introduction, Concept of Plane stress, Stress tensor for plane stress, stresses on inclined sections, principal stresses and maximum shear stresses, Mohr's circle for plane stress. **Thick and Thin Cylinder** Stresses in thin cylinders, changes in dimensions of cylinder (diameter, length and volume). Thick cylinders Lame's equation (compound cylinders not included).	**10 Hours**	
Module -3		
Bending Moment and Shear Force in Beams: Introduction, Sign conventions, relationship between shear force and bending moments. Shear force and bending moment diagrams for Cantilever, simply supported and overhanging beams subjected to concentrated loads, uniformly distributed load (UDL), uniformly varying load (UVL) and couple, simple numerical.	**10 Hours**	
Module -4		
Bending and Shear Stresses in Beams: Introduction, Theory of simple bending, assumptions in simple bending. General equation for bending. Moment carrying capacity of a section. Shearing stresses in beams, shear stress across rectangular, symmetrical I and T sections. (Composite / notched beams not included). **Deflection of Beams**: Introduction, Differential equation for deflection. Equations for deflection, slope and bending moment. Double integration method for cantilever and Macaulay's method for simply supported beams for point load, UDL and Couple. (Simple Numericals)	**10 Hours**	
Module -5		
Torsion of Circular Shafts: Introduction. Pure torsion, assumptions, derivation of torsional equations, polar modulus, torsional rigidity / stiffness of shafts. Power transmitted by solid and hollow circular shafts. **Elastic Stability of Columns:** Euler's theory for axially loaded elastic long columns. Derivation of Euler's load for various end conditions, limitations of Euler's theory, Rankine's formula.	**10 Hours**	

Course outcomes: At the end of the course, the student will be able to: CO1: Analyze the normal stresses and strains for axially loaded members using Hooke's law CO2: Enumerate principal stresses and shear stresses for simple two dimensional loadings CO3: Elucidate the stresses and strains in thick and thin cylindrical pressure vessels. CO4: Perform analysis of beams for static loading. CO5: Design torsional shafts and structural columns		
Graduate Attributes (as per NBA):		
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. **"Mechanics of Materials",** by R.C.Hibbeler, Prentice Hall. Pearson Edu., 2011. 2. **"Mechanics of materials",** James.M.Gere, Thomson, Eighth edition2013. 3. **"Mechanics of materials",** in SI Units, Ferdinand Beer & Russell Johston, 5th Ed., TATA McGraw Hill-2003. 4. **"Mechanics of Materials",** K.V. Rao, G.C. Raju, Subhash Publication, Fourth Edition, 2013		
Reference Books: 1. **"Strength of Materials",** S.S. Rattan, Tata McGraw Hill, 2009. 2. **"Strength of Materials",** S.S.Bhavikatti, Vikas publications House -1 Pvt. Ltd., 2nd Ed., 2006. 3. **"Engineering Mechanics of Solids**", Egor.P. Popov, Pearson Edu. India, 2nd, Edition, 1998. 4. **"Strength of Materials",** W.A. Nash, 5th Ed., Schaum's Outline Series, Fourth Edition-2007.		

ANALOG & DIGITAL ELECTRONICS

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

Subject Code	15MT35	IA Marks	20
Number of Lecture Hours/Week	04	Exam Marks	80
Total Number of Lecture Hours	50	Exam Hours	03

CREDITS – 04

Course objectives:

The main objective of this course is to make students understand the basic analog and digital electronics, including semiconductor properties, operational amplifiers, combinational and sequential logic and analog-to-digital digital-to-analog conversion techniques. Finally, students will gain experience in with the design of analog amplifiers, power supplies and logic devices.

Modules	**Hours Teaching**	**Revised Bloom's Taxonomy (RBT) Level**
Module -1		
Diode Applications : PN junction Diode, VI-Characteristics, Junction diode Models, Junction Diode as switch, Diode specifications, Circuit applications of diodes, Smoothing circuits, Zener diode voltage Regulators.	**10 Hours**	
Module -2		
Op-Amp active filters and oscillators : Active filters, I & II order low pass filter, I and II order high pass filters, wide Band pass and Band reject filter, phase shift oscillator, wein bridge oscillator.	**10 Hours**	
Module -3		
Comparators and 555 timers: Basic compartors, zero crossing detector, schimitt trigger, the 555 timers, monostable multivibrator, astable multivibrator, applications of astable multivibrator.	**10 Hours**	

Module -4		
Logic families: Digital circuits, basic logic operations, the NOR & NAND logic gates, other IC logic gates, logic gates characteristics, the TTL logic, CMOS logic family, emitter coupled logic. **Sequential circuits:** RS latch, Flip flops, JK flip flop, digital registers, binary and decade counters, read and write memories.	**10 Hours**	
Module -5		
Combinational circuits: multiplexers, demultiplixers, encoders, decoders, adders **Analog – Digital Converters:** Quantization of analog signals, DAC, ADC, digital instrumentation System.	**10 Hours**	

Course outcomes:

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

1. Analyze the Importance & Applications of Diode as Rectifiers, Filters, Zener Diode Regulators & Switching Circuits.
2. With the Knowledge of Active Filters & Oscillators students can better understand the Real-time Communication Systems.
3. Students are prepared to Understand, Analyze & Design Various Analog Electronics circuits if recruited to Analog Electronics Industry.
4. Students are prepared to Understand, Analyze & Design Digital Circuits, if interested to work in VLSI Industry.

Graduate Attributes (as per NBA):

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. "Electronic Circuits and systems- analog and digita l", Y.N Bapat 1992 edition, Tata Mc GrawHill.
2. "Opamp and Linear Integrated Circuits", Ramakant A Gayakwad 3rd edition, PHI.
3. "Digital Logic and Computer Design", M Morris Mano, 2001 ledition, PHI.

Reference Books:

1. "Digital Electronics: Principles and Integrated cir cuits", Anil K Maini, 2008, wiley India.
2. "Linear Integrated Circuits", D. Roy Choudhury and Shail B Jain, 2nd edition, Reprint 2006, New Age International.
3. "Digital Principles and applications", Malvino & Leach, Tata Mc. Graw Hill.

Computer Organization [As per Choice Based Credit System (CBCS) scheme] SEMESTER – III			
Subject Code	15MT36	IA Marks	20
Number of LectureHours/Week	04	Exam Marks	80
Total Number of Lecture Hours	50	Exam Hours	03

CREDITS – 04

Course objectives:

This course enables students to:

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

Modules	**Hours Teaching**	**Revised Bloom'sTaxonomy(RBT)Level**
Module -1		

Basic Structure of Computers: Computer Types, Functional Units, Basic Operational Concepts, Bus Structures, Software, Performance – Processor Clock, Basic Performance Equation. **Machine Instructions and Programs:** Numbers, Arithmetic Operations and Characters, Memory Location and Addresses, Memory Operations, Instructions and Instruction Sequencing.	**10 Hours**	
Module -2		
Machine Instructions and Programs (Continued): Addressing Modes, Assembly Language, Basic Input and Output Operations, Stacks and Queues, Subroutines, Additional Instructions. IEEE standard for Floating point Numbers (6.7.1 of Chapter 6)	**10 Hours**	
Module -3		
Input/output Organization: Accessing I/O Devices, Interrupts, Direct Memory Access, Busses, Interface Circuits, Standard I/O Devices.	**10 Hours**	
Module -4		
Memory System: Some Basic Concepts, Semiconductor RAM Memories, Read Only Memories, Cache Memories, Performance Considerations, and Virtual Memories.	**10 Hours**	
Module -5		
Basic Processing Unit: Some Fundamental Concepts, Execution of a Complete Instruction, Multiple Bus Organization, Microprogrammed Control, Hardwired Control.		
Course outcomes: After studying this course, students will be able to: 1. Understand the basic structure of computer and machine instructions. 2. Understand the interfacing concepts. 3. Understand the concepts of memory system.		
Graduate Attributes (as per NBA):		
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. Carl Hamacher, Zvonko Vranesic, Safwat Zaky, "Computer Organization", McGraw Hill, 5th Edition, 2015, ISBN:9781259005275.

Reference Books:

1. David A. Patterson, John L. Hennessy, "Computer Organization and Design – The Hardware / Software Interface ARM", Elsevier.

2. William Stallings, "Computer Organization & Architecture", Pearson.

3. Vincent P. Heuring & Harry F. Jordan, "Computer Systems Design and Architecture", Pearson.

MECHANICAL LAB-01

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

Subject Code	15MTL37	IA Marks	20
Hours/Week	03	Exam Marks	80
Total Number of Lecture Hours	-	Exam Hours	03

CREDITS – 02

Course objectives:

- Understand the characteristics and behavior of Engineering materials used for engineering applications.
- To provide training to students to enrich their practical skills.

Laboratory Experiments:	**Revised Bloom's Taxonomy (RBT) Level**
Part-A	
1. Tensile, shear and compression tests of metallic specimens using Universal Testing machine. 2. Torsion Test. 3. Bending Test on Non metallic specimens. 4. Izod and Charpy tests on M.S Specimen. 5. Brinell and rockwelll hardness test.	
Part-B	
1. Preparation of two models on lathe involving Plain turning, Taper turning, Step turning, Thread cutting, Facing, Knurling. 2. Demonstration on cutting the V Groove using a shaper and cutting a gear teeth using Milling Machine.(Not for Examination)	

Course outcomes:

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

1. Demonstrate the knowledge & skill to conduct and analysis the result with respect to Hardness testing, and different loads.
2. Demonstrate the various skills of Turning Facing, Knurling and Thread cutting using lathe.
3.

Graduate Attributes (as per NBA):

Scheme of Examination:

One Question From Part – A : **30marks**
One Question From Part - B : **40 Marks**
Viva- Voice : **10 Marks**
Total : **80 Marks**

MICRO CONTROLLER LAB

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

Subject Code	15MTL48	IA Marks	20
Hours/Week	03	Exam Marks	80
Total Number of Lecture Hours	-	Exam Hours	03

CREDITS – 02

Course objectives:

- To study assembly language programming in 8051
- To study interfacing of various peripherals using 8051
- To design and develop applications using 8051

Laboratory Experiments:	**Revised Bloom's Taxonomy (RBT)Level**
Part-A	
1. Data Transfer - Block move, Exchange, Sorting, Finding largest element in an array. 2. Arithmetic Instructions - Addition/subtraction, multiplication and division, square, Cube (16 bits Arithmetic operations – bit addressable). 3. Counters. 4. Boolean & Logical Instructions (Bit manipulations). 5. Conditional CALL & RETURN. 6. Code conversion: BCD – ASCII; ASCII – BCD, ASCII -Decimal; Decimal - ASCII; HEX - Decimal and decimal - HEX. 7. Programs to generate delay, Programs using serial port and on-Chip timer / counter.	
Part-B	
1. Write C programs to interface 8051 chip to Interfacing modules to develop single chip solutions. 2. Simple Calculator using 6 digit seven segment display and Hex Keyboard interface to 8051. 3. Interfacing of 8051 to LCD . 4. External ADC and Temperature control interface to 8051.	

5. Generate different waveforms Sine, Square, Triangular, Ramp etc. using DAC interface to 8051; change the frequency and amplitude. 6. Stepper and DC motor control interface to 8051.	

Course outcomes:

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

1. Build application on 8051 using assembly/ C language.
2. Interface between external peripherals to 8051 using C programming.

Graduate Attributes (as per NBA):

Scheme of Examination:

One Question From Part – A : **35marks**
One Question From Part - B : **35 Marks**
Viva- Voice : **10 Marks**
Total : **80 Marks**

THEORY OF MACHINES [As per Choice Based Credit System (CBCS) scheme] SEMESTER – IV			
Subject Code	15MT45	IA Marks	20
Number of Lecture Hours/Week	04	Exam Marks	80
Total Number of Lecture Hours	50	Exam Hours	03

CREDITS – 04

Course objectives:

The course has been designed to introduce the basic concepts of kinematics and dynamics associated with machine elements. The students will understand the constructional and working features of mechanisms and machines.

Modules	**Hours Teaching**	**RevisedBloom'sTaxonomy(RBT) Level**
Module -1		
Introduction: Definitions Link or element, Kinematic pairs, Degrees of freedom, Grubler's criterion (without derivation), Kinematic chain, Mechanism, Structure, Mobility of Mechanisms (with problems), Inversion, Machine. Inversion of single slider and four bar mechanisms. Intermittent Motion - Geneva wheel mechanism and Ratchet and Pawl mechanism. **Velocity and Acceleration Analysis of Mechanisms:** Velocity and acceleration analysis of four bar mechanism and slider crank mechanism by Graphical method (Relative velocity and acceleration method), Simple Problems. Introduction to Instantaneous centres method (no numericals).	**10 Hours**	
Module -2		
Gears and Gear Trains: Gear terminology, law of gearing, Path of contact Arc of contact, Contact ratio of spur gears. Simple gear trains, Compound gear trains for large speed. Reduction, Epicyclic gear trains. Tabular methods of finding velocity ratio of epicyclic gear trains.	**10 Hours**	
Module -3		
Cams: Types of cams, Types of followers. Displacement, Velocity and, Acceleration time curve for cam profiles. Disc cam with reciprocating follower having knife-edge, roller follower, Disc cam with oscillating roller follower. Follower motions including SHM, Uniform acceleration and retardation and Cycloidal motion.	**10 Hours**	

Module -4		
Balancing of Rotating Masses: Static and dynamic balancing. Balancing of single rotating mass by balancing masses in same plane and in different planes.Balancing of several rotating masses by balancing masses in same plane and in different planes. **Belt Drivers: Belt Drives:** Flat Belt Drives, Ratio of Belt Tensions, Centrifugal Tension, power Transmitted.	**10 Hours**	
Module -5		
Gyroscope: Vectorial Representation of Angular Motion, Gyroscopic Couple. Effect of Gyroscopic Couple on Ship, Plane Disc, Aircraft, Stability of Two Wheelers. **Governors:** Types of governors; force analysis of Porter and Hartnell governors. Controlling force, stability, sensitiveness, isochronism, effort and power.		

Course Outcomes:

At the end of the course, the student will be able to:

1. Explain the concepts of mechanism, machines, and types of motion, and calculate the mobility of a mechanism.
2. Determine the positions, velocities and accelerations of links of simple mechanisms by using graphical approach.
3. Explain basic cam terminology, analyze various types of CAMS, and draw CAM profile diagrams.
4. Demonstrate the knowledge of various transmission mechanisms like gears and belts, and apply them for simple problems.
5. Appreciate the principles of Balancing, Governors, and Gyroscope, and their applications

Graduate Attributes (as per NBA):

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. Theory of Machines: Sadhu Singh, Pearson Education, 2nd edition, 2007.
2. Theory of Machines: Rattan S.S Tata McGraw Hill Publishing Company Ltd., New Delhi, 2nd Edition, 2006.

3. Theory of Machines, R. S. Khurmi, J. K. Gupta, Eurasia Publishing House, 2008 Revised Edition**.**

Reference Books:

1. Theory of Machines and Mechanisms, John Joseph Uicker, G. R. Pennock, Joseph Edward Shigley, Oxford University Press, 2003.

2. Theory of Machines and Mechanisms, Amitabha Ghosh and Mallick, East West Press, 3rd Edition 2006.

3. Theory of Machines, Thomas Bevan, CBS Publication 1984.

FLUID MECHANICS AND MACHINES

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

Subject Code	15MT42	IA Marks	20
Number of Lecture Hours/Week	04	Exam Marks	80
Total Number of Lecture Hours	50	Exam Hours	03

CREDITS – 04

Course objectives:

To introduce the students to the fundamentals of fluid mechanics and analytical formulation of fluid mechanics and turbomachine problems using first principles and principles of energy transfer.

Modules	**Hours Teaching**	**RevisedBloom'sTaxonomy(RBT) Level**
Module -1		
Physical properties of fluids: Introduction, Types of fluids, Properties of fluids, viscosity, surface tension, vapor pressure and cavitation. **Fluid pressure and its Measurement**: Intensity of pressure, Pascal's law, Hydrostatic law,atmospheric, gauge and vacuum pressures, Piezometer, U-tube and differential manometers. **Fluid Statics**: Total pressure and center of pressure on submerged plane surfaces; horizontal, vertical and inclined plane surfaces submerged in liquid.	**10 Hours**	
Module -2		
Fluid Kinematics: Types of fluid flow, continuity equation in 2D and 3D (Cartesian Co-ordinates only), velocity and acceleration, velocity potential function and stream function, problems. **Fluid Dynamics**: Introduction, Euler's equation of motion, Bernoulli's equation from first principles and also from Euler's equation, limitations of Bernoulli's equation, problems.	**10 Hours**	
Module -3		

Dimensional Analysis: Introduction, derived quantities, dimensions of physical quantities, dimensional homogeneity, Rayleigh's method, Buckingham's **π**-theorem, dimensionless numbers, similitude, types of similitudes. **Fluid Flow Measurements:** Venturimeter, orificemeter, pitot-tube, V-Notch and rectangular notches (Derivations Venturimeter and V-Notch only), Problems.	**10 Hours**	
Module -4		
Turbomachines: Definition of a Turbomachine, parts of a Turbomachine, Comparison with positive displacement machine; Classification. **Energy transfer in turbo machine:** Euler Turbine equation, alternate form of Euler turbine equation, components of energy transfer, Degree of reaction, general analysis of a Turbo machine – effect of blade discharge angle on energy transfer and degree of reaction.	**10 Hours**	
Module -5		
Hydraulic Turbines: Classification; Constructional features, Velocity triangles and Efficiencies of Pelton Turbine, Francis Turbine and Kaplan Turbine, and simple problems. Function of a Draft tube, types of draft tubes. **Steam Turbines:** Classification, Single stage impulse turbine - Condition for maximum blade efficiency, stage efficiency, Compounding, need for compounding, methods of compounding. Reaction turbine - Parson's reaction turbine, condition for maximum blade efficiency, reaction staging, simple problems.	**10 Hours**	
Course outcomes: At the end of the course, the student will be able to: · Appreciate the fluid mechanics fundamentals, including concepts of mass and energy conservation. · Apply the fundamentals to flow measurement problems. · Perform dimensional analysis for problems in fluid mechanics. . Appreciate the understanding of turbomachines and principles of energy transfer in turbomachines. · Apply the fundamentals for energy transfer problems in various turbomachines.		
Graduate Attributes (as per NBA):		
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. Fluid Mechanics, Oijush.K.Kundu, IRAM COCHEN, ELSEVIER, 3rd Ed. 2005.
2. Fluid Mechanics and Fluid Machines, Dr. Bansal, R.K.Lakshmi Publications, 2004.
3. Textbook of Turbomachines, M S Govinde Gowda, M M Publishers, 2011

Reference Books:

1. Fluid Mechanics and hydraulics, Dr.Jagadishlal: MetropolitanBook Co-Ltd., 1997.
2. Fluid Mechanics (SI Units), Yunus A. Cengel John M.Oimbala, 2ndEd., Tata McGraw Hill, 2006.
3. Fluid Mechanics, John F.Douglas, Janul and M.Gasiosek and john A.Swaffield, Pearson Education Asia, 5th ed., 2006
4. Fluid Mechanics and Fluid Power Engineering, Kumar.D.S, Kataria and Sons., 2004
5. Fluid Mechanics -. Merle C. Potter, Elaine P.Scott. Cengage learning.

INSTRUMENTATION AND MEASUREMENTS

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

Subject Code	15MT46	IA Marks	20
Number ofLecture Hours/Week	04	Exam Marks	80
Total Number of Lecture Hours	50	Exam Hours	03

CREDITS – 04

Course objectives:

- To provide the fundamental knowledge of transducers, instrumentation and measurement systems.
- To understand the functional elements of instrumentation/measurement systems.
- To impart the knowledge of static and dynamic characteristics of instruments, and understand the factors in selection of instruments for measurement.
- To discuss the principle, design and working of transducers for the measurement of displacement, level, strain, resistance capacitance inductance, pressure, sound and speed.

Modules	Hours Teaching	RevisedBloom's Taxonomy(RBT) Level
Module -1		
Classification and Functional Elements of Instrument/ measurement system: Measurement, significance of measurement, instruments and measurement systems, mechanical, electrical and electronic instruments, Deflection & Null type instruments and their comparison, Analog and digital modes of operation, functions of instruments and measurement systems, applications of measurement systems, Elements of generalized measurement system, Input-output configuration of measuring instruments and measurement systems, methods of correction for interfering and modifying inputs. Transducers, Classifications of transducers-primary & secondary, active & passive, analog and digital transducers.	**10 Hours**	
Module -2		
Static and Dynamic Characteristics: Static calibration and error calibration curve, accuracy and precision, indications of precision, static error, scale range and scale span, reproducibility and drift, repeatability, signal to noise ratio, sensitivity, linearity, hysteresis, threshold, dead zone and dead time, resolution, signal to noise ratio, factors influencing the choice of transducers/instruments. Dynamic response – dynamic characteristics, time domain analysis & different types of inputs, frequency domain analysis. Time domain response – zero order system, first order electrical system, response of a first order system to step & ramp input, Second order system, response of a second order system to step input, time domain specifications, frequency response of first and second order system.	**10 Hours**	
Module -3		
Measurement of Displacement: Introduction, Principles of Transduction, Variable resistance devices, variable Inductance Transducer, Variable Capacitance Transducer, Hall Effect Devices, Proximity Devices, Digital Transducer **Measurement of Level:** Capacitance probes, conductivity probes, differential pressure level detector, float level devices, optical level switches, radiation level sensor, ultrasonic level detector, thermal level sensors	**10 Hours**	

Module -4		
Measurement of Strain: Introduction, Factors affecting strain measurements, Types of Strain Gauges, Theory of operation of resistance strain gauges, Types of Electrical Strain Gauges – Wire gauges, unbounded strain gauges, foil gauges, semiconductor strain gauges (principle, types & list of characteristics only), Materials for Strain Gauges, Strain gauge Circuits – Wheatstone bride circuit, Applications. **Measurement of resistance, induction and capacitance:** Whetstone's bridge, Kelvin Bridge; ACbridges, Capacitance Comparison Bridge, Maxwell's bridge, wein's bridge, Wagners's earth connection.	**10 Hours**	
Module -5		
Transducers – I: Introduction, Electrical transducers, Selecting a transducer, Resistive transducers,Resistive position transducer, Strain gauges, Resistance thermometer, Thermistor, Inductive transducer,Differential output transducers **and** LVDT. **Transducers – II:** Piezoelectric transducer, Photoelectric transducer,Photovoltaic transducer, Semiconductor photo devices, Temperature transducers-RTD, Thermocouple(b) Display Devices: Digital display system, classification of display, Display devices, LEDs, LCD displays	**10 Hours**	

Course outcomes:

After studying this course, students will able to:

- Define the transducer, instrument, measurement and classify different types of transducers
- Explain the functional elements of instrumentation / measurement systems
- Discuss the input-output configuration of measurement systems
- Define, interpret and analyze the static and dynamic characteristics of instruments
- Explain the principle, design and analyze the transducers for the measurement of displacement, level, strain, force, torque, pressure, sound and speed

Graduate Attributes (as per NBA):

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. Electrical and Electronic Measurements and Instrumentation – A. K. Sawhney, 17th Edition (Reprint 2004), DhanpatRai& Co. Pvt. Ltd., 2004. (Module 1 & 2)
2. Instrumentation: Devices and Systems- C. S. Rangan, G. R. Sarma, V. S. V. Mani, 2nd Edition (32nd Reprint), McGraw Hill Education (India), 2014. (Module 3-Displacement measurement, Module 4,
3. Process Measurement Instrument Engineers Handbook- Bela G. Liptak, Revised Edition, Chilton Book Company, 1982. (Module 3 – Level measurement,)
4. "Electronics Instrumentation", H.S. Kalsi, TMH, 2004-Module5

Reference Books:

1. Transducers and Instrumentation – D.V.S.Murty, 2nd Edition, PHI, 2009.
2. Introduction to Measurements and Instrumentation - A. K. Ghosh, 2nd Edition, PHI, 2007.
3. Instrumentation Measurement and Analysis- B.C.Nakra and K.K.Choudhry, 3rd Edition, McGraw Hill Education (India) Pvt.Ltd. 2009.
4. Measurement Systems Application and Design- Ernest O.Doeblin and Dhanesh N Manik, 5th Edition, McGraw Hill, 2007

MANUFACTURING TECHNOLOGY [As per Choice Based Credit System (CBCS) scheme] SEMESTER – IV			
Subject Code	15MT44	IA Marks	20
Number of Lecture Hours/Week	04	Exam Marks	80
Total Number of Lecture Hours	50	Exam Hours	03

CREDITS – 04

Course objectives:

To introduce students to the fundamentals of modern manufacturing operations.

Modules	**Hours Teaching**	**RevisedBloom'sTaxonomy(RBT) Level**
Module -1		
Introduction to Manufacturing Process: Concept of Manufacturing process, its importance. Classification of Manufacturing processes. **Casting:**Introduction to Casting process &steps involved. Various components produced by casting process, Advantages & Limitations. **Patterns:** Definition and types. **Sand Moulding:** Binders and Additives: Definition, Need and Types.Types of base sand, requirements of base sand.Types of Sand Moulding.Cores: Definition, Need and Types. Concept of Gating & Risers**:** Principle and types. Introduction to Die Casting and injection moulding. .	**10 Hours**	
Module -2		
Introduction to metal working: Classification of metal working processes, characteristics of wrought products, advantages and limitations of metalworking processes. **Forging:** Classification, Forging machines & equipment. Die-design parameters. Forgingdefects, Residual stresses in forging, Applications of forging. **Rolling:** Classification, Types of rolling mills, Defects in rolled products. Rolling variables, Applications of Rolling. **Drawing:** Drawing equipment & dies,drawing variables, Tube drawing,classification of tube drawing, Applications	**10 Hours**	
Module -3		

Extrusion: Types of extrusion processes, extrusion equipment & dies,Extrusion ofseamless tubes, lubrication & defects in extrusion, Extrusion variables, Applications **Sheet & Metal Forming:** Forming methods dies & punches, progressivedie, compound die, combination die. Rubber forming. Open back inclinablepress (OBI press), piercing, blanking, bending, deep drawing, defects of drawn products, stretch forming, Roll bending & contouring, Applications. **Advanced Welding processes:** Classification, Advantages & limitations of welding. Metal Arc welding (MAW), Flux Shielded Metal Arc Welding (FSMAW), Inert Gas Welding (TIG & MIG) Submerged Arc Welding (SAW) and Atomic Hydrogen Welding processes (AHW), Resistance welding, Applications.	**10 Hours**	
Module -4		
Non-traditional Machining Processes: Need for non-traditional machining, Principle, equipment & operation of Laser Beam, Plasma Arc Machining, Electro Chemical Machining, Ultrasonic Machining, Abrasive Jet Machining, Water Jet Machining, Electron Beam Machining, Electron Discharge Machining and Plasma Arc Machining.	**10 Hours**	
Module -5		
Introducing to CNC machines: Basics of Turning tool Geometry, ATC, Programming methods. – Manual part programming, Milling, Turning, (Simple Programs), Computer Aided part programming (Simple problems, DNC, Types, Applications, Types of CNC Programming Software's, Over view CNC machining centers, Turning centre.	**10 Hours**	
Course outcomes: **At the end of this course students should be able to** 1. Understand the principles and techniques of casting, forging, rolling & drawing. 2. Apply the knowledge of metal working process. 3. To express the different techniques of joining process for metal & non metals. 4. Understanding and applying knowledge to execute CNC machining programs.		
Graduate Attributes (as per NBA):		
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. **Manufacturing Technology,** Serope Kalpakjain, Steuen.R.Sechmid, Pearson Education Asia, 5th Ed. 2006**.**
2. **Manufacturing Technology Vol 1&2,** PN Rao, Tata McGraw Hill, 2001
   NC Machine Programming and Software Design, ChnoHwachang**,** Michel. A. Melkanoff, Prentice Hall, 1989

Reference Books:

1. **Process and Materials of Manufacturing,** Roy A Lindberg, 4th Ed. Pearson Ed. 2006.
2. **Workshop technology,** Hazara Choudhry, Vol-I &II, Media Promoters & Publishers Pvt Ltd. 2004.
3. **Production technology,** HMT, Tata McGraw Hill, 2001.
4. **Manufacturing Science,** AmitabhGhosh and Mallik, affiliated East West press, 2003.
5. **Fundamentals of metal Machining and machine Tools,** G. Boothroyd, McGraw Hill. 2000.
6. **Automation Production system and Computer Integrated Manufacturing** Mikell. O. Grover, PHI, New Delhi, 2002.

MECHANICAL LAB - II

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

Subject Code	15MTL47	IA Marks	20
Hours/Week	03	Exam Marks	80
Total Number of Lecture Hours	-	Exam Hours	03

CREDITS – 02

Course objectives:

- To understand the flow measurement in a pipe flow.
- To Measure the discharge in a open channel flow.
- To study the characteristic of turbins.
- To understand the working principle of hydraulic components & hydraulic circuit.

Laboratory Experiments:	**Revised Bloom's Taxonomy (RBT) Level**
Part-A	
1. Calibration of flow measuring devices: a. Orifice Plate meter, b. Venturimeter, c. V-notch 2. Performance testing of Turbines a. Pelton wheel b. Francis Turbine c. Kaplan Turbine	
Part-B	
1. Speed Control Circuit on Hydraulic/Pneumatic Trainer 2. Sequencing Circuit on Hydraulic/Pneumatic Trainer 3. Regenerative Circuit on Hydraulic/Pneumatic Trainer 4. Synchronizing Circuit on Hydraulic/Pneumatic Trainer	

Course outcomes:

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

- Determine the co-efficient of discharge of flow measuring devices.
- Select the type of turbine required with reference to available head of water and discharge.
- Apply the working principle of impulse and reaction turbine.
- Design hydraulic circuit for various industrial applications.

Graduate Attributes (as per NBA):

Scheme of Examination:

One Question From Part – A : **35marks**
One Question From Part - B : **35 Marks**
Viva- Voice : **10 Marks**
Total : **80 Marks**

MICROCONTROLLER
[As per Choice Based Credit System (CBCS) scheme] SEMESTER – IV

Subject Code	15MT43	IA Marks	20
Number of Lecture Hours/Week	04	Exam Marks	80
Total Number of Lecture Hours	50	Exam Hours	03

CREDITS – 04

Course objectives:
This course trains the students to understand an in-depth operation of 8051 microcontrollers, machine language programming & interfacing techniques. The emphasis is on interfacing the controller to real-world devices such as switches, displays, motors, and A/D converters, through assembly language and C language programming.

Modules	**Hours Teaching**	**RevisedBloom'sTaxonomy(RBT) Level**
Module -1		
Microprocessors and microcontroller. Introduction, Microprocessors and Microcontrollers, A Microprocessors survey. RISC & CISC CPU Architectures, Harvard & Von-Neumann CPU architecture. The 8051 Architecture: Introduction, 8051 Microcontroller Hardware, Input / Output Pins, Ports and Circuits External Memory, Counter and Timers, Serial Data Input / Output, Interrupts.	**10 Hours**	
Module -2		
Addressing Modes and Operations: Introduction, Addressing modes, External data Moves, Code Memory, Read Only Data Moves / Indexed Addressing mode, PUSH and POP Opcodes, Data exchanges, Byte level logical Operations, Bit level Logical Operations, Rotate and Swap Operations, Arithmetic Operations: Flags, Incrementing and Decrementing, Addition, Subtraction, Multiplication and Division, Decimal Arithmetic. **Jump and Call Instructions:** The JUMP and CALL Program range, Jumps, calls and Subroutines, Interrupts and Returns.	**10 Hours**	
Module -3		
8051 programming in C and Timers: Data types and time delays in 8051C, I/O programming, logic operations, data conversion programs, data serialization. **Timer / Counter Programming in 8051**: Programming 8051 Timers, Counter Programming, programming timers 0 and 1 in 8051 C.	**10 Hours**	

Module -4		
8051 Serial Communication and Interrupts: Basics of Serial Communication, 8051 connections to RS-232, 8051 Serial communication Programming, Programming the second serial port, Serial port programming in C. Interrupts Programming,8051 Interrupts, Programming Timer Interrupts, Interrupt Priority in the 8051/52.	**10 Hours**	
Module -5		
UNIT 5: 8051 Interfacing and Applications: Hardware & Software (Assembly code / C code) Interfacing of 8051 to simple switches and LEDs, LCD, ADC, Stepper motor, DC motor, Temperature sensor, Wave form generation.	**10 Hours**	

Course outcomes: Student will be able to

1. Understand the difference between microprocessor and microcontroller, operation of Peripherals of controller, and be able to program a microcontroller system in assembly code and C.
2. Design and Develop a microcontroller based system.
3. Interface the system to switches, keypads, displays, A/D and D/A converters and build a microcontroller based Robot.

Graduate Attributes (as per NBA):

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. "The 8051 Microcontroller Architecture, Programm ing & Applications", 2e Kenneth J. Ayala ;, Penram International, 1996 / Thomson Learning 2005
2. "The 8051 Microcontroller and Embedded Systems – using assembly and C "-, Muhammad Ali Mazidi and Janice Gillespie Mazidi and Rollin D. McKinlay; PHI, 2006 / Pearson, 2006

Reference Books:

1. "Programming and Customizing the 8051 Microcontr oller" Predko ;–, TMH
2. Microcontrollers: Architecture, Programming, Interfacing and System Design",Raj Kamal, "Pearson Education, 2005

3. “Microcontrollers- Theory and Applications”, Aja y V.Deshmukh; TMH,2005

4. “Microcontroller and its applications”, Dr.Raman i Kalpathi and Ganesh Raja; Sanguine Technical publishers, Bangalore-2005.

MICRO & SMART SYSTEMS TECHNOLOGY LABORATORY

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

SEMESTER – V

Subject Code	**15MTL58**	**IA Marks**	**20**
Hours/Week	**03**	**Exam Marks**	**80**
Total Number of Lecture Hours	**-**	**Exam Hours**	**03**

CREDITS – 02

Course objectives: Students will be able to

- Analyse the behavior of Mechanical Components for various kinds of loads.
- Analyse the behavior of Pressure Sensor for various kinds of Pressures applied.

Laboratory Experiments:	**Revised Bloom's Taxonomy (RBT)Level**
PART – A 1. Static structural analysis a) 2 D Mechanical Components. b) 3 D Mechanical Components. 2. Piezoelectric analysis: cantilever beam **PART – B** 1. Pressure sensor experiment a) Raw pressure sensor b) compensated pressure sensor	

Course outcomes: On the completion of the course the student will:

- Understand, Analyze & gain ability to choose Materials for desired applications.
- Understand, Analyze & gain ability to choose Sensors for desired applications.

Graduate Attributes (as per NBA):
Scheme of Examinations:
One Question from Part A : 40 **Marks**
One Question from Part B : **30 Marks**
Viva-Voice : **10 Marks**
D TOTAL : 80 Marks

DESIGN OF MACHINE ELEMENTS
[As per Choice Based Credit System (CBCS) scheme]
SEMESTER – V

Subject Code	**15MT51**	**IA Marks**	**20**
Number of Lecture Hours/Week	**05**	**Exam Marks**	**80**
Total Number of Lecture Hours	**60**	**Exam Hours**	**03**

CREDITS – 04

Course Objective: Students will be able to

1. gain knowledge of theories of failures, stress concentration and machine elements.
2. understand the techniques in machine elements.
3. determine the parameters of machine elements subjected to various load condition.
4. design of various machine elements

Modules	**Hours Teaching**	**Revised Bloom's Taxonomy(RBT) Level**
Module -1		
Module - 1 **Introduction:** Machine design, classification of machine design, design consideration, Tri axial stresses, Stress Tensor. Codes and Standards. Factor of Safety, design procedure for simple and combined stresses (No Numerical). Introduction to Stress Concentration, Stress concentration Factor and its effects (Simple problems). **Introduction to Theories of failure:** Maximum Normal Stress Theory, Maximum Shear Stress Theory, Distortion Energy Theory.	**12 Hours**	
Module -2		
Design of Keys, Couplings and Joints: Keys: Types of keys, Design of keys, Design of Couplings: Flange coupling, Bush and Pin type coupling. Design of cotter and knuckle joint. **Power Screws**: Stresses in Power Screws, Efficiency and Self-locking, Design of Power Screw, Design of Screw Jack.	**12 Hours**	
Module -3		
Design of Shafts: Design for strength and Rigidity with Steady loading, ASME & BIS codes for Power Transmission shafting, Shafts under Fluctuating loads and combined loads.	**12 Hours**	

Module -4		
Design of Spur Gears: Beam strength of spur gear, Stresses in gear teeth (Lewis equation), dynamic tooth load, design for wear **Design of helical gears:** Beam strength of helical gear, Stresses in gear teeth (Lewis equation), dynamic tooth load, design for wear.	**12 Hours**	
Module -5		
Design of Journal Bearings: Types of bearings, bearing characteristic number, coefficient of friction, minimum oil film thickness, Heat Generated, Heat dissipated, Bearing Materials. **Design of springs**: Types of springs - stresses in Helical coil springs of circular cross sections. Tension and compression springs only.	**12 Hours**	

Course Outcomes: On completion of the course the student will

1. have knowledge of theories of failures, stress concentration, power screws, shafts, keys, couplings, gears, bearings and springs.
2. understand the technique of theories of failure, stress concentration, fatigue strength etc.
3. calculate the stresses, parameters of machine elements subjected to various loads also make proper assumptions with respect to material, FOS for various machine components.
4. design machine elements like power screws, shafts, keys, couplings, gears, bearings ad springs

Graduate Attributes (as per NBA):

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. Mechanical Engineering Design, Joseph E Shigley and Charles R. Mischke. McGraw Hill International edition, 6th Edition 2009.
2. Design of Machine Elements, V.B. Bhandari, Tata McGrawHill Publishing Company Ltd., New Delhi, 3rd Edition 2010.
3. Machine Design, by Dr. P C Sharma and Dr. D K Aggarwal, S. K. Kataria& Sons, 11th Edition 2009.

DESIGN DATA HANDBOOK:

1. Design Data Hand Book, K. Lingaiah, McGraw Hill, 2nd Edition.
2. Data Hand Book, K. Mahadevan and Balaveera Reddy, CBSPublication.
3. Design Data Hand Book, H.G. Patil, I. K. International Publisher, 2010.

Reference Books:

1. Machine Design, Robert L. Norton, Pearson Education Asia, 2001.
2. Design of Machine Elements, M. F. Spotts, T. E. Shoup, L. E. Hornberger, S. R. Jayram and C. V. Venkatesh, Pearson Education,2006.
3. Machine Design, Hall, Holowenko, Laughlin (Schaum's Outlines series) Adapted by S.K. Somani, Tata McGraw Hill Publishing Company Ltd., New Delhi, Special Indian Edition, 2008.

Virtual Instrumentation

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

Subject Code	**15MT52**	**IA Marks**	**20**
Number of Lecture Hours/Week	**04**	**Exam Marks**	**80**
Total Number of Lecture Hours	**50**	**Exam Hours**	**03**

CREDITS – 04

Course objectives: Students will be able to

- gain knowledge to learn the concepts of developing basic skills necessary for importance Virtual Instrumentation and Lab View
- understand the basic programming concepts and various Operation using DAQ Devices used in Virtual Instrumentation and Lab View.
- diagnosis the problem related types of I/O module, Data Acquisition System and Communication Networks (Bus Systems) using Standard Protocol

Modules	**Hours Teaching**	**Revised Bloom's Taxonomy(RBT) Level**
Module -1		
CONCEPT OF VIRTUAL INSTRUMENTATION – Historical perspective – Need of VI – Advantages of VI – Define VI – Block diagram & Architecture of VI – Data flow techniques – Graphical programming in data flow – Comparison with conventional programming.PC based data acquisition – Typical on board DAQ card – Resolution and sampling frequency - Multiplexing of analog inputs – Single-ended and differential inputs – Different strategies for sampling of multi-channel analog inputs. Concept of universal DAQ card	**10 Hours**	
Module -2		
DATA ACQUISITION BASICS: Introduction to data acquisition on PC, Sampling fundamentals, Input/Output techniques and buses. ADC, DAC, Digital I/O, counters and timers, DMA, Software and hardware installation, Calibration, Resolution, Data acquisition interface requirements.	**10 Hours**	
Module -3		
GRAPHICAL PROGRAMMING ENVIRONMENT IN VI Concepts of graphical programming – Lab-view software – Concept of VIs and sub VI ,Loops(While Loop and For Loop) , Structures(Case, Formula node, and sequence structures) Arrays Operations, Strings Operations, and file I/O. Examples on each.	**10 Hours**	
Module -4		

CLUSTER OF INSTRUMENTS IN VI SYSTEM Interfacing of external instruments to a PC – RS232, RS 422, RS 485 and USB standards - IEEE 488 standard – ISO-OSI model for serial bus – Introduction to bus protocols of MOD bus and CAN bus.	**10 Hours**	
Module -5		
USE OF ANALYSIS TOOLS AND APPLICATION OF VI Fourier transform - Power spectrum - Correlation – Windowing and filtering tools – Simple temperature indicator – ON/OFF controller – P-I-D controller - CRO emulation - Simulation of a simple second order system – Generation of HTML page.	**10 Hours**	

Course outcomes: On completion of the course the student will

1. have a knowledge of Virtual Instrumentation and Lab View domain on various I/O Module , Sensor, DAQ Devices ,Communication and Measurement System
2. understanding the basic programming concepts and various logical Instructions, DAQ Operation used in Virtual Instrumentation and Lab View .
3. determine the extent and nature of electronic circuitry in Virtual Instrumentation and Lab View including Signal monitoring and control circuits for Communication and Interfacing.

Graduate Attributes (as per NBA):

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. "Virtual Instrumentation using LabVIEW" Jovitha Jerome, PHI publication

2. "Virtual Instrumentation, LABVIEW", Sanjay Gupta, TMH,NewDelhi,2003

Reference Books:

1 . "PC Interfacing for Data Acquisition and Process Control",S.Gupta and JP Gupta InstrumentSocietyofAmerica,1994
2. Kevin James, PC Interfacing and Data Acquisition: Techniques for Measurement, Instrumentation and Control, Newnes, 2000.

HYDRAULICS AND PNEUMATICS [As per Choice Based Credit System (CBCS) scheme] SEMESTER – V			
Subject Code	15MT53	IA Marks	20
Number of Lecture Hours/Week	04	Exam Marks	80
Total Number of Lecture Hours	50	Exam Hours	03

CREDITS – 04

Course objectives: Students will be able to

1. gain knowledge of basics of hydraulic and pneumatic systems.
2. understanding the working principles of hydraulics and pneumatics components
3. Engineering application of hydraulic and pneumatic systems

Modules	**Hours Teaching**	**Revised Bloom's Taxonomy(RBT) Level**
Module -1		
Introduction to Hydraulic Power: Definition of hydraulic system, advantages, limitations, applications, Pascal's law, structure of hydraulic control system, problems on Pascal's law. **The source of Hydraulic Power: Pumps** Classification of pumps, Pumping theory of positive displacement pumps, construction and working of Gear pumps, Vane pumps, Piston pumps, fixed and variable displacement pumps, Pump performance characteristics, pump Selection factors, problems on pumps.	**10 Hours**	
Module -2		
Hydraulic Actuators and Motors: Classification cylinder and hydraulic motors, Linear Hydraulic Actuators [cylinders], single and double acting cylinder, Mechanics of Hydraulic Cylinder Loading, mounting arrangements, cushioning, special types of cylinders, problems on cylinders, construction and working of rotary actuators such as gear, vane, piston motors, Hydraulic Motor Theoretical Torque, Power and Flow Rate, Hydraulic Motor Performance, problems, symbolic representation of hydraulic actuators (cylinders and motors). **Control Components in Hydraulic Systems:** Classification of control valves, Directional Control Valves- Symbolic representation, constructional features of	**10 Hours**	

poppet, sliding spool, rotary type valves solenoid and pilot operated DCV, shuttle valve, check valves, Pressure control valves - types, direct operated types and pilot operated types. Flow Control Valves -compensated and non-compensated FCV, needle valve, temperature compensated, pressure compensated, pressure and temperature compensated FCV, symbolic representation.		
Module -3		
Hydraulic Circuit Design And Analysis: Control of Single and Double -Acting Hydraulic Cylinder, Regenerative circuit, Pump Unloading Circuit, Double Pump Hydraulic System, Counter balance Valve Application, Hydraulic Cylinder Sequencing Circuits, Automatic cylinder reciprocating system, Locked Cylinder using Pilot check Valve, Cylinder synchronizing circuit using different methods, factors affecting synchronization, Speed Control of Hydraulic Cylinder, Speed Control of Hydraulic Motors, Safety circuit, Accumulators, types, construction and applications with circuits. **Maintenance of Hydraulic System:** Hydraulic Oils - Desirable properties, general type of Fluids, Sealing Devices, Reservoir System, Filters and Strainers, wear of Moving Parts due to solid - particle Contamination, temperature control (heat exchangers), Pressure switches, trouble shooting.	**10 Hours**	
Module -4		
Introduction to Pneumatic Control: Definition of pneumatic system, advantages, limitations, applications, Choice of working medium. Characteristic of compressed air. Structure of Pneumatic control System,fluid conditioners and FRL unit. Pneumatic Actuators: Linear cylinder - Types, Conventional type of cylinder- working, End position cushioning, seals, mounting arrangements- Applications. Rod - Less cylinders types, working, advantages, Rotary cylinders- types construction and application, symbols. **Pneumatic Control Valves:** DCV such as poppet, spool, suspended seat type slide valve, pressure control valves, flow control valves, types and construction, use of memory valve, Quick exhaust valve, time delay valve, shuttle valve, twin pressure valve, symbols. Simple Pneumatic Control: Direct and indirect actuation pneumatic cylinders, speed control of cylinders - supply air throttling and Exhaust air throttling and Exhaust air throttling.	**10 Hours**	
Module -5		
Signal Processing Elements: Use of Logic gates - OR and AND gates in pneumatic applications. Practical Examples involving the use of logic gates, Pressure dependant controls- types - construction - practical applications, Time dependent controls principle, Construction, practical applications. Multi- Cylinder Application: Coordinated and sequential motion control, Motion and control diagrams. Signal elimination methods, Cascading method- principle, Practical application examples (up to two cylinders) usingcascading method (using	**10 Hours**	

reversing valves). **Electro- Pneumatic Control: Principles -** signal input and output, pilot assisted solenoid control of directional control valves, Use of relay and contactors. Control circuitry for simple signal cylinder application.		

Course outcomes: On completion of the course the student will

1. have knowledge of hydraulic and pneumatic system and its components .
2. understand the working principle of various hydraulic and pneumatic components .
3. apply working principles of Hydraulic and Pneumatic Systems for various applications. determine cause for hydraulic and pneumatic system break down and performance of hydraulic pumps, motors.

Graduate Attributes (as per NBA):

Question paper pattern:

Text Books:

1. “Fluid Power with Applications”, Anthony Esposito, Sixth edition, Pearson Education, Inc, 2000.
2. 'Pneumatics and Hydraulics', Andrew Parr, Jaico Publishing Co

Reference Books:

1. 'Oil Hydraulic systems', Principles and Maintenance S. R. Majurr, Tata McGraw Hill Publishing Company Ltd. - 2001
2. 'Industrial Hydraulics', Pippenger, Hicks" McGraw Hill, New York
3. 'Hydraulic & Pneumatic Power for Production', HarryL. Stewart
4. 'Pneumatic Systems', S. R. Majumdar, Tata McGraw Hill Publish 1995
5. 'Hydraulic & Pneumatics' CMTI Data Book

MICRO & SMART SYTEMS TECHNOLOGY

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

Subject Code	**15MT54**	**IA Marks**	**20**
Number of Lecture Hours/Week	**04**	**Exam Marks**	**80**
Total Number of Lecture Hours	**50**	**Exam Hours**	**03**

CREDITS – 04

Course Objectives: Students will be able to

1. gain knowledge of Smart Materials, Sensors & Actuators, Microsystems.
2. understand the Operation of Smart Devices & Systems, Electronic Circuits & Control for MEMS, Methodology of Micro-manufacturing.

Modules	**Hours Teaching**	**Revised Bloom's Taxonomy(RBT) Level**
Module -1		
Introduction to Micro and Smart systems: Miniaturization, Microsystems versus MEMS, Micro-fabrication, Smart Materials, Structures & Systems, Integrated Microsystems ,Application of Smart Materials & Microsystems.	**10 Hours**	
Module -2		
Micro and Smart Devices and Systems: Principles and Materials: Definitions and salient features of sensors, actuators, and systems.Sensors: silicon capacitive accelerometer, piezoresistive pressure sensor, Portable blood analyzer, conductometric gas sensor. Actuators: Micromirror Array for Video Projection, Piezo-electric based inkjet print head,electrostatic comb-drive, Magnetic microrelay.	**10 Hours**	
Module -3		
Micromachining Technologies: Silicon as a Material for Micromachining, Silicon wafer preparation, thin-film deposition techniques, Lithography, Etching, Silicon micromachining:surface micromachining bulk micromachining. Specialized Materials for Microsystems.	**10 Hours**	
Module -4		
Electronics Circuits for Micro and Smart Systems. Semiconductor devices: Diode, Schottky diode,Tunnel diode,BJT ,MOSFET,CMOS circuits ,Electronics Amplifiers ,Op-Amp based circuits ,Practical Signal Conditioning Circuits for Microsystems. Circuits for Conditioning Sensed Signals.	**10 Hours**	

Module -5		
Implementation of Controllers for MEMS & Case Studies of Integrated Microsystems. Design Methodology, PID controller, Circuit Implementation, Digital controller, Microcontroller & PLC. Case Studies of Integrated Microsystems: BEL pressure sensor, design considerations, performance parameters, practical implementations, design of electronics circuits, Integration of pressure Sensor and Smart Structure in vibration control.	**10 Hours**	

Course Outcomes: On completion of the course the student will

1. have knowledge of Smart Materials, Sensors & Actuators ,Microsystems.
2. understand the Working Methodology of Smart Devices & Systems, Electronics Circuits & Control for MEMS, Methodology of Micro-manufacturing.

Graduate Attributes (as per NBA):

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.Micro and Smart Systems: G.K.Ananthasuresh, K.J.Vinoy, S.Gopalakrishnan, K.N.Bhat, V.K.Aatre,Wiley India 2010.

Reference Books:

1. Design and Development Methodogies, Smart Material Systems and MEMS: V. Varadan, K. J. Vinoy, S. Goplakrishnan, Wiley.
2. MEMS- Nitaigour Premchand Mahalik, TMH 2007.
3. MEMS & Microsystems: Design and Manufacture, Tai-Ran Hsu, Tata Mc-Graw-Hill.

OPERATIONS RESEARCH

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

Subject Code	**15MT552**	**IA Marks**	**20**
Number of Lecture Hours/Week	**03**	**Exam Marks**	**80**
Total Number of Lecture Hours	**40**	**Exam Hours**	**03**

CREDITS – 03

Course Objective: Students will be able to

1. gain knowledge of basics of operation research.
2. understanding various techniques of operation research for solving business decision and engineering problems.
3. determination of optimization solutions, effective decision making, model formulation and applications.

Modules	**Hours Teaching**	**Revised Bloom's Taxonomy(RBT) Level**
Module -1		
Introduction: Evolution of OR, definition of OR, scope of OR, application areas of OR, steps (phases) in OR study, characteristics and limitations of OR, models used in OR, linear programming (LP) problem-formulation and solution by graphical method. **Solution Of Linear Programming Problems:** The simplex method canonical and standard form of an LP problem.	**8 Hours**	
Module -2		
Transportation Problem: Formulation of transportation problem, types, initial basic feasible solution using different methods, optimal solution by MODI method, degeneracy in transportation problems, application of transportation problem concept for maximization cases.	**8 Hours**	
Module -3		
Pert-CPM Techniques: Introduction, network construction - rules, Fulkerson's rule for numbering the events, AON and AOA diagrams; Critical path method to find the expected completion time of a project, floats; PERT for finding expected duration of an activity and project, determining the probability of completing a project, predicting the completion time of project; crashing of simple projects.	**8 Hours**	
Module -4		
Queuing Theory: Queuing systems and their characteristics, Pure-birth and Pure-death models (only equations), empirical queuing models – M/M/1 and M/M/C models and their steady state performance analysis.	**8 Hours**	

Module -5		
Game Theory: Formulation of games, types, solution of games with saddle point, graphical method of solving mixed strategy games, dominance rule for solving mixed strategy games. **Sequencing:** Basic assumptions, sequencing 'n' jobs on single machine using priority rules, sequencing using Johnson's rule-'n' jobs on 2 machines, 'n' jobs on 3 machines, 'n' jobs on 'm' machines. Sequencing 2 jobs on 'm' machines using graphical method.	**8 Hours**	

Course outcomes: On completion of the course the student will

1. have knowledge of linear programming, Transportation, PERT-CPM, Sequencing, Queuing Theory, and Game theory.
2. understanding the techniques of linear programming, Transportation, PERT-CPM, Sequencing, Queuing Theory, and Game theory for various engineering problems.
3. determination of optimization of solutions, effective decision making model formulation and applications that are used in solving business decision problems.

Graduate Attributes (as per NBA):

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. Operations Research, P K Gupta and D S Hira, Chand Publications, New Delhi – 2007
2. Operations Research, Taha H A, Pearson Education.
3. Operations Research S.D. Sharma, LedarnathRamanath& Co,002

REFERNCE BOOKS:

1. Operations Research, A P Verma, S K Kataria&Sons, 2008
2. Operations Research, Paneerselvan, PHI
3. Operations Research, A M Natarajan, P Balasubramani, Pearson Education, 2005
4. Introduction to Operations Research, Hillier and Liberman,8th Ed., McGrawHill
5. Operations Research, S Kalavathy, Vikas Publishing House Pvt Ltd, 2002

Automation in Manufacturing
[As per Choice Based Credit System (CBCS) scheme]
SEMESTER – V

Subject Code	**15MT562**	**IA Marks**	**20**
Number of Lecture Hours/Week	**03**	**Exam Marks**	**80**
Total Number of Lecture Hours	**40**	**Exam Hours**	**03**

CREDITS – 03

COURSE OBJECTIVES: Students will be able to

1. gain knowledge of fundamental concepts of automation in manufacturing.
2. understand the techniques of automation in manufacturing for industry operations.

Modules	**Hours Teaching**	**Revised Bloom's Taxonomy(RBT) Level**
Module -1		
Introduction: Production System Facilities, Manufacturing Support systems, Automation in Production systems, Automation principles & Strategies. **Manufacturing Operations:** Manufacturing Operations, Product/Production Relationship, Production concepts and Mathematical Models & Costs of Manufacturing Operations.	**8 Hours**	
Module -2		
Industrial Control System: Basic Elements of an Automated System, Advanced Automation Functions & Levels of Automation, Continuous versus Discrete control, Computer Process control, Forms of Computer Process Control. **Quality Control Systems:** Traditional and Modern Quality Control Methods, Taguchi Methods in Quality Engineering. Introduction to SQC Tools.	**8 Hours**	
Module -3		
Automated Manufacturing Systems: Components of a Manufacturing systems, Classification of Manufacturing Systems, overview of Classification Scheme, Single Station Manned Workstations and Single Station Automated Cells. **Manufacturing Support System:** Process Planning, Computer Aided Process Planning, Concurrent Engineering & Design for Manufacturing, Advanced Manufacturing Planning, Just-in Time Production System, Basic concepts of lean and Agile manufacturing.	**8 Hours**	
Module -4		
Inspection Technologies: Automated Inspection, Coordinate Measuring Machines Construction,	**8 Hours**	

operation & Programming, Software, Application & Benefits, Flexible Inspection System, Inspection Probes on Machine Tools, Machine Vision, Optical Inspection Techniques & Non-contact Non-optical Inspection Technologies.		
Module -5		
Group Technology & Flexible Manufacturing Systems: Part Families, Parts Classification and coding, Production Flow Analysis, Cellular Manufacturing, Flexible Manufacturing Systems: What is an FMS, FMS Components, FMS Applications & Benefits, and FMS Planning &Implementation Issues.	**8 Hours**	

Course Outcomes: On completion of this course the student will

1. have knowledge of fundamental concepts of automated flow lines, traditional and modern quality control methods, manufacturing supporting system, AMS, Inspection Technologies, group technologies, FMS
2. understand various automated flow lines, assembly systems and line balancing methods, importance of automated material handling and storage systems and the importance of adaptive control systems, automated inspection systems.

Graduate Attributes (as per NBA):

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. Automation, Production Systems and Computer Integrated Manufacturing, M. P. Groover, Pearson education. Third Edition,2008
2. Principles of CIM, Vajpayee, PHI.

REFERENCE BOOKS:

1. Anatomy of Automation, Amber G.H & P. S. Amber, PrenticeHall.
2. Performance Modeling of Automated Manufacturing Systems,Viswanandham, PHI
3. Computer Based Industrial Control, Krishna Kant, EEE-PHI

VIRTUAL INSTRUMENTATION LAB

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

SEMESTER – V

Subject Code	**15MTL57**	**IA Marks**	**20**
Hours/Week	**03**	**Exam Marks**	**80**
Total Number of Lecture Hours	**-**	**Exam Hours**	**03**

CREDITS – 02

Course objectives: Students will be able to

- Understanding Virtual Instrument concepts and data acquisition operation
- Creating Virtual Instruments for practical works

Laboratory Experiments:	**Revised Bloom's Taxonomy (RBT)Level**

PART –A

1. Creating Virtual Instrumentation for simple applications**- Invert The State Of Boolean Indicator Twice A See Until Program Is Stopped By User.**

2. Programming exercises for loops in virtual instrumentation-**Continuous Monitoring of Temperature (Generated using Random no 0<t<100). for every 250 ms.**

3. Programming exercises for graphs- **Display Random Number Into 3 different CHARTS (STRIP, SLOPE,SWEEP) and understand the difference between these in the UI.**

4.Programming Exercises on case and sequence structures:**-Design the simple Calculator, making use of the inherent GUI present in the virtual instrumentation software**.

5.Programming Exercises on Arrays– **Take a 2D array input from the user and perform various array(and matrix) manipulations on it.**

6. Programming Exercises on File Input output System – **Read and write from ASCII and TDMS files.**

PART -B

1. Real time temperature acquisition and continuous monitoring using Virtual Instrumentation.
2. Developing voltmeter using DAQ cards – Acquiring a voltage and displaying it on a 'meter' indicator on the UI, thus designing a voltmeter
3. Developing Signal Generator using DAQ Card – **Using analog output; amplitude, shape and frequency controlled by user**
4. Data acquisition through Virtual Instrumentation – **Read voltage and current of the 50 Hz supply to compute power and power factor**
5. Design and Development of Filter Analysis using DAQ card – **Acquire audio and filter out bands using different filters and compare effects**
6. Real time sequential control of any batch process – **Water level control or Temperature control**

Course outcomes: On the completion of the course the student will:

- understand, design and develop data acquisition systems for Various Sensor using DAQ Cards.
- analyze the importance & applications of LabVIEW in real time Environment.

Graduate Attributes (as per NBA):

Scheme of Examination:

PART A- 35 MARKS
PART-B 35 MARKS
Viva- Voice : 10 Marks
Total : 80 Marks

POWER ELECTRONICS LABORATORY

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

Subject Code	15MTL68	IA Marks	20
Hours/Week	03	Exam Marks	80
Total Number of Lecture Hours	40	Exam Hours	03

CREDITS – 02

Course objectives: Students will be able to

1) verify the characteristics of different power electronic devices.
2) understand the usage of power devices to control the operation of electronic systems.

Laboratory Experiments:	**Revised Bloom's Taxonomy (RBT)Level**

LIST OF EXPERIMENTS

1. Static characteristics of SCR and DIAC.
2. Static characteristics of MOSFET and IGBT.
3. Controlled HWR and FWR using RC triggering circuit.
4. SCR turn off using i) LC circuit and ii) Auxiliary Commutation
5. SCR turn-on circuit using synchronized UJT relaxation oscillator.
6. SCR Digital triggering circuit for a single-phase controlled rectifier
7. Single-phase full-wave rectifier with R and R-L loads.
8. A.C. voltage controller using TRIAC and DIAC combination connected to R and R-L loads.
9. Speed control of a separately excited D.C motor using an IGBT or MOSFET chopper.
10. MOSFET OR IGBT based single-phase full-bridge inverter connected to R load.

Course outcomes:

On the completion of the course students will

1. understand and verify the characteristics of different power electronic devices .
2. use the power devices to control the operation of electronic systems.

Graduate Attributes (as per NBA):

Scheme of Examination:

Experiment : 70 Marks
Viva- Voice : 10 Marks
Total : 80 Marks

PLC AND SCADA LABORATORY

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

Subject Code	15MTL67	IA Marks	20
Hours/Week	03	Exam Marks	80
Total Number of Lecture Hours	40	Exam Hours	03

CREDITS – 02

Course objectives: Students will be able to

1. Analyse the logic Program on SCADA and PLC Interface
2. Design various applications with programmable logic controllers using relay ladder logic.

Laboratory Experiments:	**Revised Bloom's Taxonomy (RBT)Level**

LIST OF EXPERIMENTS

1. Study of various logic Execution in ladder diagram.
2. Interfacing of Lamp&button with PLC for ON&OFF Operation. Verify all logic gates.
3. PLC based thermal ON/OFF Controller.
4. Develop ladder logic to develop MUX and DE-MUX
5. Combination of counter &timer for lamp ON/OFF Operation.
6. Study& implement ON delay timer in PLC
7. Study& implement OFF delay timer in PLC
8. To study&implement of counter in PLCprogramming.(counter-up)
9. To study&implement of counter in PLCprogramming.(counter-down)
10. PLC based temperature sensing using RTD
11. Parameter reading of PLC in SCADA
12. Temperature sensing using SCADA

Course outcomes: On completion of the course the student will: CO 1: Analyze the Importance & Applications of PLC and SCADA in real time Environment. CO 2: Design and Develop PLC and SCADA Modules for Various Sensor Technologies.
Graduate Attributes (as per NBA):
Scheme of Examination: **Experiment : 70 Marks** **Viva- Voice : 10 Marks** **Total : 80 Marks**

Power Electronics

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

Subject Code	15MT63	IA Marks	20
Number of Lecture Hours/Week	04	Exam Marks	80
Total Number of Lecture Hours	50	Exam Hours	03

CREDITS – 04

Course objectives: Students will be able to

1. gain the knowledge of various conversion techniques of electrical energy using power electronic components.
2. understand the link between efficient usage of power and conservation of energy resources of the world
3. use various power electronic converters for different applications in industry.

Modules	Hours Teaching	Revised Bloom's Taxonomy(RBT) Level
Module -1		
Introduction, Power semiconductor Devices: Applications of Power Electronics, Power semiconductor devices, Control Characteristics, Types of power electronics circuits, Peripheral effects. Power MOSFETs – switching characteristics, gate drive, IGBTs, di/dt and dv/dt limitations, Isolation of gate and base drives, Simple design of gate and base drives.	**10 Hours**	
Module -2		
Thyristors: Introduction, characteristics, Two Transistor Model. Turn-on and turn-off, di/dt and dv/dt protection, Thyristor types, Thyristors firing circuits, Simple design of firing circuits using UJT. **Commutation Techniques**: Introduction. Natural Communication, Forced commutation: self commutation, impulse commutation, resonant pulse commutation and complementary commutations.	**10 Hours**	
Module -3		
AC Voltage Controllers: Introduction. Principle of ON-OFF and phase control. Single-phase bidirectional controllers with resistive and inductive loads. **Controlled Rectifiers:** Introduction. Principle of phase controlled converter operation. Single phase semi-converters. Full converters. Three-phase half-wave converters. Three-phase full-wave converters.	**10 Hours**	
Module -4		

DC Choppers: Introduction. Principle of step-down and step-up chopper with R-L load. Performance parameters. Choppers classification. Analysis of impulse commutated thyristor chopper (only qualitative analysis)	**10 Hours**	
Module -5		
Inverters: Introduction, Principle of operation. Performance parameters. Single-phase bridge inverters. Three phase inverters. Voltage control of single-phase Inverters single pulse width, multiple pulse width, and sinusoidal pulse width modulation.	**10 Hours**	

Course outcomes: On completion of the course student will:

CO1: have knowledge of power semiconductor devices, thyristors, AC voltage controllers, choppers and inverters.

CO2: understand the characteristics and working principle of thyristors, AC voltage controllers, choppers and inverters.

CO3: apply control techniques to meet desired switching objectives.

Graduate Attributes (as per NBA):

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. "Power electronics", m h. Rashid 2nd edition, p. H.i/pearson, new delhi, 2002.

Reference Books:

1. "Power Electronics – converters, Application and Design", Net Mohan, Tore M. Undeland, and William P. Robins, Third Edition, John Wiley and Sons.
2. "Thyristorised Power Controllers", G. K. Dubey, S. R. Doradla, A. Joshi and R M K. Sinha, New Age International Publishers.
3. "Power Electronics", M. D. Singh and Khanchandani K.B. T.M.H., 2001.
4. "Power Electronics", Cyril Lander, 3rd Edition, McGraw-Hill.
5. "Power Electronics: Principles and Applications", J.M. Jacob, Thomson-VikasPublicaions.
6. "Power Electronics: A Simplified Approach", R.S. Ananda Murthy and V. Nattarasu, Sanguine Technical Publisher.

SATELLITE COMMUNICATION
[As per Choice Based Credit System (CBCS) scheme]
SEMESTER – VI

Subject Code	15MT654	IA Marks	20
Number ofLecture Hours/Week	03	Exam Marks	80
Total Number of Lecture Hours	40	Exam Hours	03

CREDITS – 03

Course objectives: Students will be able to

- gain Knowledge of various kinds of Satellites, Satellite Subsystems & Orbits, Trajectory, Multiple Access Techniques .
- understand the Operation of Satellites in space for various applications.

Modules	Hours Teaching	RevisedBloom's Taxonomy(RBT) Level
Module -1		
SATELLITE ORBITS AND TRAJECTORIES: Definition, Basic Principles, Orbital parameters, Injection velocity and satellite trajectory, Types of Satellite orbits, Orbital perturbations, Satellite stabilization, Orbital effects on satellite's performance, Eclipses, Look angles: Azimuth angle, Elevation angle.	**8 Hours**	
Module -2		
SATELLITE SUBSYSTEM: Power supply subsystem, Attitude and Orbit control, Tracking, Telemetry and command subsystem, Payload. Earth Station: Types of earth station, Architecture, Design considerations, Testing, Earth station Hardware, Satellite tracking.	**8 Hours**	
Module -3		
MULTIPLE ACCESS TECHNIQUES: Introduction, FDMA (No derivation), SCPC Systems, MCPC Systems, TDMA, CDMA, SDMA. Satellite Link Design Fundamentals: Transmission Equation, Satellite Link Parameters, Propagation considerations.	**8 Hours**	
Module -4		
COMMUNICATION SATELLITES: Introduction, Related Applications, Frequency Bands, Payloads, Satellite Vs. Terrestrial Networks, Satellite Telephony, Satellite Television, Satellite radio, Regional satellite Systems, National Satellite Systems.	**8 Hours**	
Module -5		
REMOTE SENSING SATELLITES: Classification of remote sensing systems, orbits, Payloads, Types of images: Image Classification, Interpretation, Applications. Weather Forecasting Satellites: Fundamentals, Images, Orbits, Payloads, Applications. Navigation Satellites: Development of Satellite Navigation Systems, GPS system, Applications.	**8 Hours**	

Course outcomes:
On completion of course students will

CO 1: have Knowledge of various kinds of Satellites, Satellite Subsystems & Orbits, Trajectory, Multiple Access techniques .
CO 2: understand the Operation of Satellites in space for various applications

Graduate Attributes (as per NBA):

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. Anil K. Maini, Varsha Agrawal, Satellite Communications, Wiley India Pvt. Ltd., 2015, ISBN: 978-81-265-2071-8.

Reference Books:

1. Dennis Roddy, Satellite Communications, 4th Edition, McGraw- Hill International edition, 2006
2. Timothy Pratt, Charles Bostian, Jeremy Allnutt, Satellite Communications, 2nd Edition, Wiley India Pvt. Ltd , 2017,
ISBN: 978-81-265-0833-4

PLC AND SCADA

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

Subject Code	15MT61	IA Marks	20
Number ofLecture Hours/Week	04	Exam Marks	80
Total Number of Lecture Hours	50	Exam Hours	03

CREDITS – 04

Course objectives: Students will be able to

- Gain the Knowledge of various skills necessary for Industrial applications of Programmable logic controller(PLC)
- Understand the basic programming concepts and various logical Instructions used in Programmable logic controller (PLC)
- Solve the problems related to I/O module, Data Acquisition System and Communication Networks using Standard Devices.
- Design and analysis of general structure of an automated process for real time applications using Programmable logic controller (PLC) and SCADA

Modules	Hours Teaching	RevisedBloom's Taxonomy(RBT) Level
Module -1		
what is A PLC, Technical Definition of PLC, What are its advantages, characteristics functions of A PLC, Chronological Evolution of PLC, Types of PLC, Unitary PLC, Modular PLC, Small PLC, Medium PLC, Large PLC, Block Diagram of PLC: Input/output (I/O) section, Processor Section, Power supply, Memory central Processing Unit: Processor Software / Executive Software, Multi asking, Languages, Ladder Language.	**10 Hours**	
Module -2		
Bit Logic Instructions: introduction: Input and Output contact program symbols, Numbering system of inputs and outputs, Program format, introduction to logic: Equivalent Ladder diagram of AND gate, Equivalent ladder diagram of or Gate, equivalents Ladder Diagram of NOT gate, equivalent ladder diagram of XOR gate, equivalent ladder diagram of NAND gate, equivalent ladder diagram of NOR gate, equivalent ladder diagram to demonstrate De Morgan theorem. Ladder design. Examples: Training Stopping, Multiplexer, DE multiplexers	**10 Hours**	
Module -3		

PLC Timers and Counters: On Delay and OFF delay timers, Timer-on Delay, Timer off delay, Retentive and non-retentive timers. Format of a timer instruction. PLC Counter: Operation of PLC Counter, Counter Parameters, Counters Instructions Overview Count up (CTU) Count down (CTD). Advanced instructions: Introduction: Comparison instructions, discussions on comparison instructions, "EQUAL" or "EQU" instruction, "NOT EQUAL" or "NEQ" instruction, "LESS THAN" or "LESS" instruction, "LESS THANOR EQUAL' or "LEQ" instruction, GREATER THAN" OR "GRT" instruction, "GREATER THAN OR EQUAL TO" or "GRO" instruction, "MASKED COMPARISON FOR EQUAL" or "MEQ" instruction, "LIMIT TEST" or "LIM" instruction.	**10 Hours**	
Module -4		
PLC input output (I/O) modules and power supply: Introduction: Classification of I/O, I/O system overview, practical I/O system and its mapping addressing local and expansion I/O, input-output systems, direct I/O, parallel I/O systems serial I/O systems. Sinking and sourcing. Discrete input module. Rectifier with filter, threshold detection, Isolation, logic section, specifications of discrete input module, types of analog input module, special input modules, analog output module, I/O modules in hazardous locations power supply requirements, power supply configuration, filters.	**10 Hours**	
Module -5		
SCADA SYSTEMS Introduction, definition and history of Supervisory Control and Data Acquisition, typical SCADA System Architecture, Communication Requirements, Desirable properties of SCADA system, Features, advantages, disadvantages and applications of SCADA. SCADA Architecture(First generation-Monolithic, Second Generation-Distributed, Third generation-Networked Architecture), SCADA systems in operation and control of interconnected power system, Power System Automation, Petroleum Refining Process, Water Purification System, Chemical Plant	**10 Hours**	
Course outcomes: **On completion of the course students will** **CO 1:** have knowledge of Programmable Logic Controller domain on various Logical Operation and Various Advanced Logical Instruction, I/O Module, Sensor, Actuator, Communication and Measurement System. **CO 2:** Understand the basic programming concepts and various logical Instructions used in Programmable logic controller (PLC). **CO 3:** Compute the extent and nature of electronic circuitry in Programmable logic controller (PLC) and SCADA including monitoring and control circuits for Communication and Interfacing. **CO 4:** Design and analyse the general structure of an automated process for real time industrial applications		
Graduate Attributes (as per NBA):		
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. "PLC and Industrial application", MadhuchhandanGupts and SamarjitSen Gupta, pernram international pub. (Indian) Pvt. Ltd., 2011.
2. Ronald L Krutz, "Securing SCADA System", Wiley Publication

Reference Books:

1.1.GaryDunning,"Introduction to Programmable Logic Controllers", Thomson, 2nd Edition.
2. John W Webb, Ronald A Reis,"Programmable Logic Controllers: Principles and Application", PHI Learning, Newdelhi, 5th Edition
3.Stuart A Boyer, "SCADA Supervisory Control and Data Acqusition", ISA, 4th Revised edition

Computer Aided Machine Drawing

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

Subject Code	15MT64	IA Marks	20
Number of Lecture Hours/Week	2 Hours Theory and 4 Hours Lab	Exam Marks	80
Total Number of Lecture Hours	70	Exam Hours	03

CREDITS – 04

Course objectives: Students will be able to

1. gain knowledge about Engineering Drawing
2. understand the sections of solids, orthographic views, threads, fasteners, couplings, joints and machine drawing

Modules	Hours Teaching	RevisedBloom's Taxonomy(RBT) Level
Part – A		
Sections of Solids: Sections of Pyramids, Prisms, Cones and resting only on their bases (No problems on axis inclinations, spheres and hollow solids). True shape of sections. **Orthographic Views:** Conversion of pictorial views into orthographic projections of simple machine parts without sections. (Bureau of Indian Standards conventions are to be followed for the drawings). **Thread Forms:** Thread terminology, sectional views of threads. ISO Metric (Internal & External) square. **Fasteners:** Hexagonal headed bolt and nut with washer (assembly).	**20 Hours**	
Part – B		
Keys & Joints : Parallel key, Taper key, Feather key, Gib head key and Woodruff key (Only Practice) Cotter joint, knuckle joint for two rods. **Couplings:** Protected type flanged coupling, flexible coupling	**20 Hours**	
Part – C		
Assembly Drawings **(Part drawings should be given)** 1. Plummer block (Pedestal Bearing) 4. Screw jack (Bottle type) 5. Tailstock of lathe	**30 Hours**	

Geometric Dimensioning and Tolerances (Not for Exam): Types of Geometric tolerances, terminology for geometrical deviations, representation of geometrical tolerance on a drawing, dimensional tolerances, terminology for dimensional tolerances, selection of tolerances, representation of dimensional tolerances on a drawing.		

Course outcomes:
On completion of course students will :
CO 1: have knowledge about Engineering Drawing
CO 2: understand the concepts of sections of solids, orthographic views, threads, fasteners, couplings, joints and assembly drawing

Graduate Attributes (as per NBA):

Scheme of Examination:

One Question from Part - A: **20 marks**
One Question from Part - B: **20 Marks**
One Question from Part - C: **40 Marks**

Text Books:
1. 'A Primer on Computer Aided Machine Drawing-2007', Published by VTU, Belgaum.
2. 'Machine Drawing', N.D.Bhat &V.M.Panchal

Reference Books:
1. **'A Text Book of Computer Aided Machine Drawing'**, S. Trymbaka Murthy, CBS Publishers, New Delhi, 2007
2. **'Machine Drawing'**, K.R. Gopala Krishna, Subhash Publication

EMBEDDED SYSTEMS (ARM)

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

Subject Code	15MT62	IA Marks	20
Number of Lecture Hours/Week	04	Exam Marks	80
Total Number of Lecture Hours	50	Exam Hours	03

CREDITS – 04

Course objectives: Students will be able to

- gain the knowledge of various RISC and CISC architectures of processors.
- understand the embedded system based ARM processor , its programming with Embedded C and assembly language, various memory issues and memory mapping.

Modules	Hours Teaching	RevisedBloom's Taxonomy(RBT) Level
Module -1		
Introduction: The RISC design philosophy; The ARM design philosophy; Embedded system hardware and software. ARM processor fundamentals: Registers; Current Program Status Register; Pipeline; Exceptions, interrupts and the Vector Table; Core extensions; Architecture revisions; ARM processor families.	**10 Hours**	
Module -2		
Arm Instruction Set And Thumb Instruction Set: ARM instruction set: Data processing instructions; Branch instructions; Load-store instructions; Software interrupt instruction; Program Status Register functions; Loading constants; ARMv5E extensions; Conditional execution. Thumb instruction set: Thumb register usage; ARM –Thumb interworking; Other branch instructions; Data processing instructions; Single-Register Load-Store instructions; Multiple-Register Load-Store instructions; Stack instructions; Software interrupt instruction	**10 Hours**	
Module -3		
Writing And Optimizing ARM Assembly Code: Writing assembly code; Profiling and cycle counting; Instruction scheduling; Register allocation; Conditional execution; Looping constructs; Bit manipulation; Efficient switches; Handling unaligned data.	**10 Hours**	
Module -4		
Caches : The memory hierarchy and the cache memory; Cache architecture; Cache policy; Coprocessor 15 and cache; Flushing and cleaning cache memory; Cache lockdown; Caches and software performance	**10 Hours**	

Module -5		
Exception And Interrupt Handling: Exception handling; Interrupts and interrupt handling Schemes	**10 Hours**	

Course outcomes:
On completion of the course students will

CO 1: have knowledge of embedded system based on the ARM processor, various cache methods and instruction set.
CO 2: understand the various instruction set for writing and optimizing ARM assembly and C code

Graduate Attributes (as per NBA):

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. ARM System Developer's Guide – Designing and Optimizing System Software – by Andrew N. Sloss, Dominic Symes, Chris Wright, Elsevier, 2004.

Reference Books:

1. ARM Architecture Reference Manual by David Seal (Editor), 2nd Edition, Addison-Wesley, 2001.
2. ARM System-on-Chip Architecture by Steve Furber, 2nd Edition, AddisonWesley, 2000.

ROBOTICS & AUTOMATION

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

Subject Code	15MT661	IA Marks	20
Number of Lecture Hours/Week	03	Exam Marks	80
Total Number of Lecture Hours	40	Exam Hours	03

CREDITS – 03

Course objectives: Students will be able to

1. gain fundamental knowledge of Robotics and Automation
2. describe Control system, different motions of robots and Material handling system

Modules	Hours Teaching	Revised Bloom's Taxonomy (RBT) Level
Module -1		
Basic Concepts: Definition and origin of robotics – different types of robotics – various generations of robots – degrees of freedom – Asimov's laws of robotics – dynamic stabilization of robots.	8 Hours	
Module -2		
Power Sources And Sensors: Hydraulic, pneumatic and electric drives – determination of HP of motor and gearing ratio – variable speed arrangements – path determination – micro machines in robotics – machine vision – ranging – laser – acoustic – magnetic, fiber optic and tactile sensors.	8 Hours	
Module -3		
Manipulators, Actuators And Grippers: Construction of manipulators – manipulator dynamics and force control – electronic and pneumatic manipulator control circuits – end effectors – U various types of grippers – design considerations.	8 Hours	
Module -4		
Industrial Automation: • List basic Devices in Automated Systems • Distinguish Different Controllers Employed In Automated Systems. Identify Safety in Industrial Automation	8 Hours	

Material handling and Identification Technologies: Overview of Material Handling Systems, Principles and Design Consideration, Material Transport Systems, Storage Systems, Overview of Automatic Identification Methods.	**8 Hours**	

Course outcomes:

On completion of course students will

CO1: have the knowledge of Joints, Links, Sensors, Control units, Actuators. and elements of Automation

CO2: describe motions and control system of Robots.

Graduate Attributes (as per NBA):

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. Mikell P. Weiss G.M., Nagel R.N., Odraj N.G., Industrial Robotics, McGraw-Hill
2. Singapore, 1996.
3. Ghosh, Control in Robotics and Automation: Sensor Based Integration, Allied
4. Publishers, Chennai, 1998.

Reference Books:

1. Deb.S.R., Robotics technology and flexible Automation, John Wiley, USA 1992.
2. Asfahl C.R., Robots and manufacturing Automation, John Wiley, USA 1992.
3. Klafter R.D., Chimielewski T.A., Negin M., Robotic Engineering – An integrated approach, Prentice Hall of India, New Delhi, 1994.
4. Mc Kerrow P.J. Introduction to Robotics, Addison Wesley, USA, 1991.
5. Issac Asimov I Robot, Ballantine Books, New York, 1986.

SIGNAL PROCESSING LABORATORY

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

SEMESTER – VII

Subject Code	**15MTL77**	**IA Marks**	**20**
Number of Lecture Hours/Week	**03**	**Exam Marks**	**80**
Total Number of Lecture Hours	**40**	**Exam Hours**	**03**

CREDITS – 02

Course objectives: Students will be able to

1. gain knowledge of Scientific Programming using Matlab.
2. understand different functions in Matlab and TMS320C67XX board in signal processing.
3. use in different functions to solve engineering problems.

PART – A **LIST OF EXPERIMENTS USING MATLAB**	**Hours Teaching**	**Revised Bloom's Taxonomy(RBT) Level**

1. Generation of basic elementary signals and operations on these signals.
2. Verification of sampling theorem.
3. Impulse response of a given system.
4. Solving a given difference equation.
5. Computation of N point DFT and IDFT of a given sequence and to plot magnitude and phase spectrum.
6. Design and implementation of FIR filter to meet given specifications.
7. Design and implementation of IIR filter to meet given specifications.
8. Removal of noise from an audio signal.
9. Different operations on image signal.

PART – B

LIST OF EXPERIMENTS USING DSP PROCESSOR

1. Linear convolution of two given sequences.
2. Circular convolution of two given sequences.
3. Computation of N- Point DFT of a given sequence
4. Realization of an FIR filter (any type) to meet given specifications .The input can be a Signal from function generator / speech signal.

5. Noise: Add noise above 3kHz and then remove; Interference suppression using 400 Hz tone.
6. Impulse response of first order and second order system.

Course outcomes: On completion of the course the student will

CO1: have knowledge of Scientific Programming using Matlab.
CO2: understand the programming in Matlab software and hardware.
CO3: use DSP board for real time applications.

Graduate Attributes (as per NBA):

Question paper pattern:

- The question paper will have TWO questions.
- One From PART A and one from PART B.

Text Books:

Reference Books:

1. **Digital signal processing using MATLAB** - Sanjeet Mitra, TMH, 2001
2. **Digital signal processing using MATLAB** - J. G. Proakis & Ingale, MGH, 2000
3. **Digital Signal Processors**, B. Venkataramani and Bhaskar, TMH,2002

Scheme of Examination:

Experiment :

Part A : 35 Marks

Part B: 35 Marks

Viva- Voice : 10 Marks

Total : 80 Marks

THERMAL ENGINEERING

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

Subject Code	15MT72	IA Marks	20
Number ofLecture Hours/Week	04	Exam Marks	80
Total Number of Lecture Hours	50	Exam Hours	03

CREDITS – 04

Course objectives: Students will be able to

- gain fundamental knowledge of thermodynamics, and heat transfer.
- understand the laws of thermodynamics and heat transfer.
- formulate and determine thermodynamic and heat transfer parameters.

Modules	Hours Teaching	RevisedBloom's Taxonomy(RBT) Level
Module -1		
Thermodynamics - Fundamental Concepts & Definitions: Thermodynamics: definition and scope, Microscopic and Macroscopic approaches. Engineering thermodynamics: definition, some practical applications of engineering thermodynamic. System (Closed system) and Control Volume (open system): Characteristics of system boundary and control surface, examples. Thermodynamic properties; definition and units, intensive and extensive properties. Thermodynamic state, state point, state diagram, path and process, quasi-static process, cyclic and non-cyclic presses; Thermodynamic equilibrium; definition, mechanical equilibrium; diathermic wall, thermal equilibrium, chemical equilibrium. Statement of Zeroth law of thermodynamics. (No Numericals) **Work and Heat:** Thermodynamic definition of work; examples, sign convention. Displacement work: at part of a system boundary, at whole of a system boundary, expressions for displacement work in various processes through p-v diagrams. Shaft work, Electrical work. Other types of work, Heat; definition, units and sign convention, simple problems.	**10 Hours**	
Module -2		
First Law of Thermodynamics: Statement of the First law of thermodynamics, extension of the First law to non-cyclic process, energy as a property, modes of energy, pure substance; definition, two-property rule, Specific heat at constant volume, enthalpy, specific heat constant pressure. Extension of the First law to control volume; steady state-steady flow energy equation, important applications, simple problems **Second Law of Thermodynamics:** Thermal Reservoir, Concepts of Heat Engine, Heat Pump, coefficients of performance. Keivin – Planck statement of the Second	**10 Hours**	

law of Thermodynamics; PMM II and PMM I, Claussius statement of second law of Thermodynamics, equivalence of the two statements; reversible hat engines, Carnot cycle, Carnot principles. Thermodynamic temperature scale, simple problems.		
Module -3		
Air Standard cycles: Carnot, Otto, Diesel, Dual and Stirling cycles, P-V and T-S diagrams, description, efficiencies and mean effective pressures, Comparison of Otto, Diesel and dual cycles, simple problems. **Heat Transfer - Introductory Concepts and Definitions:** Modes of heat transfer: Basic laws governing conduction, convection, and radiation heat transfer; Thermal conductivity; convective heat transfer coefficient; radiation heat transfer; combined heat transfer mechanics. Boundary conditions of 1^{st}, 2^{nd} and 3^{rd} Kind, simple problems.	**10 Hours**	
Module -4		
Conduction: Derivation of general three dimensional conduction equations in Cartesian coordinate, special cases, discussion on 3-D conduction in cylindrical and spherical coordinate systems (No derivation). One dimensional conduction equations in rectangular, cylindrical and spherical coordinates for plane and composite walls. Overall heat transfer coefficient. Thermal contact resistance, Simple problems. **Free or Natural Convection:** Application of dimensional analysis for free convection- physical significance or Grashoff number; use of correlations of free convection in vertical, horizontal and inclined flat plates, vertical and horizontal cylinders and spheres, Simple problems.	**10 Hours**	
Module -5		
Forced Convections: Applications of dimensional analysis for forced convection. Physical significance of Reynolds, Prandtl, Nusselt and Stanton numbers, Simple problems. **Radiation Heat Transfer:** Thermal radiation; definitions of various terms used in radiation heat transfer, Stefan-Boltzman law, Kircoff's law. Planck's law and Wein's displacement law. Radiation heat exchange between two parallel infinite black surface, between two parallel infinite gray surfaces; effect of radiation shield; intensity of radiation and solid angle, Simple problems.	**10 Hours**	
Course outcomes: **On completion of course students will** CO1: have knowledge of thermodynamics and heat transfer. CO2: understand the concepts of system, energy interaction, temperature distribution, and heat transfer. CO3: applications of laws of thermodynamics to open and closed system and of heat transfer to different shapes and types of materials. Determine the thermodynamic performance, heat transfer and temperature distribution.		
Graduate Attributes (as per NBA):		
Question paper pattern: • The question paper will have TEN questions.		

- Each full question carries 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. **Basic and applied Thermodynamics,** P. K. Nag, Tata McGraw Hill Pub. 2002.
2. **Heat & Mass transfer,** Tirumaleshwar, Pearson education 2006.
3. **Engineering Thermodynamics,** R K Rajput, Laxmi Publications, 2007

Reference Books:

1. **Engineering Thermodynamics,** J. B. Jones and G. A. Hawkins, John Wiley and Sons.
2. **Basic Engineering Thermodynamics data hand book,** by B. T. Nijaguna. (To be supplied in the examination)
3. **Thermodynamics, An Engineering Approach,** Yunus a. Cenegal and Michael a. Boles, Tata McGraw Hill publications, 2002.
4. **Heat and Mass Transfer,** R K Rajput, S. Chand, 2007.
5. **Heat transfer,** P. K. Nag, Tata McGraw Hill 2002.
6. **Heat transfer-A basic approach,** Ozisik, Tata McGraw Hilll 2002.
7. **Heat transfer, a practical approach,** Yunus a- Cengel Tata McGraw Hill.

DIGITAL IMAGE PROCESSING

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

Subject Code	**15MT754**	**IA Marks**	**20**
Number of Lecture Hours/Week	**03**	**Exam Marks**	**80**
Total Number of Lecture Hours	**40**	**Exam Hours**	**03**

CREDITS – 03

Course objectives: Students will be able to

1. gain knowledge of image, sampling, quantization, enhancement, and restoration of image.

2. understand different methods of image enhancement and restoration.

3. transform image using different transformations.

Modules	**Hours Teaching**	**Revised Bloom's Taxonomy(RBT) Level**
Module -1		
Digital image fundamentals: What is Digital image processing? Fundamental steps in digital image processing, components of an image processing system, elements of Visual Perception.	**8 Hours**	
Module -2		
Images sensing and Acquisition: images sampling and Quantization's, Some Basic Relationships between Pixels, Linear and Nonlinear Operations.	**8 Hours**	
Module -3		
Image Transforms: Two-dimensional orthogonal & unitary transforms, properties of unitary transforms, two dimensional discrete Fourier transform. Discrete cosine transform, Hadamard transform, Haar transform,	**8 Hours**	
Module -4		
Image Enhancement: Image Enhancement in Spatial domain, Some Basic Gray Level Transformations, Histogram Processing, Enhancement using Arithmetic/Logic Operations. Basics of Spatial Filtering Image enhancement in the Frequency Domain filters, Smoothing Frequency Domain filters, Sharpening Domain filters, homomorphic filtering.	**8 Hours**	
Module -5		
Model of image degrading/restoration process: noise models, Restoration in the Present of Noise, Linear Position-Invariant Degradations, inverse filtering, minimum mean square error (Weiner) filtering. Color Fundamentals. Color Models,	**8 Hours**	

Pseudo color. Image Processing., processing basics of full color image processing		

Course outcomes: On completion of the course the student will

CO1: have knowledge of different images, enhancement and restoration.

CO2: understand how images are formed, sampled, quantized and represented digitally.

CO3: process the images by applying different operations and transformation

Graduate Attributes (as per NBA):

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. "Digital Image Processing", Rafael C. Gonzalez and Richard e. Woods, Pearson Eucation, 2001, 2nd edition.

Reference Books:

1. "Fundamentals of Digital Image Processing", Anil K, Jain, Pearson Edun, 20010
2. "Digital Image Processing and Analysis", B. Chanda and D. Dutta Majumdar, PHI, 2003

INDUSTRIAL ROBOTICS

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

Subject Code	**15MT71**	IA Marks	20
Number ofLecture Hours/Week	04	Exam Marks	80
Total Number of Lecture Hours	50	Exam Hours	03

CREDITS – 04

Course objectives: Students will be able to

1. gain knowledge of Robotics and automation.
2. understand the working methodology of robotics and automation.
3. write the program for robot for various applications.

Modules	Hours Teaching	RevisedBloom's Taxonomy(RBT) Level
Module -1		
Fundamentals ofAutomation: Automation and robotics, history of robotics, robotics market and future prospects. **Fundamentals of Robotics:** robot anatomy, work volume, robot drive systems, control systems, precision of movement, end effectors, robotic sensors, robot programming and work cell control, robot applications, problems. Basic control systems and components: Basic control systems concepts and models, control system analysis, robot sensors and actuators.	**10 Hours**	
Module -2		
Robot Motion Analysis: Introduction to manipulator kinematics, homogeneous transformations and robot kinematics, manipulator path control, robot dynamics, configuration of a robot controller. **Robot End Effectors**: types of end effecters, mechanical grippers, other types of grippers, tools as end effectors, robot/end effector interface, consideration in gripper selection and design, problems. **Sensors in Robotics**: Transducers and sensors, sensors in robotics, tactile sensors, proximity and range sensors, uses of sensors in robotics, problems.	**10 Hours**	
Module -3		
Machine Vision, : Introduction to machine vision, sensing and digitizing function in machine vision, image processing and analysis, training the vision system, robotic applications, problems. **Robot Programming**: Methods of robot programming, lead -through programming methods, a robot program as a path in space, motion interpolation, wait, signal and delay commands, branching, capabilities and limitations of lead-through methods, problems. **Artificial Intelligence (AI):** Introduction & goals of AI in research, AI techniques, LISP programming, AI & robotics, LISP in factory, robotic paradigms, problems.	**10 Hours**	
Module -4		
Robot Cell Design & Control :Robot cell layouts, multiple robots and machine interference, considerations in work -cell design, work-cell control, interlocks, error detection and recovery, work -cell controller, robot cycle time analysis, graphic simulation of robotic work-	**10 Hours**	

cells, problems. **Material Transfer, Machine Loading/Unloading :**Material Transfer, Machine Loading/Unloading: General considerations in robot material handling, material transfer applications, machine loading and unloading.		
Module -5		
Robots in Automatic Processing Operations: Introduction, spot welding, continuous arc welding, spray coating, other processing operations. **Assembly & Inspection**: Assembly and robotic assembly automation, parts presentation methods, assembly operations, compliance and remote centre compliance (RCC) device, assembly system configurations, adaptable programmable assembly system, designing for robotic assembly, inspection automation.	**10 Hours**	

Course outcomes:

On completion of course students will

CO1: have knowledge of Robotics, automation, robotics motion, sensors and control, machine vision, robotic programming and roles of robots in industry

CO2: understand the working methodology of robotics and automation, motion and control, machine vision and programming, application of robots in industry.

CO3: write the program for robot for various applications

Graduate Attributes (as per NBA):

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. Mikell P. Groover, Mitchel Weiss, Roger N. Nagel, Nicholas G. Odrey and Ashish Dutta, "Industrial Robotics: Technology, Programming and Applications", 2 nd Edition, Tata McGraw Hill, 2012.
2. Roland Siegwart, Illah R. Nourbakhsh, an d Davide Scaramuzza, "Introduction to Autonomous Mobile Robots", 2 nd Edition, PHI, 2011.

ROBOTICS LABORATORY
[As per Choice Based Credit System (CBCS) scheme] SEMESTER – VII

Subject Code	15MTL77	IA Marks	20
Hours/Week	03	Exam Marks	80
Total Number of Lecture Hours	40	Exam Hours	03

CREDITS – 02

Course objectives: Students will be able to
1: Understand the Importance & Applications of Robots in Virtual Environment
2: Design the Robots system for Industrial Application

Laboratory Experiments:	**Revised Bloom's Taxonomy (RBT)Level**

LIST OF EXPERIMENTS

PART-A

1. Design the Robot programming for Point to Point using two Cubes.
2. Design the Robot programming for Drilling Operation using Cube and Cylinder.
3. Design the Robot programming using Smart Components.
4. Design the Robot programming for MutimoveOperation.
5. Design the Robot programming for Conveyor Tracking System.
6. Design the Robot programming for Continuous Path Operation on Cylinder

PART-B

1. Design a Robot System for Pick and Place Operation.
2. Design a Robot System for Point to Point operation.[Cube]
3. Design a Robot System for Continuous Path Operation.
4. Design a Robot System for Circle Path Operation.
5. Design a Robot System for Drilling Operation of Cube.
6. Design a Robot System for Continuous Path Operation for any 3 Objects [Cube, Box, Circle]

Note:

Part A: Experiments to be conducted using Software.

Part B: Experiments to be conducted using Robot system.

Course outcomes: On completion of the course the student will:

CO 1: Understand the importance of Robot system in Industrial Process in Virtual Environments
CO 2: Design and Develop a Robot System for Real time Industrial Process.

Scheme of Examination:

Experiment :
Part A : 35 Marks
Part B: 35 Marks
Viva- Voice : 10 Marks
Total : 80 Marks

REAL TIME SYSTEMS

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

Subject Code	**15MT743**	**IA Marks**	**20**
Number of Lecture Hours/Week	**03**	**Exam Marks**	**80**
Total Number of Lecture Hours	**40**	**Exam Hours**	**03**

CREDITS – 03

Course objectives: Students will be able to

- gain knowledge of real time systems, computer control, hardware & software requirements, operating systems, RTS developing methodologies.
- understand the operation of real time systems, computer control, hardware & software implementation for RTS, operating systems, RTS developing methodologies.

Modules	Hours Teaching	Revised Bloom's Taxonomy(RBT) Level
Module -1		
Introduction to Real-Time systems: Historical background, RTS definition, Classification of Real-time systems, Time constraints, Classification of Programs. **Concepts of computer control:** Introduction, Sequence Control, Loop control, Supervisory control, Centralized computer control, Distributed system, Human-computer interface, Benefits of computer control systems.	**8 Hours**	
Module -2		
Computer Hardware requirements for RTS: Introduction, General purpose computer, single chip microcontroller, specialized processors, Process-related Interfaces, Data transfer techniques, Communications, Standard Interface.	**8 Hours**	
Module -3		
Languages for Real-Time applications: Introduction, Syntax layout and readability, declaration and Initialization of Variables and Constants, Modularity and Variables. Compilation. Data types ,Control Structure, Exception Handling, Low-level facilities, Co routines, Interrupts and Device handling, concurrency, Real-time support, Overview of real-time languages.	**8 Hours**	
Module -4		
Operating Systems: Introduction, Real-time multi-tasking OS, Scheduling strategies. Priority Structures, Task management, Scheduler and real-time clock interrupt handles. Memory Management, Code sharing, Resource control, task co-operation and communication, Mutual exclusion, Minimum OS kernel.	**08 Hours**	
Module -5		

Design of RTSS- General Introduction: Introduction, Specification documentation, Preliminary design, single-program approach, Foreground/background systems. **RTS development methodologies:** Introduction, Yourdon Methodology, Ward and Mellor Method, Hately and Pirbhai method.	**08Hours**	

Course outcomes: On completion of the course the student will

CO1: have knowledge of real time systems, computer control, hardware & software requirements, operating systems, RTS developing methodologies.

CO2: understand the operation of real time systems, computer control, hardware & software implementation for RTS, operating systems, RTS developing methodologies.

Graduate Attributes (as per NBA):

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. **Real – time Computer Control – an introduction,** Sturt Bennel, 2ne Edn. Pearson Education. 2005.

Reference Books:

1. **Real-Time Systems Design and Analysis,** Philip, a. Laplante, second edition, PHI, 2005.
2. **Real-Time Systems Development,** Rob Williams, 2006.
3. **Embedded Systems,** Raj Kamal, Tata McGraw Hill, India, 2005.

SIGNAL PROCESS

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

SEMESTER – VII

Subject Code	**15MT73**	**IA Marks**	**20**
Number of Lecture Hours/Week	**04**	**Exam Marks**	**80**
Total Number of Lecture Hours	**50**	**Exam Hours**	**03**

CREDITS – 04

Course objectives: Students will be able to

1. gain knowledge of signal, system, transformation and filter.
2. understand time domain, frequency domain signals, analog and digital systems.
3. operate on signals and systems to bring out its characteristics and desired information.
4. design analog and digital filers and implement discrete time systems.

Modules	**Hours Teaching**	**Revised Bloom's Taxonomy(RBT) Level**
Module -1		
Introduction: Definitions of a signal and a system, classification of signals, basic Operations on signals, Basic elementary signals, properties of systems.	**10 Hours**	
Module -2		
Time-domain representations for LTI systems: Convolution, impulse response representation, Convolution Sum and Convolution Integral. Properties of impulse response representation,	**10 Hours**	
Module -3		
Discrete Fourier Transforms (DFT): Introduction to DFT, Properties of DFT, multiplication of two DFTs- the circular convolution, additional DFT properties, use of DFT in linear filtering, overlap-save and overlap-add method. Fast-Fourier-Transform (FFT) algorithms: Direct computation of DFT, need for efficient computation of the DFT (FFT algorithms). Radix-2 FFT algorithm for the computation of DFT and IDFT–decimation-in-time and Decimation-in-frequency Algorithms	**10 Hours**	
Module -4		
IIR filter design: Characteristics of commonly used analog filters – Butterworth and Chebyshev filters, analog to analog frequency transformations. Design of IIR filters from analog filters (Butterworth and Chebyshev) - impulse invariance method. Mapping of transfer functions: Approximation of derivative (bilinear transformation) method, Verification for stability and linearity during mapping	**10 Hours**	

Module -5		
FIR filter design: Introduction to FIR filters, design of FIR filters using - Rectangular, Hamming, Hanning and Kaiser windows, FIR filter design using frequency sampling Technique. Implementation of discrete-time systems: Structures for IIR and FIR systems-direct form I and direct form II systems, cascade, lattice and parallel realization.	**10 Hours**	

Course outcomes: On completion of the course the student will

CO1: have knowledge of signal, system, transformation, filter design.

CO2: understand the difference between time domain, frequency domain, analog and digital filters.

CO3: transform the signals from one domain to other domain using transformation techniques.

CO4: design analog and digital filters for specific applications.

Graduate Attributes (as per NBA):

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. **Digital signal processing** – **Principles Algorithms & Applications**, Proakis & Monalakis, Pearson education, 4th Edition, New Delhi, 2007.
2. **"Signals and Systems",** Simon Haykin and Barry Van Veen John Wiley & Sons, 2001.

Reference Books:

1. **Discrete Time Signal Processing**, Oppenheim & Schaffer, PHI, 2003.
2. **Digital Signal Processing**, S. K. Mitra, Tata Mc-Graw Hill, 2nd Edition, 2004.
3. **Digital Signal Processing**, Lee Tan: Elsivier publications, 2007
4. Alan V Oppenheim, Alan S, Willsky and A Hamid Nawab, "Signals and Systems" Pearson Education Asia / PHI, 2nd edition, 1997. Indian Reprint 2002
5. H. P Hsu, R. Ranjan, "Signals and Systems", Scham's outlines, TMH, 2006
6. B. P. Lathi, "Linear Systems and Signals", Oxford University Press, 2005.
7. Ganesh Rao and Satish Tunga, "Signals and Systems", Sanguine Technical Publishers, 2004.

AUTOMOTIVE ELECTRONICS AND HYBRID VEHICLES

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

Subject Code	**15MT81**	**IA Marks**	**20**
Number of Lecture Hours/Week	**04**	**Exam Marks**	**80**
Total Number of Lecture Hours	**50**	**Exam Hours**	**03**

CREDITS – 04

Course objectives: Students will be able to

- gain Knowledge of developing basic skills necessary to diagnose automotive electrical problems, to include electrical principles, use of basic electrical test equipment.
- understand the advanced automotive electrical systems, to include body electrical accessories, and basic computer control.
- diagnosis the problem automotive batteries, starting, and charging, lighting systems, body electrical accessories, and basic computer control.

Modules	Hours Teaching	Revised Bloom's Taxonomy(RBT) Level
Module -1		
Automotive Fundamentals Overview: Four Stroke Cycle, Engine Control, Ignition System, Spark plug, Spark pulse generation, Ignition Timing, Drive Train, Transmission, Brakes, Steering System, Battery, Starting System.**Air/Fuel Systems** Fuel Handling, Air Intake System, Air/ Fuel Management	**10 Hours**	
Module -2		
Sensors – Oxygen (02/EGO) Sensors, Throttle Position Sensor (TPS), Engine Crankshaft Angular Position (CKP)Sensors, Hall effect Position Sensor, Shielded Field Sensor, Optical Crankshaft Position Sensor, Manifold Absolute Pressure (MAP) Sensor – Strain gauge and Capacitor capsule, Engine Coolant Temperature (ECT) Sensor, Intake Air Temperature (IAT) Sensor, Knock Sensor, Airflow rate sensor, Throttle angle Sensor. **Actuators:** Fuel Metering Actuator, Fuel Injector, Ignition Actuator. Exhaust After-Treatment Systems – AIR, Catalytic Converter, Exhaust Gas Recirculation (EGR), Evaporative Emission Systems.	**10 Hours**	
Module -3		
Automotive Instrumentation and Communication: Sampling, Measurement & Signal Conversion of various parameters (Speed, fuel, pressure). Serial Data, Communication Systems, Protection, Body and Chassis is Electrical Systems,	**10 Hours**	

Remote Keyless Entry, GPS		
Module -4		
Vehicle Motion Control: Cruise control, Chassis, Power Brakes, Antilock Brake System (ABS), Electronic Steering Control, Power Steering, Traction Control, Electronically controlled suspension. **Automotive Diagnostics –**Timing Light, Engine Analyzer, On-board diagnostics, Off-board diagnostics, Expert Systems. **Future Automotive Electronics Systems: Alternative** Fuel Engines, Collision Avoidance Radar warning Systems, Low tire pressure warning system, Radio navigation, Advance Driver Information System	**10 Hours**	
Module -5		
Introduction to Alternative Vehicles: Electric Vehicle, Hybrid Electric vehicle, Electric Hybrid Vehicle, Vehicle components, Electric and Hybrid history EV/CEV Comparison. **Alternative Vehicle Architecture:** Electric Vehicles, Hybrid Electric Vehicles, Plug-in Hybrid Electric Vehicles, Power Train component Sizing, Mass Analysis & Packaging, Vehicle Simulation.	**10 Hours**	

Course outcomes: On completion of the course the student will

CO1: have knowledge of automotive electronics domain of various Engine parts, Sensor, Actuator, Communication and Measurement System.

CO2: understanding the engine parameters and a critical awareness of current problems within the automotive electronics domain using Various Measurement Technology.

CO3: determine the extent and nature of electronic circuitry in automotive systems including monitoring and control circuits for engines, transmissions, brakes, steering, suspension, climate control, instrumentation and radios and accessories involved in Automotive Industry.

Graduate Attributes (as per NBA):

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) **Willliam B. Ribbens:** Understanding Automotive Electronics, 6th Edition, SAMS/Elsevier Publishing
2) Iqbal Husain "Electric and Hybrid Vehicles: Design fundamentals". CRC Press, 2011.

Reference Books:

1. **Robert Bosch GmbH:** Automotive Electronics Systems and Components 5th Edition, John Wiley & Sons Ltd., 2007
2. James Laminie and John Lowry. "Electric Vehicle Technology – Explained', CRC Press 2010.
3. Society of Automobile Engineers, "Hybrid Electric vehicles", CRC Press, 2011.

COMMUNICATION SYSTEM

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

Subject Code	**15MT81**	**IA Marks**	**20**
Number of Lecture Hours/Week	**04**	**Exam Marks**	**80**
Total Number of Lecture Hours	**50**	**Exam Hours**	**03**

CREDITS – 04

Course objectives: Students will be able to

- gain the Knowledge Of different modulation techniques, analog and digital modulation and demodulation, different wave form code techniques and spread spectrum
- understand the concept of methods of generating modulated and demodulated signals, encoding and decoding techniques, multiplexing and demultiplexing of signals

Modules	Hours Teaching	Revised Bloom's Taxonomy(RBT) Level
Module -1		
Introduction To Communication Systems: Information, Transmitter, chanel-noise, Receiver, modulation, need for modulation, band width requirements, sine wave and Fourier series review, frequency spectra of non sinusoidal waves. Basic signal processing operations in digital communication. Sampling Principles: Sampling Theorem	**10 Hours**	
Module -2		
Amplitude Modulation: Introduction AM Time-Domain description, Frequency – Domain description. Generation of AM wave: square law modulator, switching modulator. Detection of AM waves: square law detector, envelop detector. Double side band suppressed carrier modulation (DSBSC): Time-Domain description, Frequency-Domain representation, Generation of DSBSC waves: balanced modulator, ring modulator. Coherent detection of DSBSC modulated waves. Costas loop.	**10 Hours**	
Module -3		
Angle Modulation & Demodulation: Basic definitions, FM, narrow band FM, wide band FM, transmission bandwidth of FM waves, generation of FM waves: indirect FM and direct FM, Demodulation of FM waves, FM stereo multiplexing, Phase-locked loop, Nonlinear model of the phase – locked loop, Linear model of the phase – locked loop, Nonlinear effects in FM systems.	**10 Hours**	
Module -4		

Waveform Coding Techniques: PAM, TDM. Waveform Coding Techniques, PCM, Quantization noise and SNR, robust quantization. DPCM, DM, applications. Line Codes : Unipolar RZ& NRZ, Polar RZ& NRZ, Bi-Polar RZ & NRZ ,Manchester	**10 Hours**	
Module -5		
Spread Spectrum Modulation: Pseudo noise sequences, notion of spread spectrum, direct sequence spread spectrum, coherent binary PSK, frequency hop spread spectrum, applications. Digital Multiplexers: FDM ,TDM ,Classification of Multiplexers ,T1 Carrier System	**10 Hours**	

Course outcomes: On completion of the course the student will

CO 1: have Knowledge Of different modulation techniques, analog and digital modulation and demodulation, different wave form code techniques and spread spectrum

CO 2: understand the concept of generation modulated and demodulated signals, encoding and decoding techniques multiplexing and demultiplexing of signals

Graduate Attributes (as per NBA):

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. Communication Systems, Simon Haykins, 3rd Edition, John Willey, 1996.
2. An Introduction to Analog and Digital Communication, Simon Haykins, John Wiley, 2003
3. Digital communications, Simon Haykin, John Wiley, 2003.

Reference Books:

1. Modern digital and analog Communication systems B. P. Lathi, 3rd ed 2005 Oxford University press.
2. Communication Systems, Harold P.E, Stern Samy and A Mahmond, Pearson Edn, 2004.
3. Communication Systems: Singh and Sapre: Analog and
4. Digital and analog communication systems & An introduction to Analog and Digital Communication, K. Sam Shanmugam, John Wiley, 1996. 2.Simon Haykin, John Wiley, 2005

PRODUCT DESIGN & DEVELOPMENT

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

SEMESTER – VIII

Subject Code	**15MT831**	IA Marks	20
Number ofLecture Hours/Week	03	Exam Marks	80
Total Number of Lecture Hours	40	Exam Hours	03

CREDITS – 03

Course objectives: Students will be able to

1. gain knowledge of Product life-cycle , Product design process, Product analysis
2. understand the value engineering, product design tools and Reverse Engineering

Modules	**Hours Teaching**	**RevisedBloom's Taxonomy(RBT) Level**
Module -1		
·**Product life-cycle:** Product policy of an organization. Selection of a profitable product, Product design process, Product analysis.	**8 Hours**	
Module -2		
· **Value engineering in product design:** Advantages, Applications in product design, Problem identification and selection, Analysis of functions, Anatomy of function. Primary versus secondary versus tertiary/unnecessary functions, Functional analysis: Functional Analysis System Technique (FAST), Case studies.	**8 Hours**	
Module -3		
Introduction to product design tools: QFD, Computer Aided Design, Robust design, DFX, DFM, DFA, Ergonomics in product design	**8 Hours**	
Module -4		
Product design for manual assembly: Design guidelines for metallic and non metallic products to be manufactured by different processes such as casting, machining, injection molding etc., Rapid prototyping, needs, advantages,	**8 Hours**	
Module -5		
Reverse engineering: Functionality- dimensional- developing technical data - digitizing techniques - construction of surface model - solid-part material-characteristics evaluation -software and application prototyping – verification	**8 Hours**	

Course outcomes:

On completion of course students will

CO1: have knowledge of Product life-cycle , Product design process, Product analysis .

CO2: understand the value engineering, product design tools and Reverse Engineering

Graduate Attributes (as per NBA):

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. **Product Design** and **Development** by Karl T. Ulrich and Steven D. Eppinger (McGraw-Hill 1995, 2000, 2004, 2008)
2. Reverse Engineering, Katheryn, A. Ingle, McGraw-Hill, 1994

Reference Books:

1. "**Engineering Design**", George E.Dieter, Linda C.Schmidt, McGraw-Hill International Edition, 4th Edition, 2009, ISBN 978-007-127189-9

2. "**Product Design and Development** ", Anita Goyal, Karl T Ulrich, Steven D Eppinger, 4th Edition, 2009, Tata McGraw-Hill Education, ISBN-10-007-14679-9

3. "**Product Design**", Kevin Otto, Kristin Wood, Indian Reprint 2004, Pearson Education,ISBN 9788177588217

4. "**Engineering Design Process**", Yousef Haik, T. M. M. Shahin, 2nd Edition Reprint, Cengage Learning, 2010, ISBN 0495668141

5. "**Engineering Design: A Project-based Introduction**", Clive L.Dym, Patrick Little, 3rd Edition, John Wiley & Sons, 2009, ISBN 978-0-470-22596-7

ANALOG AND DIGITAL ELECTRONICS LAB

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

Subject Code	15MTL38	IA Marks	20
Hours/Week	03	Exam Marks	80
Total Number of Lecture Hours	-	Exam Hours	03

CREDITS – 02

Course objectives:

1) Is to understand the characteristics and working of analog and digital components.
2) Is to design and develop analog and digital applications

Laboratory Experiments:	**Revised Bloom's Taxonomy (RBT) Level**
1. Clipper circuits and Clamper circuits using diodes. 2. Single stage RC coupled amplifier using BJT and its frequency respons. 3. Invering Amplifier, Non inverting Amplifier, voltage Follower using Opamp. 4. Astable and Monostable multivibrator using timer 555. 5. RC phase shift Oscillator using BJT. 6. Simplification and realization of Boolean expression using logic gates/ universal gates. 7. Half adder and Full Adder using logic gates. 8. Decoder and Encoders 9. Multiplexers and demultiplexers. 10. Design and development of counters.	

Course outcomes:

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

CONTROL SYSTEMS

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

Subject Code	15MT34	IA Marks	20
Number ofLecture Hours/Week	04	Exam Marks	80
Total Number of Lecture Hours	50	Exam Hours	03

CREDITS – 04

Course objectives:
The main objective of this course is to teach the fundamental concepts of Control systems, mathematical modeling of the system and to study the concept of time response and frequency response of the system and teach the basics of stability analysis of the system.

Modules	Hours Teaching	RevisedBloom'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**	
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**	
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. Construction of root loci. Stability analysis using Root locus Technique Numerical problems on all topics.	**10 Hours**	
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	**10 Hours**	

analysis using Polar plot. Numerical problems on all		
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 Nonhomogeneous state equations. Properties of state transition matrix, computation of state transition matrix by matrix exponential and Laplace transform method. Numerical problems	**10 Hours**	

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):

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

Syllabus of mapped course

VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELGAUM

SYLLABUS FOR 2015 -2019

ENGINEERING MATHEMATICS-III

(Common to all Branches)

Course Title: Engineering Mathematics - III	**Course Code : 15MAT31**
Credits: 04	**L-T-P : 4-0-0**
Contact Hours/Week : 04	**Total Hours: 50**
Exam. Marks : 80	**IA Marks : 20**
Exam. Hours : 03	

Course Objectives:

The objectives of this course is to introduce students to the mostly used analytical and numerical methods in the different engineering fields by making them to learn Fourier series, Fourier transforms and Z-transforms, statistical methods, numerical methods to solve algebraic and transcendental equations, vector integration and calculus of variations.

MODULE	RBT Levels	No. of Hrs
MODULE-I **Fourier Series:** Periodic functions, Dirichlet's condition, Fourier Series of periodic functions with period 2π and with arbitrary period $2c$. Fourier series of even and odd functions. Half range Fourier Series, practical harmonic analysis-Illustrative examples from engineering field.	L1, L2 & L4	10
MODULE-II **Fourier Transforms:** Infinite Fourier transforms, Fourier sine and cosine transforms. Inverse Fourier transform. **Z-transform:** Difference equations, basic definition, z-transform-definition, Standard z-transforms, Damping rule, Shifting rule, Initial value and final value theorems (without proof) and problems, Inverse z-transform. Applications of z-transforms to solve difference equations.	L2, L3 & L4	10
MODULE- III **Statistical Methods:** Review of measures of central tendency and dispersion. Correlation-Karl Pearson's coefficient of correlation-problems. Regression analysis- lines of regression (without proof) –problems **Curve Fitting:** Curve fitting by the method of least squares- fitting of the curves of the form, $y = ax + b$, $y = ax^2 + bx + c$ *and* $y = ae^{bx}$. **Numerical Methods:** Numerical solution of algebraic and transcendental equations by Regula- Falsi Method and Newton-Raphson method.	L3	10
MODULE-IV **Finite differences:** Forward and backward differences, Newton's forward and backward interpolation formulae. Divided differences- Newton's divided difference formula. Lagrange's interpolation formula and inverse interpolation formula (all formulae without proof)-Problems. **Numerical integration:** : Simpson's $(1/3)^{rd}$ and $(3/8)^{th}$ rules, Weddle's rule (without proof) –Problems.	L3	10
MODULE-V **Vector integration:** Line integrals-definition and problems, surface and volume integrals-definition, Green's theorem in a plane, Stokes and Gauss-divergence theorem(without proof) and problems. **Calculus of Variations:** Variation of function and Functional, variational problems. Euler's equation, Geodesics, hanging chain, problems.	L3 & L4 L2 & L4	10

Course Outcomes: On completion of this course, students are able to:

1. Know the use of periodic signals and Fourier series to analyze circuits and system communications.
2. Explain the general linear system theory for continuous-time signals and digital signal processing using the Fourier Transforms and z-transform.
3. Employ appropriate numerical methods to solve algebraic and transcendental equations.
4. Apply Green's Theorem, Divergence Theorem and Stokes' theorem in various applications in the field of electro-magnetic and gravitational fields and fluid flow problems.
5. Determine the extremals of functionals and solve the simple problems of the calculus of variations.

Question paper pattern:

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

Graduate Attributes (as per NBA)

1. Engineering Knowledge
2. Problem Analysis
3. Life-Long Learning
4. Accomplishment of Complex Problems

Text Books:

1. *B.S. Grewal: Higher Engineering Mathematics, Khanna Publishers, 43rd Ed., 2015.*
2. *E. Kreyszig: Advanced Engineering Mathematics, John Wiley & Sons, 10th Ed., 2015.*

Reference books:

1. *N.P.Bali and Manish Goyal: A Text Book of Engineering Mathematics, Laxmi Publishers, 7th Ed., 2010.*
2. *B.V.Ramana: "Higher Engineering Mathematics" Tata McGraw-Hill, 2006.*
3. *H. K. Dass and Er. RajnishVerma: "Higher Engineering Mathematics", S. Chand publishing, 1st edition, 2011.*

Web links and Video Lectures:

1. http://nptel.ac.in/courses.php?disciplineID=111
2. http://www.khanacademy.org/
3. http://www.class-central.com/subject/math

MATERIAL SCIENCE AND TECHNOLOGY

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

Subject Code	15MT32	IA Marks	20
Number of Lecture Hours/Week	04	Exam Marks	80
Total Number of Lecture Hours	50	Exam Hours	03

CREDITS – 04

Course objectives:

To gain an understanding of the relationships between the structures, properties, processing and applications of various engineering materials.

Modules	**Hours Teaching**	**Revised Bloom's Taxonomy (RBT) Level**
Module -1		
Mechanical Behavior : Stress- Strain diagram showing ductile and brittle behavior of materials, Liner and non-linear elastic behavior and properties, mechanical Properties in plastic range, Yield strength offset yield strength, ductility, ultimate tensile strength, toughness plastic deformation of single crystal by slip and twinning. Atomic diffusion, flick's laws of Diffusion, Factors attaching the Diffusion **Fracture:** Types, creep: Description of the phenomenon with examples, 3 stages of creep properties, stress relaxation fatigue: types of fatigue lauding with examples, Mechanism of fatigue, Fatigue properties, Fatigue testing and S-N diagram.	**10 Hours**	
Module -2		
Heat Treating of metals: TTT curves, Continuous cooling curves, Annealing and its types, Normalizing, Hardening, Tempering, Martempering, Austemparing, hardenability, Surface hardening methods like Carburizing, Cyaniding Nitriding, flame hardening and induction hardening, age hardening of aluminum and copper	**10 Hours**	

alloys. **Ferrous and non ferrous materials:** Properties composition and use of grey cush iron, malleable iron, SG iron and steel. Copper alloys- brasses and bronzes, aluminum alloys Al-Cu, Al-Si, Al-Zn alloys.		
Module -3		
Solidification and phase diagram: Mechanism of solidification, Homogenous and Heterogeneous nucleation. Cristal Growth, Cast metal strictures, Phase diagram. Solid solutions Substitution and Interstitial solid solution, Hume rothary rule, Intermediate phase, construction of equilibrium diagram involving complete and partial solubility, lever rule, Gibb's phase rule.	**10 Hours**	
Module -4		
Composite materials: Definition, classification, type of matrix materials and reinforcements, advantages and application of composites**.** **Processing of FRP Composites:** Layup and curing, fabricating process, open and closed mould process, hand layup technique; structural laminate bag molding, production procedures for bag molding; filament winding, pultrusion, pulforming, thermo-forming, injection molding, blow molding. **Metal Matrix Composites:** Reinforcement materials, types, characteristics and selection, base metals selection. Need for MMC's and its application.	**10 Hours**	
Module -5		
Smart Materials: Piezoelectric Materials, Electrostrictive Materials, Magnetostrictive Materials, Magnetoelectric Materials. Magnetorheological Fluids, Electrorheological Fluids, Shape Memory Materials, Fiber-Optic Sensors. Smart Sensor, Actuator and Transducer Technologies: Smart Sensors: Accelerometers; Force Sensors; Load Cells; Torque Sensors; Pressure Sensors; Microphones; Impact Hammers	**10 Hours**	
Course outcomes: At the end of the course, the students will be able to: · Appreciate the necessity of engineering materials, Smart Sensors and its applications in various fields. · Identify possible cause of failure due to fatigue and Creep. · Demonstrate the knowledge of nucleation, Crystal growth, Solid solution and Phase diagrams. . Appreciate the significance and applications of Various heat treatment processes. · Explain the definition and classification and fabrication processes of composite materials.		
Graduate Attributes (as per NBA):		

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. Materials Science and Engineering,William D. Callister Jr., John Wiley & Sons. Inc, 5th Edition, 2001.
2. Mechanics of Composite Materials, Second Edition, Autar K. Kaw, CRC Press, 2005.
3. Smart Materials and Structures - M. V. Gandhi and B. So Thompson - Chapman & Hall, London; New York - 1992 (ISBN: 0412370107).
4. Materials Science and Engineering,William D. Callister Jr., John Wiley & Sons. Inc, 5th Edition, 2001
5. Materials Science, Shackleford.,& M. K. Muralidhara, Pearson Publication – 2007.
6. "Material Science & Metallurgy For Engineers", Dr. V.D. Kodgire& S. V. Kodgire, Everest Publication.
7. "Mechanical Behavior & Testing Of Materials", A. K. Bhargava, C.P. Sharma.P H I Learning Private Ltd.

Reference Books:

1. An Introduction to Metallurgy; Alan Cottrell, Universities Press India Oriental Longman Pvt. Ltd., 1974.
2. Engineering Materials Science, W.C.Richards, PHI, 1965
3. Physical Metallurgy; Lakhtin, Mir Publications
4. Materials Science and Engineering, V.Raghavan,PHI, 2002
5. Elements of Materials Science and Engineering, H. VanVlack, Addison- Wesley Edn., 1998
6. Materials Science and Engineering,William D. Callister Jr., John Wiley & Sons. Inc, 5th Edition, 2001.
7. The Science and Engineering of Materials, Donald R. Askland and Pradeep.P. Phule, Cengage Learning, 4th Ed., 2003

MECHANICS OF MATERIALS

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

Subject Code	15MT33	IA Marks	20
Number of Lecture Hours/Week	04	Exam Marks	80
Total Number of Lecture Hours	50	Exam Hours	03

CREDITS – 04

Course objectives:

This course is designed to introduce basic principles of statics for deformable bodies. The main objective is to help the students develop an intuition for equilibrium, properly constrained systems, and deformation under external loadings. It is also anticipated that the theory and design approach for the mechanics of deformable bodies will help prepare the students for complex systems that will be encountered in advanced design courses.

Modules	**Hours Teaching**	**Revised Bloom's Taxonomy (RBT) Level**
Module -1		
Simple Stress and Strain: Introduction, Concept of Stress and Strain, Linear elasticity, Hooke's Law and Poisson's ratio. Extension / Shortening of a bar, bars with varying cross sections (step and tapering circular and rectangular), Elongation due to self weight, Principle of super position, St. Venant's Principle. **Simple shear stress and Shear strain. Volumetric strain**: expression for volumetric strain, Elastic Constants and relations. Stresses in Composite Section and temperature stresses (No numerical).	**10 Hours**	

Module -2		
Compound Stresses: Introduction, Concept of Plane stress, Stress tensor for plane stress, stresses on inclined sections, principal stresses and maximum shear stresses, Mohr's circle for plane stress. **Thick and Thin Cylinder** Stresses in thin cylinders, changes in dimensions of cylinder (diameter, length and volume). Thick cylinders Lame's equation (compound cylinders not included).	**10 Hours**	
Module -3		
Bending Moment and Shear Force in Beams: Introduction, Sign conventions, relationship between shear force and bending moments. Shear force and bending moment diagrams for Cantilever, simply supported and overhanging beams subjected to concentrated loads, uniformly distributed load (UDL), uniformly varying load (UVL) and couple, simple numerical.	**10 Hours**	
Module -4		
Bending and Shear Stresses in Beams: Introduction, Theory of simple bending, assumptions in simple bending. General equation for bending. Moment carrying capacity of a section. Shearing stresses in beams, shear stress across rectangular, symmetrical I and T sections. (Composite / notched beams not included). **Deflection of Beams**: Introduction, Differential equation for deflection. Equations for deflection, slope and bending moment. Double integration method for cantilever and Macaulay's method for simply supported beams for point load, UDL and Couple. (Simple Numericals)	**10 Hours**	
Module -5		
Torsion of Circular Shafts: Introduction. Pure torsion, assumptions, derivation of torsional equations, polar modulus, torsional rigidity / stiffness of shafts. Power transmitted by solid and hollow circular shafts. **Elastic Stability of Columns:** Euler's theory for axially loaded elastic long columns. Derivation of Euler's load for various end conditions, limitations of Euler's theory, Rankine's formula.	**10 Hours**	

Course outcomes: At the end of the course, the student will be able to: CO1: Analyze the normal stresses and strains for axially loaded members using Hooke's law CO2: Enumerate principal stresses and shear stresses for simple two dimensional loadings CO3: Elucidate the stresses and strains in thick and thin cylindrical pressure vessels. CO4: Perform analysis of beams for static loading. CO5: Design torsional shafts and structural columns		
Graduate Attributes (as per NBA):		
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. **"Mechanics of Materials",** by R.C.Hibbeler, Prentice Hall. Pearson Edu., 2011. 2. **"Mechanics of materials",** James.M.Gere, Thomson, Eighth edition2013. 3. **"Mechanics of materials",** in SI Units, Ferdinand Beer & Russell Johston, 5th Ed., TATA McGraw Hill-2003. 4. **"Mechanics of Materials",** K.V. Rao, G.C. Raju, Subhash Publication, Fourth Edition, 2013		
Reference Books: 1. **"Strength of Materials",** S.S. Rattan, Tata McGraw Hill, 2009. 2. **"Strength of Materials",** S.S.Bhavikatti, Vikas publications House -1 Pvt. Ltd., 2nd Ed., 2006. 3. **"Engineering Mechanics of Solids**", Egor.P. Popov, Pearson Edu. India, 2nd, Edition, 1998. 4. **"Strength of Materials",** W.A. Nash, 5th Ed., Schaum's Outline Series, Fourth Edition-2007.		

ANALOG & DIGITAL ELECTRONICS

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

Subject Code	15MT35	IA Marks	20
Number of Lecture Hours/Week	04	Exam Marks	80
Total Number of Lecture Hours	50	Exam Hours	03

CREDITS – 04

Course objectives:

The main objective of this course is to make students understand the basic analog and digital electronics, including semiconductor properties, operational amplifiers, combinational and sequential logic and analog-to-digital digital-to-analog conversion techniques. Finally, students will gain experience in with the design of analog amplifiers, power supplies and logic devices.

Modules	**Hours Teaching**	**Revised Bloom's Taxonomy (RBT) Level**
Module -1		
Diode Applications : PN junction Diode, VI-Characteristics, Junction diode Models, Junction Diode as switch, Diode specifications, Circuit applications of diodes, Smoothing circuits, Zener diode voltage Regulators.	**10 Hours**	
Module -2		
Op-Amp active filters and oscillators : Active filters, I & II order low pass filter, I and II order high pass filters, wide Band pass and Band reject filter, phase shift oscillator, wein bridge oscillator.	**10 Hours**	
Module -3		
Comparators and 555 timers: Basic compartors, zero crossing detector, schimitt trigger, the 555 timers, monostable multivibrator, astable multivibrator, applications of astable multivibrator.	**10 Hours**	

Module -4		
Logic families: Digital circuits, basic logic operations, the NOR & NAND logic gates, other IC logic gates, logic gates characteristics, the TTL logic, CMOS logic family, emitter coupled logic. **Sequential circuits:** RS latch, Flip flops, JK flip flop, digital registers, binary and decade counters, read and write memories.	**10 Hours**	
Module -5		
Combinational circuits: multiplexers, demultiplixers, encoders, decoders, adders **Analog – Digital Converters:** Quantization of analog signals, DAC, ADC, digital instrumentation System.	**10 Hours**	

Course outcomes:

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

1. Analyze the Importance & Applications of Diode as Rectifiers, Filters, Zener Diode Regulators & Switching Circuits.
2. With the Knowledge of Active Filters & Oscillators students can better understand the Real-time Communication Systems.
3. Students are prepared to Understand, Analyze & Design Various Analog Electronics circuits if recruited to Analog Electronics Industry.
4. Students are prepared to Understand, Analyze & Design Digital Circuits, if interested to work in VLSI Industry.

Graduate Attributes (as per NBA):

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. "Electronic Circuits and systems- analog and digita l", Y.N Bapat 1992 edition, Tata Mc GrawHill.
2. "Opamp and Linear Integrated Circuits", Ramakant A Gayakwad 3rd edition, PHI.
3. "Digital Logic and Computer Design", M Morris Mano, 2001 ledition, PHI.

Reference Books:

1. "Digital Electronics: Principles and Integrated cir cuits", Anil K Maini, 2008, wiley India.
2. "Linear Integrated Circuits", D. Roy Choudhury and Shail B Jain, 2nd edition, Reprint 2006, New Age International.
3. "Digital Principles and applications", Malvino & Leach, Tata Mc. Graw Hill.

Computer Organization [As per Choice Based Credit System (CBCS) scheme] SEMESTER – III			
Subject Code	15MT36	IA Marks	20
Number of LectureHours/Week	04	Exam Marks	80
Total Number of Lecture Hours	50	Exam Hours	03

CREDITS – 04

Course objectives:

This course enables students to:

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

Modules	**Hours Teaching**	**Revised Bloom'sTaxonomy(RBT)Level**
Module -1		

Basic Structure of Computers: Computer Types, Functional Units, Basic Operational Concepts, Bus Structures, Software, Performance – Processor Clock, Basic Performance Equation. **Machine Instructions and Programs:** Numbers, Arithmetic Operations and Characters, Memory Location and Addresses, Memory Operations, Instructions and Instruction Sequencing.	**10 Hours**	
Module -2		
Machine Instructions and Programs (Continued): Addressing Modes, Assembly Language, Basic Input and Output Operations, Stacks and Queues, Subroutines, Additional Instructions. IEEE standard for Floating point Numbers (6.7.1 of Chapter 6)	**10 Hours**	
Module -3		
Input/output Organization: Accessing I/O Devices, Interrupts, Direct Memory Access, Busses, Interface Circuits, Standard I/O Devices.	**10 Hours**	
Module -4		
Memory System: Some Basic Concepts, Semiconductor RAM Memories, Read Only Memories, Cache Memories, Performance Considerations, and Virtual Memories.	**10 Hours**	
Module -5		
Basic Processing Unit: Some Fundamental Concepts, Execution of a Complete Instruction, Multiple Bus Organization, Microprogrammed Control, Hardwired Control.		
Course outcomes: After studying this course, students will be able to: 1. Understand the basic structure of computer and machine instructions. 2. Understand the interfacing concepts. 3. Understand the concepts of memory system.		
Graduate Attributes (as per NBA):		
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. Carl Hamacher, Zvonko Vranesic, Safwat Zaky, "Computer Organization", McGraw Hill, 5th Edition, 2015, ISBN:9781259005275.

Reference Books:

1. David A. Patterson, John L. Hennessy, "Computer Organization and Design – The Hardware / Software Interface ARM", Elsevier.

2. William Stallings, "Computer Organization & Architecture", Pearson.

3. Vincent P. Heuring & Harry F. Jordan, "Computer Systems Design and Architecture", Pearson.

MECHANICAL LAB-01

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

Subject Code	15MTL37	IA Marks	20
Hours/Week	03	Exam Marks	80
Total Number of Lecture Hours	-	Exam Hours	03

CREDITS – 02

Course objectives:

- Understand the characteristics and behavior of Engineering materials used for engineering applications.
- To provide training to students to enrich their practical skills.

Laboratory Experiments:	**Revised Bloom's Taxonomy (RBT)Level**
Part-A	
1. Tensile, shear and compression tests of metallic specimens using Universal Testing machine. 2. Torsion Test. 3. Bending Test on Non metallic specimens. 4. Izod and Charpy tests on M.S Specimen. 5. Brinell and rockwelll hardness test.	
Part-B	
1. Preparation of two models on lathe involving Plain turning, Taper turning, Step turning, Thread cutting, Facing, Knurling. 2. Demonstration on cutting the V Groove using a shaper and cutting a gear teeth using Milling Machine.(Not for Examination)	

Course outcomes:

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

1. Demonstrate the knowledge & skill to conduct and analysis the result with respect to Hardness testing, and different loads.
2. Demonstrate the various skills of Turning Facing, Knurling and Thread cutting using lathe.
3.

Graduate Attributes (as per NBA):

Scheme of Examination:

One Question From Part – A : **30marks**
One Question From Part - B : **40 Marks**
Viva- Voice : **10 Marks**
Total : **80 Marks**

MICRO CONTROLLER LAB

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

Subject Code	15MTL48	IA Marks	20
Hours/Week	03	Exam Marks	80
Total Number of Lecture Hours	-	Exam Hours	03

CREDITS – 02

Course objectives:

- To study assembly language programming in 8051
- To study interfacing of various peripherals using 8051
- To design and develop applications using 8051

Laboratory Experiments:	**Revised Bloom's Taxonomy (RBT)Level**
Part-A	
1. Data Transfer - Block move, Exchange, Sorting, Finding largest element in an array. 2. Arithmetic Instructions - Addition/subtraction, multiplication and division, square, Cube (16 bits Arithmetic operations – bit addressable). 3. Counters. 4. Boolean & Logical Instructions (Bit manipulations). 5. Conditional CALL & RETURN. 6. Code conversion: BCD – ASCII; ASCII – BCD, ASCII -Decimal; Decimal - ASCII; HEX - Decimal and decimal - HEX. 7. Programs to generate delay, Programs using serial port and on-Chip timer / counter.	
Part-B	
1. Write C programs to interface 8051 chip to Interfacing modules to develop single chip solutions. 2. Simple Calculator using 6 digit seven segment display and Hex Keyboard interface to 8051. 3. Interfacing of 8051 to LCD . 4. External ADC and Temperature control interface to 8051.	

5. Generate different waveforms Sine, Square, Triangular, Ramp etc. using DAC interface to 8051; change the frequency and amplitude. 6. Stepper and DC motor control interface to 8051.	

Course outcomes:

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

1. Build application on 8051 using assembly/ C language.
2. Interface between external peripherals to 8051 using C programming.

Graduate Attributes (as per NBA):

Scheme of Examination:

One Question From Part – A : **35marks**
One Question From Part - B : **35 Marks**
Viva- Voice : **10 Marks**
Total : **80 Marks**

THEORY OF MACHINES [As per Choice Based Credit System (CBCS) scheme] SEMESTER – IV			
Subject Code	15MT45	IA Marks	20
Number of Lecture Hours/Week	04	Exam Marks	80
Total Number of Lecture Hours	50	Exam Hours	03

CREDITS – 04

Course objectives:

The course has been designed to introduce the basic concepts of kinematics and dynamics associated with machine elements. The students will understand the constructional and working features of mechanisms and machines.

Modules	**Hours Teaching**	**RevisedBloom'sTaxonomy(RBT) Level**
Module -1		
Introduction: Definitions Link or element, Kinematic pairs, Degrees of freedom, Grubler's criterion (without derivation), Kinematic chain, Mechanism, Structure, Mobility of Mechanisms (with problems), Inversion, Machine. Inversion of single slider and four bar mechanisms. Intermittent Motion - Geneva wheel mechanism and Ratchet and Pawl mechanism. **Velocity and Acceleration Analysis of Mechanisms:** Velocity and acceleration analysis of four bar mechanism and slider crank mechanism by Graphical method (Relative velocity and acceleration method), Simple Problems. Introduction to Instantaneous centres method (no numericals).	**10 Hours**	
Module -2		
Gears and Gear Trains: Gear terminology, law of gearing, Path of contact Arc of contact, Contact ratio of spur gears. Simple gear trains, Compound gear trains for large speed. Reduction, Epicyclic gear trains. Tabular methods of finding velocity ratio of epicyclic gear trains.	**10 Hours**	
Module -3		
Cams: Types of cams, Types of followers. Displacement, Velocity and, Acceleration time curve for cam profiles. Disc cam with reciprocating follower having knife-edge, roller follower, Disc cam with oscillating roller follower. Follower motions including SHM, Uniform acceleration and retardation and Cycloidal motion.	**10 Hours**	

Module -4		
Balancing of Rotating Masses: Static and dynamic balancing. Balancing of single rotating mass by balancing masses in same plane and in different planes.Balancing of several rotating masses by balancing masses in same plane and in different planes. **Belt Drivers: Belt Drives:** Flat Belt Drives, Ratio of Belt Tensions, Centrifugal Tension, power Transmitted.	**10 Hours**	
Module -5		
Gyroscope: Vectorial Representation of Angular Motion, Gyroscopic Couple. Effect of Gyroscopic Couple on Ship, Plane Disc, Aircraft, Stability of Two Wheelers. **Governors:** Types of governors; force analysis of Porter and Hartnell governors. Controlling force, stability, sensitiveness, isochronism, effort and power.		

Course Outcomes:

At the end of the course, the student will be able to:

1. Explain the concepts of mechanism, machines, and types of motion, and calculate the mobility of a mechanism.
2. Determine the positions, velocities and accelerations of links of simple mechanisms by using graphical approach.
3. Explain basic cam terminology, analyze various types of CAMS, and draw CAM profile diagrams.
4. Demonstrate the knowledge of various transmission mechanisms like gears and belts, and apply them for simple problems.
5. Appreciate the principles of Balancing, Governors, and Gyroscope, and their applications

Graduate Attributes (as per NBA):

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. Theory of Machines: Sadhu Singh, Pearson Education, 2nd edition, 2007.
2. Theory of Machines: Rattan S.S Tata McGraw Hill Publishing Company Ltd., New Delhi, 2nd Edition, 2006.

3. Theory of Machines, R. S. Khurmi, J. K. Gupta, Eurasia Publishing House, 2008 Revised Edition**.**

Reference Books:

1. Theory of Machines and Mechanisms, John Joseph Uicker, G. R. Pennock, Joseph Edward Shigley, Oxford University Press, 2003.

2. Theory of Machines and Mechanisms, Amitabha Ghosh and Mallick, East West Press, 3rd Edition 2006.

3. Theory of Machines, Thomas Bevan, CBS Publication 1984.

FLUID MECHANICS AND MACHINES

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

Subject Code	15MT42	IA Marks	20
Number of Lecture Hours/Week	04	Exam Marks	80
Total Number of Lecture Hours	50	Exam Hours	03

CREDITS – 04

Course objectives:

To introduce the students to the fundamentals of fluid mechanics and analytical formulation of fluid mechanics and turbomachine problems using first principles and principles of energy transfer.

Modules	**Hours Teaching**	**RevisedBloom'sTaxonomy(RBT) Level**
Module -1		
Physical properties of fluids: Introduction, Types of fluids, Properties of fluids, viscosity, surface tension, vapor pressure and cavitation. **Fluid pressure and its Measurement**: Intensity of pressure, Pascal's law, Hydrostatic law,atmospheric, gauge and vacuum pressures, Piezometer, U-tube and differential manometers. **Fluid Statics**: Total pressure and center of pressure on submerged plane surfaces; horizontal, vertical and inclined plane surfaces submerged in liquid.	**10 Hours**	
Module -2		
Fluid Kinematics: Types of fluid flow, continuity equation in 2D and 3D (Cartesian Co-ordinates only), velocity and acceleration, velocity potential function and stream function, problems. **Fluid Dynamics**: Introduction, Euler's equation of motion, Bernoulli's equation from first principles and also from Euler's equation, limitations of Bernoulli's equation, problems.	**10 Hours**	
Module -3		

Dimensional Analysis: Introduction, derived quantities, dimensions of physical quantities, dimensional homogeneity, Rayleigh's method, Buckingham's **π**-theorem, dimensionless numbers, similitude, types of similitudes. **Fluid Flow Measurements:** Venturimeter, orificemeter, pitot-tube, V-Notch and rectangular notches (Derivations Venturimeter and V-Notch only), Problems.	**10 Hours**	
Module -4		
Turbomachines: Definition of a Turbomachine, parts of a Turbomachine, Comparison with positive displacement machine; Classification. **Energy transfer in turbo machine:** Euler Turbine equation, alternate form of Euler turbine equation, components of energy transfer, Degree of reaction, general analysis of a Turbo machine – effect of blade discharge angle on energy transfer and degree of reaction.	**10 Hours**	
Module -5		
Hydraulic Turbines: Classification; Constructional features, Velocity triangles and Efficiencies of Pelton Turbine, Francis Turbine and Kaplan Turbine, and simple problems. Function of a Draft tube, types of draft tubes. **Steam Turbines:** Classification, Single stage impulse turbine - Condition for maximum blade efficiency, stage efficiency, Compounding, need for compounding, methods of compounding. Reaction turbine - Parson's reaction turbine, condition for maximum blade efficiency, reaction staging, simple problems.	**10 Hours**	
Course outcomes: At the end of the course, the student will be able to: · Appreciate the fluid mechanics fundamentals, including concepts of mass and energy conservation. · Apply the fundamentals to flow measurement problems. · Perform dimensional analysis for problems in fluid mechanics. . Appreciate the understanding of turbomachines and principles of energy transfer in turbomachines. · Apply the fundamentals for energy transfer problems in various turbomachines.		
Graduate Attributes (as per NBA):		
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. Fluid Mechanics, Oijush.K.Kundu, IRAM COCHEN, ELSEVIER, 3rd Ed. 2005.
2. Fluid Mechanics and Fluid Machines, Dr. Bansal, R.K.Lakshmi Publications, 2004.
3. Textbook of Turbomachines, M S Govinde Gowda, M M Publishers, 2011

Reference Books:

1. Fluid Mechanics and hydraulics, Dr.Jagadishlal: MetropolitanBook Co-Ltd., 1997.
2. Fluid Mechanics (SI Units), Yunus A. Cengel John M.Oimbala, 2ndEd., Tata McGraw Hill, 2006.
3. Fluid Mechanics, John F.Douglas, Janul and M.Gasiosek and john A.Swaffield, Pearson Education Asia, 5th ed., 2006
4. Fluid Mechanics and Fluid Power Engineering, Kumar.D.S, Kataria and Sons., 2004
5. Fluid Mechanics -. Merle C. Potter, Elaine P.Scott. Cengage learning.

INSTRUMENTATION AND MEASUREMENTS

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

Subject Code	15MT46	IA Marks	20
Number ofLecture Hours/Week	04	Exam Marks	80
Total Number of Lecture Hours	50	Exam Hours	03

CREDITS – 04

Course objectives:

- To provide the fundamental knowledge of transducers, instrumentation and measurement systems.
- To understand the functional elements of instrumentation/measurement systems.
- To impart the knowledge of static and dynamic characteristics of instruments, and understand the factors in selection of instruments for measurement.
- To discuss the principle, design and working of transducers for the measurement of displacement, level, strain, resistance capacitance inductance, pressure, sound and speed.

Modules	Hours Teaching	RevisedBloom's Taxonomy(RBT) Level
Module -1		
Classification and Functional Elements of Instrument/ measurement system: Measurement, significance of measurement, instruments and measurement systems, mechanical, electrical and electronic instruments, Deflection & Null type instruments and their comparison, Analog and digital modes of operation, functions of instruments and measurement systems, applications of measurement systems, Elements of generalized measurement system, Input-output configuration of measuring instruments and measurement systems, methods of correction for interfering and modifying inputs. Transducers, Classifications of transducers-primary & secondary, active & passive, analog and digital transducers.	**10 Hours**	
Module -2		
Static and Dynamic Characteristics: Static calibration and error calibration curve, accuracy and precision, indications of precision, static error, scale range and scale span, reproducibility and drift, repeatability, signal to noise ratio, sensitivity, linearity, hysteresis, threshold, dead zone and dead time, resolution, signal to noise ratio, factors influencing the choice of transducers/instruments. Dynamic response – dynamic characteristics, time domain analysis & different types of inputs, frequency domain analysis. Time domain response – zero order system, first order electrical system, response of a first order system to step & ramp input, Second order system, response of a second order system to step input, time domain specifications, frequency response of first and second order system.	**10 Hours**	
Module -3		
Measurement of Displacement: Introduction, Principles of Transduction, Variable resistance devices, variable Inductance Transducer, Variable Capacitance Transducer, Hall Effect Devices, Proximity Devices, Digital Transducer **Measurement of Level:** Capacitance probes, conductivity probes, differential pressure level detector, float level devices, optical level switches, radiation level sensor, ultrasonic level detector, thermal level sensors	**10 Hours**	

Module -4		
Measurement of Strain: Introduction, Factors affecting strain measurements, Types of Strain Gauges, Theory of operation of resistance strain gauges, Types of Electrical Strain Gauges – Wire gauges, unbounded strain gauges, foil gauges, semiconductor strain gauges (principle, types & list of characteristics only), Materials for Strain Gauges, Strain gauge Circuits – Wheatstone bride circuit, Applications. **Measurement of resistance, induction and capacitance:** Whetstone's bridge, Kelvin Bridge; ACbridges, Capacitance Comparison Bridge, Maxwell's bridge, wein's bridge, Wagners's earth connection.	**10 Hours**	
Module -5		
Transducers – I: Introduction, Electrical transducers, Selecting a transducer, Resistive transducers,Resistive position transducer, Strain gauges, Resistance thermometer, Thermistor, Inductive transducer,Differential output transducers **and** LVDT. **Transducers – II:** Piezoelectric transducer, Photoelectric transducer,Photovoltaic transducer, Semiconductor photo devices, Temperature transducers-RTD, Thermocouple(b) Display Devices: Digital display system, classification of display, Display devices, LEDs, LCD displays	**10 Hours**	

Course outcomes:

After studying this course, students will able to:

- Define the transducer, instrument, measurement and classify different types of transducers
- Explain the functional elements of instrumentation / measurement systems
- Discuss the input-output configuration of measurement systems
- Define, interpret and analyze the static and dynamic characteristics of instruments
- Explain the principle, design and analyze the transducers for the measurement of displacement, level, strain, force, torque, pressure, sound and speed

Graduate Attributes (as per NBA):

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. Electrical and Electronic Measurements and Instrumentation – A. K. Sawhney, 17th Edition (Reprint 2004), DhanpatRai& Co. Pvt. Ltd., 2004. (Module 1 & 2)
2. Instrumentation: Devices and Systems- C. S. Rangan, G. R. Sarma, V. S. V. Mani, 2nd Edition (32nd Reprint), McGraw Hill Education (India), 2014. (Module 3-Displacement measurement, Module 4,
3. Process Measurement Instrument Engineers Handbook- Bela G. Liptak, Revised Edition, Chilton Book Company, 1982. (Module 3 – Level measurement,)
4. "Electronics Instrumentation", H.S. Kalsi, TMH, 2004-Module5

Reference Books:

1. Transducers and Instrumentation – D.V.S.Murty, 2nd Edition, PHI, 2009.
2. Introduction to Measurements and Instrumentation - A. K. Ghosh, 2nd Edition, PHI, 2007.
3. Instrumentation Measurement and Analysis- B.C.Nakra and K.K.Choudhry, 3rd Edition, McGraw Hill Education (India) Pvt.Ltd. 2009.
4. Measurement Systems Application and Design- Ernest O.Doeblin and Dhanesh N Manik, 5th Edition, McGraw Hill, 2007

MANUFACTURING TECHNOLOGY [As per Choice Based Credit System (CBCS) scheme] SEMESTER – IV			
Subject Code	15MT44	IA Marks	20
Number of Lecture Hours/Week	04	Exam Marks	80
Total Number of Lecture Hours	50	Exam Hours	03

CREDITS – 04

Course objectives:

To introduce students to the fundamentals of modern manufacturing operations.

Modules	**Hours Teaching**	**RevisedBloom'sTaxonomy(RBT) Level**
Module -1		
Introduction to Manufacturing Process: Concept of Manufacturing process, its importance. Classification of Manufacturing processes. **Casting:**Introduction to Casting process &steps involved. Various components produced by casting process, Advantages & Limitations. **Patterns:** Definition and types. **Sand Moulding:** Binders and Additives: Definition, Need and Types.Types of base sand, requirements of base sand.Types of Sand Moulding.Cores: Definition, Need and Types. Concept of Gating & Risers**:** Principle and types. Introduction to Die Casting and injection moulding. .	**10 Hours**	
Module -2		
Introduction to metal working: Classification of metal working processes, characteristics of wrought products, advantages and limitations of metalworking processes. **Forging:** Classification, Forging machines & equipment. Die-design parameters. Forgingdefects, Residual stresses in forging, Applications of forging. **Rolling:** Classification, Types of rolling mills, Defects in rolled products. Rolling variables, Applications of Rolling. **Drawing:** Drawing equipment & dies,drawing variables, Tube drawing,classification of tube drawing, Applications	**10 Hours**	
Module -3		

Extrusion: Types of extrusion processes, extrusion equipment & dies,Extrusion ofseamless tubes, lubrication & defects in extrusion, Extrusion variables, Applications **Sheet & Metal Forming:** Forming methods dies & punches, progressivedie, compound die, combination die. Rubber forming. Open back inclinablepress (OBI press), piercing, blanking, bending, deep drawing, defects of drawn products, stretch forming, Roll bending & contouring, Applications. **Advanced Welding processes:** Classification, Advantages & limitations of welding. Metal Arc welding (MAW), Flux Shielded Metal Arc Welding (FSMAW), Inert Gas Welding (TIG & MIG) Submerged Arc Welding (SAW) and Atomic Hydrogen Welding processes (AHW), Resistance welding, Applications.	**10 Hours**	
Module -4		
Non-traditional Machining Processes: Need for non-traditional machining, Principle, equipment & operation of Laser Beam, Plasma Arc Machining, Electro Chemical Machining, Ultrasonic Machining, Abrasive Jet Machining, Water Jet Machining, Electron Beam Machining, Electron Discharge Machining and Plasma Arc Machining.	**10 Hours**	
Module -5		
Introducing to CNC machines: Basics of Turning tool Geometry, ATC, Programming methods. – Manual part programming, Milling, Turning, (Simple Programs), Computer Aided part programming (Simple problems, DNC, Types, Applications, Types of CNC Programming Software's, Over view CNC machining centers, Turning centre.	**10 Hours**	
Course outcomes: **At the end of this course students should be able to** 1. Understand the principles and techniques of casting, forging, rolling & drawing. 2. Apply the knowledge of metal working process. 3. To express the different techniques of joining process for metal & non metals. 4. Understanding and applying knowledge to execute CNC machining programs.		
Graduate Attributes (as per NBA):		
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. **Manufacturing Technology,** Serope Kalpakjain, Steuen.R.Sechmid, Pearson Education Asia, 5th Ed. 2006**.**
2. **Manufacturing Technology Vol 1&2,** PN Rao, Tata McGraw Hill, 2001
   NC Machine Programming and Software Design, ChnoHwachang**,** Michel. A. Melkanoff, Prentice Hall, 1989

Reference Books:

1. **Process and Materials of Manufacturing,** Roy A Lindberg, 4th Ed. Pearson Ed. 2006.
2. **Workshop technology,** Hazara Choudhry, Vol-I &II, Media Promoters & Publishers Pvt Ltd. 2004.
3. **Production technology,** HMT, Tata McGraw Hill, 2001.
4. **Manufacturing Science,** AmitabhGhosh and Mallik, affiliated East West press, 2003.
5. **Fundamentals of metal Machining and machine Tools,** G. Boothroyd, McGraw Hill. 2000.
6. **Automation Production system and Computer Integrated Manufacturing** Mikell. O. Grover, PHI, New Delhi, 2002.

MECHANICAL LAB - II

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

Subject Code	15MTL47	IA Marks	20
Hours/Week	03	Exam Marks	80
Total Number of Lecture Hours	-	Exam Hours	03

CREDITS – 02

Course objectives:

- To understand the flow measurement in a pipe flow.
- To Measure the discharge in a open channel flow.
- To study the characteristic of turbins.
- To understand the working principle of hydraulic components & hydraulic circuit.

Laboratory Experiments:	**Revised Bloom's Taxonomy (RBT) Level**
Part-A	
1. Calibration of flow measuring devices: a. Orifice Plate meter, b. Venturimeter, c. V-notch 2. Performance testing of Turbines a. Pelton wheel b. Francis Turbine c. Kaplan Turbine	
Part-B	
1. Speed Control Circuit on Hydraulic/Pneumatic Trainer 2. Sequencing Circuit on Hydraulic/Pneumatic Trainer 3. Regenerative Circuit on Hydraulic/Pneumatic Trainer 4. Synchronizing Circuit on Hydraulic/Pneumatic Trainer	

Course outcomes:

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

- Determine the co-efficient of discharge of flow measuring devices.
- Select the type of turbine required with reference to available head of water and discharge.
- Apply the working principle of impulse and reaction turbine.
- Design hydraulic circuit for various industrial applications.

Graduate Attributes (as per NBA):

Scheme of Examination:

One Question From Part – A : **35marks**
One Question From Part - B : **35 Marks**
Viva- Voice : **10 Marks**
Total : **80 Marks**

MICROCONTROLLER

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

Subject Code	15MT43	IA Marks	20
Number of Lecture Hours/Week	04	Exam Marks	80
Total Number of Lecture Hours	50	Exam Hours	03

CREDITS – 04

Course objectives:

This course trains the students to understand an in-depth operation of 8051 microcontrollers, machine language programming & interfacing techniques. The emphasis is on interfacing the controller to real-world devices such as switches, displays, motors, and A/D converters, through assembly language and C language programming.

Modules	**Hours Teaching**	**RevisedBloom'sTaxonomy(RBT) Level**
Module -1		
Microprocessors and microcontroller. Introduction, Microprocessors and Microcontrollers, A Microprocessors survey. RISC & CISC CPU Architectures, Harvard & Von-Neumann CPU architecture. The 8051 Architecture: Introduction, 8051 Microcontroller Hardware, Input / Output Pins, Ports and Circuits External Memory, Counter and Timers, Serial Data Input / Output, Interrupts.	**10 Hours**	
Module -2		
Addressing Modes and Operations: Introduction, Addressing modes, External data Moves, Code Memory, Read Only Data Moves / Indexed Addressing mode, PUSH and POP Opcodes, Data exchanges, Byte level logical Operations, Bit level Logical Operations, Rotate and Swap Operations, Arithmetic Operations: Flags, Incrementing and Decrementing, Addition, Subtraction, Multiplication and Division, Decimal Arithmetic. **Jump and Call Instructions:** The JUMP and CALL Program range, Jumps, calls and Subroutines, Interrupts and Returns.	**10 Hours**	
Module -3		
8051 programming in C and Timers: Data types and time delays in 8051C, I/O programming, logic operations, data conversion programs, data serialization. **Timer / Counter Programming in 8051**: Programming 8051 Timers, Counter Programming, programming timers 0 and 1 in 8051 C.	**10 Hours**	

Module -4		
8051 Serial Communication and Interrupts: Basics of Serial Communication, 8051 connections to RS-232, 8051 Serial communication Programming, Programming the second serial port, Serial port programming in C. Interrupts Programming,8051 Interrupts, Programming Timer Interrupts, Interrupt Priority in the 8051/52.	**10 Hours**	
Module -5		
UNIT 5: 8051 Interfacing and Applications: Hardware & Software (Assembly code / C code) Interfacing of 8051 to simple switches and LEDs, LCD, ADC, Stepper motor, DC motor, Temperature sensor, Wave form generation.	**10 Hours**	

Course outcomes: Student will be able to

1. Understand the difference between microprocessor and microcontroller, operation of Peripherals of controller, and be able to program a microcontroller system in assembly code and C.
2. Design and Develop a microcontroller based system.
3. Interface the system to switches, keypads, displays, A/D and D/A converters and build a microcontroller based Robot.

Graduate Attributes (as per NBA):

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. "The 8051 Microcontroller Architecture, Programm ing & Applications", 2e Kenneth J. Ayala ;, Penram International, 1996 / Thomson Learning 2005
2. "The 8051 Microcontroller and Embedded Systems – using assembly and C "-, Muhammad Ali Mazidi and Janice Gillespie Mazidi and Rollin D. McKinlay; PHI, 2006 / Pearson, 2006

Reference Books:

1. "Programming and Customizing the 8051 Microcontr oller" Predko ;–, TMH
2. Microcontrollers: Architecture, Programming, Interfacing and System Design",Raj Kamal, "Pearson Education, 2005

3. “Microcontrollers- Theory and Applications”, Aja y V.Deshmukh; TMH,2005

4. “Microcontroller and its applications”, Dr.Raman i Kalpathi and Ganesh Raja; Sanguine Technical publishers, Bangalore-2005.

MICRO & SMART SYSTEMS TECHNOLOGY LABORATORY

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

SEMESTER – V

Subject Code	**15MTL58**	**IA Marks**	**20**
Hours/Week	**03**	**Exam Marks**	**80**
Total Number of Lecture Hours	**-**	**Exam Hours**	**03**

CREDITS – 02

Course objectives: Students will be able to

- Analyse the behavior of Mechanical Components for various kinds of loads.
- Analyse the behavior of Pressure Sensor for various kinds of Pressures applied.

Laboratory Experiments:	**Revised Bloom's Taxonomy (RBT)Level**
PART – A 1. Static structural analysis a) 2 D Mechanical Components. b) 3 D Mechanical Components. 2. Piezoelectric analysis: cantilever beam **PART – B** 1. Pressure sensor experiment a) Raw pressure sensor b) compensated pressure sensor	

Course outcomes: On the completion of the course the student will:

- Understand, Analyze & gain ability to choose Materials for desired applications.
- Understand, Analyze & gain ability to choose Sensors for desired applications.

Graduate Attributes (as per NBA):
Scheme of Examinations:
One Question from Part A : 40 **Marks**
One Question from Part B : **30 Marks**
Viva-Voice : **10 Marks**
D TOTAL : 80 Marks

DESIGN OF MACHINE ELEMENTS
[As per Choice Based Credit System (CBCS) scheme]
SEMESTER – V

Subject Code	**15MT51**	**IA Marks**	**20**
Number of Lecture Hours/Week	**05**	**Exam Marks**	**80**
Total Number of Lecture Hours	**60**	**Exam Hours**	**03**

CREDITS – 04

Course Objective: Students will be able to

1. gain knowledge of theories of failures, stress concentration and machine elements.
2. understand the techniques in machine elements.
3. determine the parameters of machine elements subjected to various load condition.
4. design of various machine elements

Modules	**Hours Teaching**	**Revised Bloom's Taxonomy(RBT) Level**
Module -1		
Module - 1 **Introduction:** Machine design, classification of machine design, design consideration, Tri axial stresses, Stress Tensor. Codes and Standards. Factor of Safety, design procedure for simple and combined stresses (No Numerical). Introduction to Stress Concentration, Stress concentration Factor and its effects (Simple problems). **Introduction to Theories of failure:** Maximum Normal Stress Theory, Maximum Shear Stress Theory, Distortion Energy Theory.	**12 Hours**	
Module -2		
Design of Keys, Couplings and Joints: Keys: Types of keys, Design of keys, Design of Couplings: Flange coupling, Bush and Pin type coupling. Design of cotter and knuckle joint. **Power Screws**: Stresses in Power Screws, Efficiency and Self-locking, Design of Power Screw, Design of Screw Jack.	**12 Hours**	
Module -3		
Design of Shafts: Design for strength and Rigidity with Steady loading, ASME & BIS codes for Power Transmission shafting, Shafts under Fluctuating loads and combined loads.	**12 Hours**	

Module -4		
Design of Spur Gears: Beam strength of spur gear, Stresses in gear teeth (Lewis equation), dynamic tooth load, design for wear **Design of helical gears:** Beam strength of helical gear, Stresses in gear teeth (Lewis equation), dynamic tooth load, design for wear.	**12 Hours**	
Module -5		
Design of Journal Bearings: Types of bearings, bearing characteristic number, coefficient of friction, minimum oil film thickness, Heat Generated, Heat dissipated, Bearing Materials. **Design of springs**: Types of springs - stresses in Helical coil springs of circular cross sections. Tension and compression springs only.	**12 Hours**	

Course Outcomes: On completion of the course the student will

1. have knowledge of theories of failures, stress concentration, power screws, shafts, keys, couplings, gears, bearings and springs.
2. understand the technique of theories of failure, stress concentration, fatigue strength etc.
3. calculate the stresses, parameters of machine elements subjected to various loads also make proper assumptions with respect to material, FOS for various machine components.
4. design machine elements like power screws, shafts, keys, couplings, gears, bearings ad springs

Graduate Attributes (as per NBA):

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. Mechanical Engineering Design, Joseph E Shigley and Charles R. Mischke. McGraw Hill International edition, 6th Edition 2009.
2. Design of Machine Elements, V.B. Bhandari, Tata McGrawHill Publishing Company Ltd., New Delhi, 3rd Edition 2010.
3. Machine Design, by Dr. P C Sharma and Dr. D K Aggarwal, S. K. Kataria& Sons, 11th Edition 2009.

DESIGN DATA HANDBOOK:

1. Design Data Hand Book, K. Lingaiah, McGraw Hill, 2nd Edition.
2. Data Hand Book, K. Mahadevan and Balaveera Reddy, CBSPublication.
3. Design Data Hand Book, H.G. Patil, I. K. International Publisher, 2010.

Reference Books:

1. Machine Design, Robert L. Norton, Pearson Education Asia, 2001.
2. Design of Machine Elements, M. F. Spotts, T. E. Shoup, L. E. Hornberger, S. R. Jayram and C. V. Venkatesh, Pearson Education,2006.
3. Machine Design, Hall, Holowenko, Laughlin (Schaum's Outlines series) Adapted by S.K. Somani, Tata McGraw Hill Publishing Company Ltd., New Delhi, Special Indian Edition, 2008.

Virtual Instrumentation

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

Subject Code	**15MT52**	**IA Marks**	**20**
Number of Lecture Hours/Week	**04**	**Exam Marks**	**80**
Total Number of Lecture Hours	**50**	**Exam Hours**	**03**

CREDITS – 04

Course objectives: Students will be able to

- gain knowledge to learn the concepts of developing basic skills necessary for importance Virtual Instrumentation and Lab View
- understand the basic programming concepts and various Operation using DAQ Devices used in Virtual Instrumentation and Lab View.
- diagnosis the problem related types of I/O module, Data Acquisition System and Communication Networks (Bus Systems) using Standard Protocol

Modules	**Hours Teaching**	**Revised Bloom's Taxonomy(RBT) Level**
Module -1		
CONCEPT OF VIRTUAL INSTRUMENTATION – Historical perspective – Need of VI – Advantages of VI – Define VI – Block diagram & Architecture of VI – Data flow techniques – Graphical programming in data flow – Comparison with conventional programming.PC based data acquisition – Typical on board DAQ card – Resolution and sampling frequency - Multiplexing of analog inputs – Single-ended and differential inputs – Different strategies for sampling of multi-channel analog inputs. Concept of universal DAQ card	**10 Hours**	
Module -2		
DATA ACQUISITION BASICS: Introduction to data acquisition on PC, Sampling fundamentals, Input/Output techniques and buses. ADC, DAC, Digital I/O, counters and timers, DMA, Software and hardware installation, Calibration, Resolution, Data acquisition interface requirements.	**10 Hours**	
Module -3		
GRAPHICAL PROGRAMMING ENVIRONMENT IN VI Concepts of graphical programming – Lab-view software – Concept of VIs and sub VI ,Loops(While Loop and For Loop) , Structures(Case, Formula node, and sequence structures) Arrays Operations, Strings Operations, and file I/O. Examples on each.	**10 Hours**	
Module -4		

CLUSTER OF INSTRUMENTS IN VI SYSTEM Interfacing of external instruments to a PC – RS232, RS 422, RS 485 and USB standards - IEEE 488 standard – ISO-OSI model for serial bus – Introduction to bus protocols of MOD bus and CAN bus.	**10 Hours**	
Module -5		
USE OF ANALYSIS TOOLS AND APPLICATION OF VI Fourier transform - Power spectrum - Correlation – Windowing and filtering tools – Simple temperature indicator – ON/OFF controller – P-I-D controller - CRO emulation - Simulation of a simple second order system – Generation of HTML page.	**10 Hours**	

Course outcomes: On completion of the course the student will

1. have a knowledge of Virtual Instrumentation and Lab View domain on various I/O Module , Sensor, DAQ Devices ,Communication and Measurement System
2. understanding the basic programming concepts and various logical Instructions, DAQ Operation used in Virtual Instrumentation and Lab View .
3. determine the extent and nature of electronic circuitry in Virtual Instrumentation and Lab View including Signal monitoring and control circuits for Communication and Interfacing.

Graduate Attributes (as per NBA):

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. "Virtual Instrumentation using LabVIEW" Jovitha Jerome, PHI publication

2. "Virtual Instrumentation, LABVIEW", Sanjay Gupta, TMH,NewDelhi,2003

Reference Books:

1 . "PC Interfacing for Data Acquisition and Process Control",S.Gupta and JP Gupta InstrumentSocietyofAmerica,1994
2. Kevin James, PC Interfacing and Data Acquisition: Techniques for Measurement, Instrumentation and Control, Newnes, 2000.

HYDRAULICS AND PNEUMATICS [As per Choice Based Credit System (CBCS) scheme] SEMESTER – V			
Subject Code	15MT53	IA Marks	20
Number of Lecture Hours/Week	04	Exam Marks	80
Total Number of Lecture Hours	50	Exam Hours	03

CREDITS – 04

Course objectives: Students will be able to

1. gain knowledge of basics of hydraulic and pneumatic systems.
2. understanding the working principles of hydraulics and pneumatics components
3. Engineering application of hydraulic and pneumatic systems

Modules	**Hours Teaching**	**Revised Bloom's Taxonomy(RBT) Level**
Module -1		
Introduction to Hydraulic Power: Definition of hydraulic system, advantages, limitations, applications, Pascal's law, structure of hydraulic control system, problems on Pascal's law. **The source of Hydraulic Power: Pumps** Classification of pumps, Pumping theory of positive displacement pumps, construction and working of Gear pumps, Vane pumps, Piston pumps, fixed and variable displacement pumps, Pump performance characteristics, pump Selection factors, problems on pumps.	**10 Hours**	
Module -2		
Hydraulic Actuators and Motors: Classification cylinder and hydraulic motors, Linear Hydraulic Actuators [cylinders], single and double acting cylinder, Mechanics of Hydraulic Cylinder Loading, mounting arrangements, cushioning, special types of cylinders, problems on cylinders, construction and working of rotary actuators such as gear, vane, piston motors, Hydraulic Motor Theoretical Torque, Power and Flow Rate, Hydraulic Motor Performance, problems, symbolic representation of hydraulic actuators (cylinders and motors). **Control Components in Hydraulic Systems:** Classification of control valves, Directional Control Valves- Symbolic representation, constructional features of	**10 Hours**	

poppet, sliding spool, rotary type valves solenoid and pilot operated DCV, shuttle valve, check valves, Pressure control valves - types, direct operated types and pilot operated types. Flow Control Valves -compensated and non-compensated FCV, needle valve, temperature compensated, pressure compensated, pressure and temperature compensated FCV, symbolic representation.		
Module -3		
Hydraulic Circuit Design And Analysis: Control of Single and Double -Acting Hydraulic Cylinder, Regenerative circuit, Pump Unloading Circuit, Double Pump Hydraulic System, Counter balance Valve Application, Hydraulic Cylinder Sequencing Circuits, Automatic cylinder reciprocating system, Locked Cylinder using Pilot check Valve, Cylinder synchronizing circuit using different methods, factors affecting synchronization, Speed Control of Hydraulic Cylinder, Speed Control of Hydraulic Motors, Safety circuit, Accumulators, types, construction and applications with circuits. **Maintenance of Hydraulic System:** Hydraulic Oils - Desirable properties, general type of Fluids, Sealing Devices, Reservoir System, Filters and Strainers, wear of Moving Parts due to solid - particle Contamination, temperature control (heat exchangers), Pressure switches, trouble shooting.	**10 Hours**	
Module -4		
Introduction to Pneumatic Control: Definition of pneumatic system, advantages, limitations, applications, Choice of working medium. Characteristic of compressed air. Structure of Pneumatic control System,fluid conditioners and FRL unit. Pneumatic Actuators: Linear cylinder - Types, Conventional type of cylinder- working, End position cushioning, seals, mounting arrangements- Applications. Rod - Less cylinders types, working, advantages, Rotary cylinders- types construction and application, symbols. **Pneumatic Control Valves:** DCV such as poppet, spool, suspended seat type slide valve, pressure control valves, flow control valves, types and construction, use of memory valve, Quick exhaust valve, time delay valve, shuttle valve, twin pressure valve, symbols. Simple Pneumatic Control: Direct and indirect actuation pneumatic cylinders, speed control of cylinders - supply air throttling and Exhaust air throttling and Exhaust air throttling.	**10 Hours**	
Module -5		
Signal Processing Elements: Use of Logic gates - OR and AND gates in pneumatic applications. Practical Examples involving the use of logic gates, Pressure dependant controls- types - construction - practical applications, Time dependent controls principle, Construction, practical applications. Multi- Cylinder Application: Coordinated and sequential motion control, Motion and control diagrams. Signal elimination methods, Cascading method- principle, Practical application examples (up to two cylinders) usingcascading method (using	**10 Hours**	

reversing valves). **Electro- Pneumatic Control: Principles -** signal input and output, pilot assisted solenoid control of directional control valves, Use of relay and contactors. Control circuitry for simple signal cylinder application.		

Course outcomes: On completion of the course the student will

1. have knowledge of hydraulic and pneumatic system and its components .
2. understand the working principle of various hydraulic and pneumatic components .
3. apply working principles of Hydraulic and Pneumatic Systems for various applications. determine cause for hydraulic and pneumatic system break down and performance of hydraulic pumps, motors.

Graduate Attributes (as per NBA):

Question paper pattern:

Text Books:

1. “Fluid Power with Applications”, Anthony Esposito, Sixth edition, Pearson Education, Inc, 2000.
2. 'Pneumatics and Hydraulics', Andrew Parr, Jaico Publishing Co

Reference Books:

1. 'Oil Hydraulic systems', Principles and Maintenance S. R. Majurr, Tata McGraw Hill Publishing Company Ltd. - 2001
2. 'Industrial Hydraulics', Pippenger, Hicks" McGraw Hill, New York
3. 'Hydraulic & Pneumatic Power for Production', HarryL. Stewart
4. 'Pneumatic Systems', S. R. Majumdar, Tata McGraw Hill Publish 1995
5. 'Hydraulic & Pneumatics' CMTI Data Book

MICRO & SMART SYTEMS TECHNOLOGY

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

Subject Code	**15MT54**	**IA Marks**	**20**
Number of Lecture Hours/Week	**04**	**Exam Marks**	**80**
Total Number of Lecture Hours	**50**	**Exam Hours**	**03**

CREDITS – 04

Course Objectives: Students will be able to

1. gain knowledge of Smart Materials, Sensors & Actuators, Microsystems.
2. understand the Operation of Smart Devices & Systems, Electronic Circuits & Control for MEMS, Methodology of Micro-manufacturing.

Modules	**Hours Teaching**	**Revised Bloom's Taxonomy(RBT) Level**
Module -1		
Introduction to Micro and Smart systems: Miniaturization, Microsystems versus MEMS, Micro-fabrication, Smart Materials, Structures & Systems, Integrated Microsystems ,Application of Smart Materials & Microsystems.	**10 Hours**	
Module -2		
Micro and Smart Devices and Systems: Principles and Materials: Definitions and salient features of sensors, actuators, and systems.Sensors: silicon capacitive accelerometer, piezoresistive pressure sensor, Portable blood analyzer, conductometric gas sensor. Actuators: Micromirror Array for Video Projection, Piezo-electric based inkjet print head,electrostatic comb-drive, Magnetic microrelay.	**10 Hours**	
Module -3		
Micromachining Technologies: Silicon as a Material for Micromachining, Silicon wafer preparation, thin-film deposition techniques, Lithography, Etching, Silicon micromachining:surface micromachining bulk micromachining. Specialized Materials for Microsystems.	**10 Hours**	
Module -4		
Electronics Circuits for Micro and Smart Systems. Semiconductor devices: Diode, Schottky diode,Tunnel diode,BJT ,MOSFET,CMOS circuits ,Electronics Amplifiers ,Op-Amp based circuits ,Practical Signal Conditioning Circuits for Microsystems. Circuits for Conditioning Sensed Signals.	**10 Hours**	

Module -5		
Implementation of Controllers for MEMS & Case Studies of Integrated Microsystems. Design Methodology, PID controller, Circuit Implementation, Digital controller, Microcontroller & PLC. Case Studies of Integrated Microsystems: BEL pressure sensor, design considerations, performance parameters, practical implementations, design of electronics circuits, Integration of pressure Sensor and Smart Structure in vibration control.	**10 Hours**	

Course Outcomes: On completion of the course the student will

1. have knowledge of Smart Materials, Sensors & Actuators ,Microsystems.
2. understand the Working Methodology of Smart Devices & Systems, Electronics Circuits & Control for MEMS, Methodology of Micro-manufacturing.

Graduate Attributes (as per NBA):

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.Micro and Smart Systems: G.K.Ananthasuresh, K.J.Vinoy, S.Gopalakrishnan, K.N.Bhat, V.K.Aatre,Wiley India 2010.

Reference Books:

1. Design and Development Methodogies, Smart Material Systems and MEMS: V. Varadan, K. J. Vinoy, S. Goplakrishnan, Wiley.
2. MEMS- Nitaigour Premchand Mahalik, TMH 2007.
3. MEMS & Microsystems: Design and Manufacture, Tai-Ran Hsu, Tata Mc-Graw-Hill.

OPERATIONS RESEARCH

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

Subject Code	**15MT552**	**IA Marks**	**20**
Number of Lecture Hours/Week	**03**	**Exam Marks**	**80**
Total Number of Lecture Hours	**40**	**Exam Hours**	**03**

CREDITS – 03

Course Objective: Students will be able to

1. gain knowledge of basics of operation research.
2. understanding various techniques of operation research for solving business decision and engineering problems.
3. determination of optimization solutions, effective decision making, model formulation and applications.

Modules	**Hours Teaching**	**Revised Bloom's Taxonomy(RBT) Level**
Module -1		
Introduction: Evolution of OR, definition of OR, scope of OR, application areas of OR, steps (phases) in OR study, characteristics and limitations of OR, models used in OR, linear programming (LP) problem-formulation and solution by graphical method. **Solution Of Linear Programming Problems:** The simplex method canonical and standard form of an LP problem.	**8 Hours**	
Module -2		
Transportation Problem: Formulation of transportation problem, types, initial basic feasible solution using different methods, optimal solution by MODI method, degeneracy in transportation problems, application of transportation problem concept for maximization cases.	**8 Hours**	
Module -3		
Pert-CPM Techniques: Introduction, network construction - rules, Fulkerson's rule for numbering the events, AON and AOA diagrams; Critical path method to find the expected completion time of a project, floats; PERT for finding expected duration of an activity and project, determining the probability of completing a project, predicting the completion time of project; crashing of simple projects.	**8 Hours**	
Module -4		
Queuing Theory: Queuing systems and their characteristics, Pure-birth and Pure-death models (only equations), empirical queuing models – M/M/1 and M/M/C models and their steady state performance analysis.	**8 Hours**	

Module -5		
Game Theory: Formulation of games, types, solution of games with saddle point, graphical method of solving mixed strategy games, dominance rule for solving mixed strategy games. **Sequencing:** Basic assumptions, sequencing 'n' jobs on single machine using priority rules, sequencing using Johnson's rule-'n' jobs on 2 machines, 'n' jobs on 3 machines, 'n' jobs on 'm' machines. Sequencing 2 jobs on 'm' machines using graphical method.	**8 Hours**	

Course outcomes: On completion of the course the student will

1. have knowledge of linear programming, Transportation, PERT-CPM, Sequencing, Queuing Theory, and Game theory.
2. understanding the techniques of linear programming, Transportation, PERT-CPM, Sequencing, Queuing Theory, and Game theory for various engineering problems.
3. determination of optimization of solutions, effective decision making model formulation and applications that are used in solving business decision problems.

Graduate Attributes (as per NBA):

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. Operations Research, P K Gupta and D S Hira, Chand Publications, New Delhi – 2007
2. Operations Research, Taha H A, Pearson Education.
3. Operations Research S.D. Sharma, LedarnathRamanath& Co, 002

REFERNCE BOOKS:

1. Operations Research, A P Verma, S K Kataria&Sons, 2008
2. Operations Research, Paneerselvan, PHI
3. Operations Research, A M Natarajan, P Balasubramani, Pearson Education, 2005
4. Introduction to Operations Research, Hillier and Liberman, 8th Ed., McGraw Hill
5. Operations Research, S Kalavathy, Vikas Publishing House Pvt Ltd, 2002

Automation in Manufacturing
[As per Choice Based Credit System (CBCS) scheme]
SEMESTER – V

Subject Code	**15MT562**	**IA Marks**	**20**
Number of Lecture Hours/Week	**03**	**Exam Marks**	**80**
Total Number of Lecture Hours	**40**	**Exam Hours**	**03**

CREDITS – 03

COURSE OBJECTIVES: Students will be able to

1. gain knowledge of fundamental concepts of automation in manufacturing.
2. understand the techniques of automation in manufacturing for industry operations.

Modules	**Hours Teaching**	**Revised Bloom's Taxonomy(RBT) Level**
Module -1		
Introduction: Production System Facilities, Manufacturing Support systems, Automation in Production systems, Automation principles & Strategies. **Manufacturing Operations:** Manufacturing Operations, Product/Production Relationship, Production concepts and Mathematical Models & Costs of Manufacturing Operations.	**8 Hours**	
Module -2		
Industrial Control System: Basic Elements of an Automated System, Advanced Automation Functions & Levels of Automation, Continuous versus Discrete control, Computer Process control, Forms of Computer Process Control. **Quality Control Systems:** Traditional and Modern Quality Control Methods, Taguchi Methods in Quality Engineering. Introduction to SQC Tools.	**8 Hours**	
Module -3		
Automated Manufacturing Systems: Components of a Manufacturing systems, Classification of Manufacturing Systems, overview of Classification Scheme, Single Station Manned Workstations and Single Station Automated Cells. **Manufacturing Support System:** Process Planning, Computer Aided Process Planning, Concurrent Engineering & Design for Manufacturing, Advanced Manufacturing Planning, Just-in Time Production System, Basic concepts of lean and Agile manufacturing.	**8 Hours**	
Module -4		
Inspection Technologies: Automated Inspection, Coordinate Measuring Machines Construction,	**8 Hours**	

operation & Programming, Software, Application & Benefits, Flexible Inspection System, Inspection Probes on Machine Tools, Machine Vision, Optical Inspection Techniques & Non-contact Non-optical Inspection Technologies.		
Module -5		
Group Technology & Flexible Manufacturing Systems: Part Families, Parts Classification and coding, Production Flow Analysis, Cellular Manufacturing, Flexible Manufacturing Systems: What is an FMS, FMS Components, FMS Applications & Benefits, and FMS Planning &Implementation Issues.	**8 Hours**	

Course Outcomes: On completion of this course the student will

1. have knowledge of fundamental concepts of automated flow lines, traditional and modern quality control methods, manufacturing supporting system, AMS, Inspection Technologies, group technologies, FMS
2. understand various automated flow lines, assembly systems and line balancing methods, importance of automated material handling and storage systems and the importance of adaptive control systems, automated inspection systems.

Graduate Attributes (as per NBA):

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. Automation, Production Systems and Computer Integrated Manufacturing, M. P. Groover, Pearson education. Third Edition,2008
2. Principles of CIM, Vajpayee, PHI.

REFERENCE BOOKS:

1. Anatomy of Automation, Amber G.H & P. S. Amber, PrenticeHall.
2. Performance Modeling of Automated Manufacturing Systems,Viswanandham, PHI
3. Computer Based Industrial Control, Krishna Kant, EEE-PHI

VIRTUAL INSTRUMENTATION LAB

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

SEMESTER – V

Subject Code	**15MTL57**	**IA Marks**	**20**
Hours/Week	**03**	**Exam Marks**	**80**
Total Number of Lecture Hours	**-**	**Exam Hours**	**03**

CREDITS – 02

Course objectives: Students will be able to

- Understanding Virtual Instrument concepts and data acquisition operation
- Creating Virtual Instruments for practical works

Laboratory Experiments:	**Revised Bloom's Taxonomy (RBT)Level**

PART –A

1. Creating Virtual Instrumentation for simple applications**- Invert The State Of Boolean Indicator Twice A See Until Program Is Stopped By User.**

2. Programming exercises for loops in virtual instrumentation-**Continuous Monitoring of Temperature (Generated using Random no 0<t<100). for every 250 ms.**

3. Programming exercises for graphs- **Display Random Number Into 3 different CHARTS (STRIP, SLOPE,SWEEP) and understand the difference between these in the UI.**

4.Programming Exercises on case and sequence structures:**-Design the simple Calculator, making use of the inherent GUI present in the virtual instrumentation software**.

5.Programming Exercises on Arrays– **Take a 2D array input from the user and perform various array(and matrix) manipulations on it.**

6. Programming Exercises on File Input output System – **Read and write from ASCII and TDMS files.**

PART -B

1. Real time temperature acquisition and continuous monitoring using Virtual Instrumentation.
2. Developing voltmeter using DAQ cards – Acquiring a voltage and displaying it on a 'meter' indicator on the UI, thus designing a voltmeter
3. Developing Signal Generator using DAQ Card – **Using analog output; amplitude, shape and frequency controlled by user**
4. Data acquisition through Virtual Instrumentation – **Read voltage and current of the 50 Hz supply to compute power and power factor**
5. Design and Development of Filter Analysis using DAQ card – **Acquire audio and filter out bands using different filters and compare effects**
6. Real time sequential control of any batch process – **Water level control or Temperature control**

Course outcomes: On the completion of the course the student will:

- understand, design and develop data acquisition systems for Various Sensor using DAQ Cards.
- analyze the importance & applications of LabVIEW in real time Environment.

Graduate Attributes (as per NBA):

Scheme of Examination:

PART A- 35 MARKS
PART-B 35 MARKS
Viva- Voice : 10 Marks
Total : 80 Marks

POWER ELECTRONICS LABORATORY

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

Subject Code	15MTL68	IA Marks	20
Hours/Week	03	Exam Marks	80
Total Number of Lecture Hours	40	Exam Hours	03

CREDITS – 02

Course objectives: Students will be able to

1) verify the characteristics of different power electronic devices.
2) understand the usage of power devices to control the operation of electronic systems.

Laboratory Experiments:	**Revised Bloom's Taxonomy (RBT)Level**

LIST OF EXPERIMENTS

1. Static characteristics of SCR and DIAC.
2. Static characteristics of MOSFET and IGBT.
3. Controlled HWR and FWR using RC triggering circuit.
4. SCR turn off using i) LC circuit and ii) Auxiliary Commutation
5. SCR turn-on circuit using synchronized UJT relaxation oscillator.
6. SCR Digital triggering circuit for a single-phase controlled rectifier
7. Single-phase full-wave rectifier with R and R-L loads.
8. A.C. voltage controller using TRIAC and DIAC combination connected to R and R-L loads.
9. Speed control of a separately excited D.C motor using an IGBT or MOSFET chopper.
10. MOSFET OR IGBT based single-phase full-bridge inverter connected to R load.

Course outcomes:

On the completion of the course students will

1. understand and verify the characteristics of different power electronic devices .
2. use the power devices to control the operation of electronic systems.

Graduate Attributes (as per NBA):

Scheme of Examination:

Experiment : 70 Marks
Viva- Voice : 10 Marks
Total : 80 Marks

PLC AND SCADA LABORATORY

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

Subject Code	15MTL67	IA Marks	20
Hours/Week	03	Exam Marks	80
Total Number of Lecture Hours	40	Exam Hours	03

CREDITS – 02

Course objectives: Students will be able to

1. Analyse the logic Program on SCADA and PLC Interface
2. Design various applications with programmable logic controllers using relay ladder logic.

Laboratory Experiments:	**Revised Bloom's Taxonomy (RBT)Level**

LIST OF EXPERIMENTS

1. Study of various logic Execution in ladder diagram.
2. Interfacing of Lamp&button with PLC for ON&OFF Operation. Verify all logic gates.
3. PLC based thermal ON/OFF Controller.
4. Develop ladder logic to develop MUX and DE-MUX
5. Combination of counter &timer for lamp ON/OFF Operation.
6. Study& implement ON delay timer in PLC
7. Study& implement OFF delay timer in PLC
8. To study&implement of counter in PLCprogramming.(counter-up)
9. To study&implement of counter in PLCprogramming.(counter-down)
10. PLC based temperature sensing using RTD
11. Parameter reading of PLC in SCADA
12. Temperature sensing using SCADA

Course outcomes: On completion of the course the student will: CO 1: Analyze the Importance & Applications of PLC and SCADA in real time Environment. CO 2: Design and Develop PLC and SCADA Modules for Various Sensor Technologies.
Graduate Attributes (as per NBA):
Scheme of Examination: **Experiment : 70 Marks** **Viva- Voice : 10 Marks** **Total : 80 Marks**

Power Electronics

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

Subject Code	15MT63	IA Marks	20
Number of Lecture Hours/Week	04	Exam Marks	80
Total Number of Lecture Hours	50	Exam Hours	03

CREDITS – 04

Course objectives: Students will be able to

1. gain the knowledge of various conversion techniques of electrical energy using power electronic components.
2. understand the link between efficient usage of power and conservation of energy resources of the world
3. use various power electronic converters for different applications in industry.

Modules	Hours Teaching	Revised Bloom's Taxonomy(RBT) Level
Module -1		
Introduction, Power semiconductor Devices: Applications of Power Electronics, Power semiconductor devices, Control Characteristics, Types of power electronics circuits, Peripheral effects. Power MOSFETs – switching characteristics, gate drive, IGBTs, di/dt and dv/dt limitations, Isolation of gate and base drives, Simple design of gate and base drives.	**10 Hours**	
Module -2		
Thyristors: Introduction, characteristics, Two Transistor Model. Turn-on and turn-off, di/dt and dv/dt protection, Thyristor types, Thyristors firing circuits, Simple design of firing circuits using UJT. **Commutation Techniques**: Introduction. Natural Communication, Forced commutation: self commutation, impulse commutation, resonant pulse commutation and complementary commutations.	**10 Hours**	
Module -3		
AC Voltage Controllers: Introduction. Principle of ON-OFF and phase control. Single-phase bidirectional controllers with resistive and inductive loads. **Controlled Rectifiers:** Introduction. Principle of phase controlled converter operation. Single phase semi-converters. Full converters. Three-phase half-wave converters. Three-phase full-wave converters.	**10 Hours**	
Module -4		

DC Choppers: Introduction. Principle of step-down and step-up chopper with R-L load. Performance parameters. Choppers classification. Analysis of impulse commutated thyristor chopper (only qualitative analysis)	**10 Hours**	
Module -5		
Inverters: Introduction, Principle of operation. Performance parameters. Single-phase bridge inverters. Three phase inverters. Voltage control of single-phase Inverters single pulse width, multiple pulse width, and sinusoidal pulse width modulation.	**10 Hours**	

Course outcomes: On completion of the course student will:

CO1: have knowledge of power semiconductor devices, thyristors, AC voltage controllers, choppers and inverters.

CO2: understand the characteristics and working principle of thyristors, AC voltage controllers, choppers and inverters.

CO3: apply control techniques to meet desired switching objectives.

Graduate Attributes (as per NBA):

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. "Power electronics", m h. Rashid 2nd edition, p. H.i/pearson, new delhi, 2002.

Reference Books:

1. "Power Electronics – converters, Application and Design", Net Mohan, Tore M. Undeland, and William P. Robins, Third Edition, John Wiley and Sons.
2. "Thyristorised Power Controllers", G. K. Dubey, S. R. Doradla, A. Joshi and R M K. Sinha, New Age International Publishers.
3. "Power Electronics", M. D. Singh and Khanchandani K.B. T.M.H., 2001.
4. "Power Electronics", Cyril Lander, 3rd Edition, McGraw-Hill.
5. "Power Electronics: Principles and Applications", J.M. Jacob, Thomson-VikasPublicaions.
6. "Power Electronics: A Simplified Approach", R.S. Ananda Murthy and V. Nattarasu, Sanguine Technical Publisher.

SATELLITE COMMUNICATION
[As per Choice Based Credit System (CBCS) scheme]
SEMESTER – VI

Subject Code	15MT654	IA Marks	20
Number ofLecture Hours/Week	03	Exam Marks	80
Total Number of Lecture Hours	40	Exam Hours	03

CREDITS – 03

Course objectives: Students will be able to

- gain Knowledge of various kinds of Satellites, Satellite Subsystems & Orbits, Trajectory, Multiple Access Techniques .
- understand the Operation of Satellites in space for various applications.

Modules	Hours Teaching	RevisedBloom's Taxonomy(RBT) Level
Module -1		
SATELLITE ORBITS AND TRAJECTORIES: Definition, Basic Principles, Orbital parameters, Injection velocity and satellite trajectory, Types of Satellite orbits, Orbital perturbations, Satellite stabilization, Orbital effects on satellite's performance, Eclipses, Look angles: Azimuth angle, Elevation angle.	**8 Hours**	
Module -2		
SATELLITE SUBSYSTEM: Power supply subsystem, Attitude and Orbit control, Tracking, Telemetry and command subsystem, Payload. Earth Station: Types of earth station, Architecture, Design considerations, Testing, Earth station Hardware, Satellite tracking.	**8 Hours**	
Module -3		
MULTIPLE ACCESS TECHNIQUES: Introduction, FDMA (No derivation), SCPC Systems, MCPC Systems, TDMA, CDMA, SDMA. Satellite Link Design Fundamentals: Transmission Equation, Satellite Link Parameters, Propagation considerations.	**8 Hours**	
Module -4		
COMMUNICATION SATELLITES: Introduction, Related Applications, Frequency Bands, Payloads, Satellite Vs. Terrestrial Networks, Satellite Telephony, Satellite Television, Satellite radio, Regional satellite Systems, National Satellite Systems.	**8 Hours**	
Module -5		
REMOTE SENSING SATELLITES: Classification of remote sensing systems, orbits, Payloads, Types of images: Image Classification, Interpretation, Applications. Weather Forecasting Satellites: Fundamentals, Images, Orbits, Payloads, Applications. Navigation Satellites: Development of Satellite Navigation Systems, GPS system, Applications.	**8 Hours**	

Course outcomes:
On completion of course students will

CO 1: have Knowledge of various kinds of Satellites, Satellite Subsystems & Orbits, Trajectory, Multiple Access techniques .
CO 2: understand the Operation of Satellites in space for various applications

Graduate Attributes (as per NBA):

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. Anil K. Maini, Varsha Agrawal, Satellite Communications, Wiley India Pvt. Ltd., 2015, ISBN: 978-81-265-2071-8.

Reference Books:

1. Dennis Roddy, Satellite Communications, 4th Edition, McGraw- Hill International edition, 2006
2. Timothy Pratt, Charles Bostian, Jeremy Allnutt, Satellite Communications, 2nd Edition, Wiley India Pvt. Ltd , 2017,
ISBN: 978-81-265-0833-4

PLC AND SCADA

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

Subject Code	15MT61	IA Marks	20
Number ofLecture Hours/Week	04	Exam Marks	80
Total Number of Lecture Hours	50	Exam Hours	03

CREDITS – 04

Course objectives: Students will be able to

- Gain the Knowledge of various skills necessary for Industrial applications of Programmable logic controller(PLC)
- Understand the basic programming concepts and various logical Instructions used in Programmable logic controller (PLC)
- Solve the problems related to I/O module, Data Acquisition System and Communication Networks using Standard Devices.
- Design and analysis of general structure of an automated process for real time applications using Programmable logic controller (PLC) and SCADA

Modules	Hours Teaching	RevisedBloom's Taxonomy(RBT) Level
Module -1		
what is A PLC, Technical Definition of PLC, What are its advantages, characteristics functions of A PLC, Chronological Evolution of PLC, Types of PLC, Unitary PLC, Modular PLC, Small PLC, Medium PLC, Large PLC, Block Diagram of PLC: Input/output (I/O) section, Processor Section, Power supply, Memory central Processing Unit: Processor Software / Executive Software, Multi asking, Languages, Ladder Language.	**10 Hours**	
Module -2		
Bit Logic Instructions: introduction: Input and Output contact program symbols, Numbering system of inputs and outputs, Program format, introduction to logic: Equivalent Ladder diagram of AND gate, Equivalent ladder diagram of or Gate, equivalents Ladder Diagram of NOT gate, equivalent ladder diagram of XOR gate, equivalent ladder diagram of NAND gate, equivalent ladder diagram of NOR gate, equivalent ladder diagram to demonstrate De Morgan theorem. Ladder design. Examples: Training Stopping, Multiplexer, DE multiplexers	**10 Hours**	
Module -3		

PLC Timers and Counters: On Delay and OFF delay timers, Timer-on Delay, Timer off delay, Retentive and non-retentive timers. Format of a timer instruction. PLC Counter: Operation of PLC Counter, Counter Parameters, Counters Instructions Overview Count up (CTU) Count down (CTD). Advanced instructions: Introduction: Comparison instructions, discussions on comparison instructions, "EQUAL" or "EQU" instruction, "NOT EQUAL" or "NEQ" instruction, "LESS THAN" or "LESS" instruction, "LESS THANOR EQUAL' or "LEQ" instruction, GREATER THAN" OR "GRT" instruction, "GREATER THAN OR EQUAL TO" or "GRO" instruction, "MASKED COMPARISON FOR EQUAL" or "MEQ" instruction, "LIMIT TEST" or "LIM" instruction.	**10 Hours**	
Module -4		
PLC input output (I/O) modules and power supply: Introduction: Classification of I/O, I/O system overview, practical I/O system and its mapping addressing local and expansion I/O, input-output systems, direct I/O, parallel I/O systems serial I/O systems. Sinking and sourcing. Discrete input module. Rectifier with filter, threshold detection, Isolation, logic section, specifications of discrete input module, types of analog input module, special input modules, analog output module, I/O modules in hazardous locations power supply requirements, power supply configuration, filters.	**10 Hours**	
Module -5		
SCADA SYSTEMS Introduction, definition and history of Supervisory Control and Data Acquisition, typical SCADA System Architecture, Communication Requirements, Desirable properties of SCADA system, Features, advantages, disadvantages and applications of SCADA. SCADA Architecture(First generation-Monolithic, Second Generation-Distributed, Third generation-Networked Architecture), SCADA systems in operation and control of interconnected power system, Power System Automation, Petroleum Refining Process, Water Purification System, Chemical Plant	**10 Hours**	
Course outcomes: **On completion of the course students will** **CO 1:** have knowledge of Programmable Logic Controller domain on various Logical Operation and Various Advanced Logical Instruction, I/O Module, Sensor, Actuator, Communication and Measurement System. **CO 2:** Understand the basic programming concepts and various logical Instructions used in Programmable logic controller (PLC). **CO 3:** Compute the extent and nature of electronic circuitry in Programmable logic controller (PLC) and SCADA including monitoring and control circuits for Communication and Interfacing. **CO 4:** Design and analyse the general structure of an automated process for real time industrial applications		
Graduate Attributes (as per NBA):		
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. "PLC and Industrial application", MadhuchhandanGupts and SamarjitSen Gupta, pernram international pub. (Indian) Pvt. Ltd., 2011.
2. Ronald L Krutz, "Securing SCADA System", Wiley Publication

Reference Books:

1.1.GaryDunning,"Introduction to Programmable Logic Controllers", Thomson, 2nd Edition.
2. John W Webb, Ronald A Reis,"Programmable Logic Controllers: Principles and Application", PHI Learning, Newdelhi, 5th Edition
3.Stuart A Boyer, "SCADA Supervisory Control and Data Acqusition", ISA, 4th Revised edition

Computer Aided Machine Drawing

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

Subject Code	15MT64	IA Marks	20
Number of Lecture Hours/Week	2 Hours Theory and 4 Hours Lab	Exam Marks	80
Total Number of Lecture Hours	70	Exam Hours	03

CREDITS – 04

Course objectives: Students will be able to

1. gain knowledge about Engineering Drawing
2. understand the sections of solids, orthographic views, threads, fasteners, couplings, joints and machine drawing

Modules	Hours Teaching	RevisedBloom's Taxonomy(RBT) Level
Part – A		
Sections of Solids: Sections of Pyramids, Prisms, Cones and resting only on their bases (No problems on axis inclinations, spheres and hollow solids). True shape of sections. **Orthographic Views:** Conversion of pictorial views into orthographic projections of simple machine parts without sections. (Bureau of Indian Standards conventions are to be followed for the drawings). **Thread Forms:** Thread terminology, sectional views of threads. ISO Metric (Internal & External) square. **Fasteners:** Hexagonal headed bolt and nut with washer (assembly).	**20 Hours**	
Part – B		
Keys & Joints : Parallel key, Taper key, Feather key, Gib head key and Woodruff key (Only Practice) Cotter joint, knuckle joint for two rods. **Couplings:** Protected type flanged coupling, flexible coupling	**20 Hours**	
Part – C		
Assembly Drawings **(Part drawings should be given)** 1. Plummer block (Pedestal Bearing) 4. Screw jack (Bottle type) 5. Tailstock of lathe	**30 Hours**	

Geometric Dimensioning and Tolerances (Not for Exam): Types of Geometric tolerances, terminology for geometrical deviations, representation of geometrical tolerance on a drawing, dimensional tolerances, terminology for dimensional tolerances, selection of tolerances, representation of dimensional tolerances on a drawing.		

Course outcomes:
On completion of course students will :
CO 1: have knowledge about Engineering Drawing
CO 2: understand the concepts of sections of solids, orthographic views, threads, fasteners, couplings, joints and assembly drawing

Graduate Attributes (as per NBA):

Scheme of Examination:

One Question from Part - A: **20 marks**
One Question from Part - B: **20 Marks**
One Question from Part - C: **40 Marks**

Text Books:
1. 'A Primer on Computer Aided Machine Drawing-2007', Published by VTU, Belgaum.
2. 'Machine Drawing', N.D.Bhat &V.M.Panchal

Reference Books:
1. **'A Text Book of Computer Aided Machine Drawing'**, S. Trymbaka Murthy, CBS Publishers, New Delhi, 2007
2. **'Machine Drawing'**, K.R. Gopala Krishna, Subhash Publication

EMBEDDED SYSTEMS (ARM)

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

Subject Code	15MT62	IA Marks	20
Number of Lecture Hours/Week	04	Exam Marks	80
Total Number of Lecture Hours	50	Exam Hours	03

CREDITS – 04

Course objectives: Students will be able to

- gain the knowledge of various RISC and CISC architectures of processors.
- understand the embedded system based ARM processor , its programming with Embedded C and assembly language, various memory issues and memory mapping.

Modules	Hours Teaching	RevisedBloom's Taxonomy(RBT) Level
Module -1		
Introduction: The RISC design philosophy; The ARM design philosophy; Embedded system hardware and software. ARM processor fundamentals: Registers; Current Program Status Register; Pipeline; Exceptions, interrupts and the Vector Table; Core extensions; Architecture revisions; ARM processor families.	**10 Hours**	
Module -2		
Arm Instruction Set And Thumb Instruction Set: ARM instruction set: Data processing instructions; Branch instructions; Load-store instructions; Software interrupt instruction; Program Status Register functions; Loading constants; ARMv5E extensions; Conditional execution. Thumb instruction set: Thumb register usage; ARM –Thumb interworking; Other branch instructions; Data processing instructions; Single-Register Load-Store instructions; Multiple-Register Load-Store instructions; Stack instructions; Software interrupt instruction	**10 Hours**	
Module -3		
Writing And Optimizing ARM Assembly Code: Writing assembly code; Profiling and cycle counting; Instruction scheduling; Register allocation; Conditional execution; Looping constructs; Bit manipulation; Efficient switches; Handling unaligned data.	**10 Hours**	
Module -4		
Caches : The memory hierarchy and the cache memory; Cache architecture; Cache policy; Coprocessor 15 and cache; Flushing and cleaning cache memory; Cache lockdown; Caches and software performance	**10 Hours**	

Module -5		
Exception And Interrupt Handling: Exception handling; Interrupts and interrupt handling Schemes	**10 Hours**	

Course outcomes:
On completion of the course students will

CO 1: have knowledge of embedded system based on the ARM processor, various cache methods and instruction set.
CO 2: understand the various instruction set for writing and optimizing ARM assembly and C code

Graduate Attributes (as per NBA):

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. ARM System Developer's Guide – Designing and Optimizing System Software – by Andrew N. Sloss, Dominic Symes, Chris Wright, Elsevier, 2004.

Reference Books:

1. ARM Architecture Reference Manual by David Seal (Editor), 2nd Edition, Addison-Wesley, 2001.
2. ARM System-on-Chip Architecture by Steve Furber, 2nd Edition, AddisonWesley, 2000.

ROBOTICS & AUTOMATION

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

Subject Code	15MT661	IA Marks	20
Number of Lecture Hours/Week	03	Exam Marks	80
Total Number of Lecture Hours	40	Exam Hours	03

CREDITS – 03

Course objectives: Students will be able to

1. gain fundamental knowledge of Robotics and Automation
2. describe Control system, different motions of robots and Material handling system

Modules	Hours Teaching	Revised Bloom's Taxonomy (RBT) Level
Module -1		
Basic Concepts: Definition and origin of robotics – different types of robotics – various generations of robots – degrees of freedom – Asimov's laws of robotics – dynamic stabilization of robots.	8 Hours	
Module -2		
Power Sources And Sensors: Hydraulic, pneumatic and electric drives – determination of HP of motor and gearing ratio – variable speed arrangements – path determination – micro machines in robotics – machine vision – ranging – laser – acoustic – magnetic, fiber optic and tactile sensors.	8 Hours	
Module -3		
Manipulators, Actuators And Grippers: Construction of manipulators – manipulator dynamics and force control – electronic and pneumatic manipulator control circuits – end effectors – U various types of grippers – design considerations.	8 Hours	
Module -4		
Industrial Automation: • List basic Devices in Automated Systems • Distinguish Different Controllers Employed In Automated Systems. Identify Safety in Industrial Automation	8 Hours	

Material handling and Identification Technologies: Overview of Material Handling Systems, Principles and Design Consideration, Material Transport Systems, Storage Systems, Overview of Automatic Identification Methods.	**8 Hours**	

Course outcomes:

On completion of course students will

CO1: have the knowledge of Joints, Links, Sensors, Control units, Actuators. and elements of Automation

CO2: describe motions and control system of Robots.

Graduate Attributes (as per NBA):

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. Mikell P. Weiss G.M., Nagel R.N., Odraj N.G., Industrial Robotics, McGraw-Hill
2. Singapore, 1996.
3. Ghosh, Control in Robotics and Automation: Sensor Based Integration, Allied
4. Publishers, Chennai, 1998.

Reference Books:

1. Deb.S.R., Robotics technology and flexible Automation, John Wiley, USA 1992.
2. Asfahl C.R., Robots and manufacturing Automation, John Wiley, USA 1992.
3. Klafter R.D., Chimielewski T.A., Negin M., Robotic Engineering – An integrated approach, Prentice Hall of India, New Delhi, 1994.
4. Mc Kerrow P.J. Introduction to Robotics, Addison Wesley, USA, 1991.
5. Issac Asimov I Robot, Ballantine Books, New York, 1986.

SIGNAL PROCESSING LABORATORY

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

SEMESTER – VII

Subject Code	**15MTL77**	**IA Marks**	**20**
Number of Lecture Hours/Week	**03**	**Exam Marks**	**80**
Total Number of Lecture Hours	**40**	**Exam Hours**	**03**

CREDITS – 02

Course objectives: Students will be able to

1. gain knowledge of Scientific Programming using Matlab.
2. understand different functions in Matlab and TMS320C67XX board in signal processing.
3. use in different functions to solve engineering problems.

PART – A **LIST OF EXPERIMENTS USING MATLAB**	**Hours Teaching**	**Revised Bloom's Taxonomy(RBT) Level**

1. Generation of basic elementary signals and operations on these signals.
2. Verification of sampling theorem.
3. Impulse response of a given system.
4. Solving a given difference equation.
5. Computation of N point DFT and IDFT of a given sequence and to plot magnitude and phase spectrum.
6. Design and implementation of FIR filter to meet given specifications.
7. Design and implementation of IIR filter to meet given specifications.
8. Removal of noise from an audio signal.
9. Different operations on image signal.

PART – B

LIST OF EXPERIMENTS USING DSP PROCESSOR

1. Linear convolution of two given sequences.
2. Circular convolution of two given sequences.
3. Computation of N- Point DFT of a given sequence
4. Realization of an FIR filter (any type) to meet given specifications .The input can be a Signal from function generator / speech signal.

5. Noise: Add noise above 3kHz and then remove; Interference suppression using 400 Hz tone.
6. Impulse response of first order and second order system.

Course outcomes: On completion of the course the student will

CO1: have knowledge of Scientific Programming using Matlab.
CO2: understand the programming in Matlab software and hardware.
CO3: use DSP board for real time applications.

Graduate Attributes (as per NBA):

Question paper pattern:

- The question paper will have TWO questions.
- One From PART A and one from PART B.

Text Books:

Reference Books:

1. **Digital signal processing using MATLAB** - Sanjeet Mitra, TMH, 2001
2. **Digital signal processing using MATLAB** - J. G. Proakis & Ingale, MGH, 2000
3. **Digital Signal Processors**, B. Venkataramani and Bhaskar, TMH,2002

Scheme of Examination:

Experiment :

Part A : 35 Marks

Part B: 35 Marks

Viva- Voice : 10 Marks

Total : 80 Marks

THERMAL ENGINEERING

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

Subject Code	15MT72	IA Marks	20
Number ofLecture Hours/Week	04	Exam Marks	80
Total Number of Lecture Hours	50	Exam Hours	03

CREDITS – 04

Course objectives: Students will be able to

- gain fundamental knowledge of thermodynamics, and heat transfer.
- understand the laws of thermodynamics and heat transfer.
- formulate and determine thermodynamic and heat transfer parameters.

Modules	Hours Teaching	RevisedBloom's Taxonomy(RBT) Level
Module -1		
Thermodynamics - Fundamental Concepts & Definitions: Thermodynamics: definition and scope, Microscopic and Macroscopic approaches. Engineering thermodynamics: definition, some practical applications of engineering thermodynamic. System (Closed system) and Control Volume (open system): Characteristics of system boundary and control surface, examples. Thermodynamic properties; definition and units, intensive and extensive properties. Thermodynamic state, state point, state diagram, path and process, quasi-static process, cyclic and non-cyclic presses; Thermodynamic equilibrium; definition, mechanical equilibrium; diathermic wall, thermal equilibrium, chemical equilibrium. Statement of Zeroth law of thermodynamics. (No Numericals) **Work and Heat:** Thermodynamic definition of work; examples, sign convention. Displacement work: at part of a system boundary, at whole of a system boundary, expressions for displacement work in various processes through p-v diagrams. Shaft work, Electrical work. Other types of work, Heat; definition, units and sign convention, simple problems.	**10 Hours**	
Module -2		
First Law of Thermodynamics: Statement of the First law of thermodynamics, extension of the First law to non-cyclic process, energy as a property, modes of energy, pure substance; definition, two-property rule, Specific heat at constant volume, enthalpy, specific heat constant pressure. Extension of the First law to control volume; steady state-steady flow energy equation, important applications, simple problems **Second Law of Thermodynamics:** Thermal Reservoir, Concepts of Heat Engine, Heat Pump, coefficients of performance. Keivin – Planck statement of the Second	**10 Hours**	

law of Thermodynamics; PMM II and PMM I, Claussius statement of second law of Thermodynamics, equivalence of the two statements; reversible hat engines, Carnot cycle, Carnot principles. Thermodynamic temperature scale, simple problems.		
Module -3		
Air Standard cycles: Carnot, Otto, Diesel, Dual and Stirling cycles, P-V and T-S diagrams, description, efficiencies and mean effective pressures, Comparison of Otto, Diesel and dual cycles, simple problems. **Heat Transfer - Introductory Concepts and Definitions:** Modes of heat transfer: Basic laws governing conduction, convection, and radiation heat transfer; Thermal conductivity; convective heat transfer coefficient; radiation heat transfer; combined heat transfer mechanics. Boundary conditions of 1^{st}, 2^{nd} and 3^{rd} Kind, simple problems.	**10 Hours**	
Module -4		
Conduction: Derivation of general three dimensional conduction equations in Cartesian coordinate, special cases, discussion on 3-D conduction in cylindrical and spherical coordinate systems (No derivation). One dimensional conduction equations in rectangular, cylindrical and spherical coordinates for plane and composite walls. Overall heat transfer coefficient. Thermal contact resistance, Simple problems. **Free or Natural Convection:** Application of dimensional analysis for free convection- physical significance or Grashoff number; use of correlations of free convection in vertical, horizontal and inclined flat plates, vertical and horizontal cylinders and spheres, Simple problems.	**10 Hours**	
Module -5		
Forced Convections: Applications of dimensional analysis for forced convection. Physical significance of Reynolds, Prandtl, Nusselt and Stanton numbers, Simple problems. **Radiation Heat Transfer:** Thermal radiation; definitions of various terms used in radiation heat transfer, Stefan-Boltzman law, Kircoff's law. Planck's law and Wein's displacement law. Radiation heat exchange between two parallel infinite black surface, between two parallel infinite gray surfaces; effect of radiation shield; intensity of radiation and solid angle, Simple problems.	**10 Hours**	
Course outcomes: **On completion of course students will** CO1: have knowledge of thermodynamics and heat transfer. CO2: understand the concepts of system, energy interaction, temperature distribution, and heat transfer. CO3: applications of laws of thermodynamics to open and closed system and of heat transfer to different shapes and types of materials. Determine the thermodynamic performance, heat transfer and temperature distribution.		
Graduate Attributes (as per NBA):		
Question paper pattern: • The question paper will have TEN questions.		

- Each full question carries 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. **Basic and applied Thermodynamics,** P. K. Nag, Tata McGraw Hill Pub. 2002.
2. **Heat & Mass transfer,** Tirumaleshwar, Pearson education 2006.
3. **Engineering Thermodynamics,** R K Rajput, Laxmi Publications, 2007

Reference Books:

1. **Engineering Thermodynamics,** J. B. Jones and G. A. Hawkins, John Wiley and Sons.
2. **Basic Engineering Thermodynamics data hand book,** by B. T. Nijaguna. (To be supplied in the examination)
3. **Thermodynamics, An Engineering Approach,** Yunus a. Cenegal and Michael a. Boles, Tata McGraw Hill publications, 2002.
4. **Heat and Mass Transfer,** R K Rajput, S. Chand, 2007.
5. **Heat transfer,** P. K. Nag, Tata McGraw Hill 2002.
6. **Heat transfer-A basic approach,** Ozisik, Tata McGraw Hilll 2002.
7. **Heat transfer, a practical approach,** Yunus a- Cengel Tata McGraw Hill.

DIGITAL IMAGE PROCESSING

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

Subject Code	**15MT754**	**IA Marks**	**20**
Number of Lecture Hours/Week	**03**	**Exam Marks**	**80**
Total Number of Lecture Hours	**40**	**Exam Hours**	**03**

CREDITS – 03

Course objectives: Students will be able to

1. gain knowledge of image, sampling, quantization, enhancement, and restoration of image.

2. understand different methods of image enhancement and restoration.

3. transform image using different transformations.

Modules	**Hours Teaching**	**Revised Bloom's Taxonomy(RBT) Level**
Module -1		
Digital image fundamentals: What is Digital image processing? Fundamental steps in digital image processing, components of an image processing system, elements of Visual Perception.	**8 Hours**	
Module -2		
Images sensing and Acquisition: images sampling and Quantization's, Some Basic Relationships between Pixels, Linear and Nonlinear Operations.	**8 Hours**	
Module -3		
Image Transforms: Two-dimensional orthogonal & unitary transforms, properties of unitary transforms, two dimensional discrete Fourier transform. Discrete cosine transform, Hadamard transform, Haar transform,	**8 Hours**	
Module -4		
Image Enhancement: Image Enhancement in Spatial domain, Some Basic Gray Level Transformations, Histogram Processing, Enhancement using Arithmetic/Logic Operations. Basics of Spatial Filtering Image enhancement in the Frequency Domain filters, Smoothing Frequency Domain filters, Sharpening Domain filters, homomorphic filtering.	**8 Hours**	
Module -5		
Model of image degrading/restoration process: noise models, Restoration in the Present of Noise, Linear Position-Invariant Degradations, inverse filtering, minimum mean square error (Weiner) filtering. Color Fundamentals. Color Models,	**8 Hours**	

Pseudo color. Image Processing., processing basics of full color image processing		

Course outcomes: On completion of the course the student will

CO1: have knowledge of different images, enhancement and restoration.

CO2: understand how images are formed, sampled, quantized and represented digitally.

CO3: process the images by applying different operations and transformation

Graduate Attributes (as per NBA):

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. "Digital Image Processing", Rafael C. Gonzalez and Richard e. Woods, Pearson Eucation, 2001, 2nd edition.

Reference Books:

1. "Fundamentals of Digital Image Processing", Anil K, Jain, Pearson Edun, 20010
2. "Digital Image Processing and Analysis", B. Chanda and D. Dutta Majumdar, PHI, 2003

INDUSTRIAL ROBOTICS

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

Subject Code	**15MT71**	IA Marks	20
Number ofLecture Hours/Week	04	Exam Marks	80
Total Number of Lecture Hours	50	Exam Hours	03

CREDITS – 04

Course objectives: Students will be able to

1. gain knowledge of Robotics and automation.
2. understand the working methodology of robotics and automation.
3. write the program for robot for various applications.

Modules	Hours Teaching	RevisedBloom's Taxonomy(RBT) Level
Module -1		
Fundamentals of Automation: Automation and robotics, history of robotics, robotics market and future prospects. **Fundamentals of Robotics:** robot anatomy, work volume, robot drive systems, control systems, precision of movement, end effectors, robotic sensors, robot programming and work cell control, robot applications, problems. Basic control systems and components: Basic control systems concepts and models, control system analysis, robot sensors and actuators.	**10 Hours**	
Module -2		
Robot Motion Analysis: Introduction to manipulator kinematics, homogeneous transformations and robot kinematics, manipulator path control, robot dynamics, configuration of a robot controller. **Robot End Effectors**: types of end effecters, mechanical grippers, other types of grippers, tools as end effectors, robot/end effector interface, consideration in gripper selection and design, problems. **Sensors in Robotics**: Transducers and sensors, sensors in robotics, tactile sensors, proximity and range sensors, uses of sensors in robotics, problems.	**10 Hours**	
Module -3		
Machine Vision, : Introduction to machine vision, sensing and digitizing function in machine vision, image processing and analysis, training the vision system, robotic applications, problems. **Robot Programming**: Methods of robot programming, lead -through programming methods, a robot program as a path in space, motion interpolation, wait, signal and delay commands, branching, capabilities and limitations of lead-through methods, problems. **Artificial Intelligence (AI):** Introduction & goals of AI in research, AI techniques, LISP programming, AI & robotics, LISP in factory, robotic paradigms, problems.	**10 Hours**	
Module -4		
Robot Cell Design & Control :Robot cell layouts, multiple robots and machine interference, considerations in work -cell design, work-cell control, interlocks, error detection and recovery, work -cell controller, robot cycle time analysis, graphic simulation of robotic work-	**10 Hours**	

cells, problems. **Material Transfer, Machine Loading/Unloading :**Material Transfer, Machine Loading/Unloading: General considerations in robot material handling, material transfer applications, machine loading and unloading.		
Module -5		
Robots in Automatic Processing Operations: Introduction, spot welding, continuous arc welding, spray coating, other processing operations. **Assembly & Inspection**: Assembly and robotic assembly automation, parts presentation methods, assembly operations, compliance and remote centre compliance (RCC) device, assembly system configurations, adaptable programmable assembly system, designing for robotic assembly, inspection automation.	**10 Hours**	

Course outcomes:

On completion of course students will

CO1: have knowledge of Robotics, automation, robotics motion, sensors and control, machine vision, robotic programming and roles of robots in industry

CO2: understand the working methodology of robotics and automation, motion and control, machine vision and programming, application of robots in industry.

CO3: write the program for robot for various applications

Graduate Attributes (as per NBA):

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. Mikell P. Groover, Mitchel Weiss, Roger N. Nagel, Nicholas G. Odrey and Ashish Dutta, "Industrial Robotics: Technology, Programming and Applications", 2 nd Edition, Tata McGraw Hill, 2012.
2. Roland Siegwart, Illah R. Nourbakhsh, an d Davide Scaramuzza, "Introduction to Autonomous Mobile Robots", 2 nd Edition, PHI, 2011.

ROBOTICS LABORATORY
[As per Choice Based Credit System (CBCS) scheme] SEMESTER – VII

Subject Code	15MTL77	IA Marks	20
Hours/Week	03	Exam Marks	80
Total Number of Lecture Hours	40	Exam Hours	03

CREDITS – 02

Course objectives: Students will be able to
1: Understand the Importance & Applications of Robots in Virtual Environment
2: Design the Robots system for Industrial Application

Laboratory Experiments:	**Revised Bloom's Taxonomy (RBT)Level**

LIST OF EXPERIMENTS

PART-A

1. Design the Robot programming for Point to Point using two Cubes.
2. Design the Robot programming for Drilling Operation using Cube and Cylinder.
3. Design the Robot programming using Smart Components.
4. Design the Robot programming for MutimoveOperation.
5. Design the Robot programming for Conveyor Tracking System.
6. Design the Robot programming for Continuous Path Operation on Cylinder

PART-B

1. Design a Robot System for Pick and Place Operation.
2. Design a Robot System for Point to Point operation.[Cube]
3. Design a Robot System for Continuous Path Operation.
4. Design a Robot System for Circle Path Operation.
5. Design a Robot System for Drilling Operation of Cube.
6. Design a Robot System for Continuous Path Operation for any 3 Objects [Cube, Box, Circle]

Note:

Part A: Experiments to be conducted using Software.

Part B: Experiments to be conducted using Robot system.

Course outcomes: On completion of the course the student will:

CO 1: Understand the importance of Robot system in Industrial Process in Virtual Environments
CO 2: Design and Develop a Robot System for Real time Industrial Process.

Scheme of Examination:

Experiment :
Part A : 35 Marks
Part B: 35 Marks
Viva- Voice : 10 Marks
Total : 80 Marks

REAL TIME SYSTEMS

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

Subject Code	**15MT743**	**IA Marks**	**20**
Number of Lecture Hours/Week	**03**	**Exam Marks**	**80**
Total Number of Lecture Hours	**40**	**Exam Hours**	**03**

CREDITS – 03

Course objectives: Students will be able to

- gain knowledge of real time systems, computer control, hardware & software requirements, operating systems, RTS developing methodologies.
- understand the operation of real time systems, computer control, hardware & software implementation for RTS, operating systems, RTS developing methodologies.

Modules	Hours Teaching	Revised Bloom's Taxonomy(RBT) Level
Module -1		
Introduction to Real-Time systems: Historical background, RTS definition, Classification of Real-time systems, Time constraints, Classification of Programs. **Concepts of computer control:** Introduction, Sequence Control, Loop control, Supervisory control, Centralized computer control, Distributed system, Human-computer interface, Benefits of computer control systems.	**8 Hours**	
Module -2		
Computer Hardware requirements for RTS: Introduction, General purpose computer, single chip microcontroller, specialized processors, Process-related Interfaces, Data transfer techniques, Communications, Standard Interface.	**8 Hours**	
Module -3		
Languages for Real-Time applications: Introduction, Syntax layout and readability, declaration and Initialization of Variables and Constants, Modularity and Variables. Compilation. Data types ,Control Structure, Exception Handling, Low-level facilities, Co routines, Interrupts and Device handling, concurrency, Real-time support, Overview of real-time languages.	**8 Hours**	
Module -4		
Operating Systems: Introduction, Real-time multi-tasking OS, Scheduling strategies. Priority Structures, Task management, Scheduler and real-time clock interrupt handles. Memory Management, Code sharing, Resource control, task co-operation and communication, Mutual exclusion, Minimum OS kernel.	**08 Hours**	
Module -5		

Design of RTSS- General Introduction: Introduction, Specification documentation, Preliminary design, single-program approach, Foreground/background systems. **RTS development methodologies:** Introduction, Yourdon Methodology, Ward and Mellor Method, Hately and Pirbhai method.	**08Hours**	

Course outcomes: On completion of the course the student will

CO1: have knowledge of real time systems, computer control, hardware & software requirements, operating systems, RTS developing methodologies.

CO2: understand the operation of real time systems, computer control, hardware & software implementation for RTS, operating systems, RTS developing methodologies.

Graduate Attributes (as per NBA):

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. **Real – time Computer Control – an introduction,** Sturt Bennel, 2ne Edn. Pearson Education. 2005.

Reference Books:

1. **Real-Time Systems Design and Analysis,** Philip, a. Laplante, second edition, PHI, 2005.
2. **Real-Time Systems Development,** Rob Williams, 2006.
3. **Embedded Systems,** Raj Kamal, Tata McGraw Hill, India, 2005.

SIGNAL PROCESS

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

SEMESTER – VII

Subject Code	**15MT73**	**IA Marks**	**20**
Number of Lecture Hours/Week	**04**	**Exam Marks**	**80**
Total Number of Lecture Hours	**50**	**Exam Hours**	**03**

CREDITS – 04

Course objectives: Students will be able to

1. gain knowledge of signal, system, transformation and filter.
2. understand time domain, frequency domain signals, analog and digital systems.
3. operate on signals and systems to bring out its characteristics and desired information.
4. design analog and digital filers and implement discrete time systems.

Modules	**Hours Teaching**	**Revised Bloom's Taxonomy(RBT) Level**
Module -1		
Introduction: Definitions of a signal and a system, classification of signals, basic Operations on signals, Basic elementary signals, properties of systems.	**10 Hours**	
Module -2		
Time-domain representations for LTI systems: Convolution, impulse response representation, Convolution Sum and Convolution Integral. Properties of impulse response representation,	**10 Hours**	
Module -3		
Discrete Fourier Transforms (DFT): Introduction to DFT, Properties of DFT, multiplication of two DFTs- the circular convolution, additional DFT properties, use of DFT in linear filtering, overlap-save and overlap-add method. Fast-Fourier-Transform (FFT) algorithms: Direct computation of DFT, need for efficient computation of the DFT (FFT algorithms). Radix-2 FFT algorithm for the computation of DFT and IDFT–decimation-in-time and Decimation-in-frequency Algorithms	**10 Hours**	
Module -4		
IIR filter design: Characteristics of commonly used analog filters – Butterworth and Chebyshev filters, analog to analog frequency transformations. Design of IIR filters from analog filters (Butterworth and Chebyshev) - impulse invariance method. Mapping of transfer functions: Approximation of derivative (bilinear transformation) method, Verification for stability and linearity during mapping	**10 Hours**	

Module -5		
FIR filter design: Introduction to FIR filters, design of FIR filters using - Rectangular, Hamming, Hanning and Kaiser windows, FIR filter design using frequency sampling Technique. Implementation of discrete-time systems: Structures for IIR and FIR systems-direct form I and direct form II systems, cascade, lattice and parallel realization.	**10 Hours**	

Course outcomes: On completion of the course the student will

CO1: have knowledge of signal, system, transformation, filter design.

CO2: understand the difference between time domain, frequency domain, analog and digital filters.

CO3: transform the signals from one domain to other domain using transformation techniques.

CO4: design analog and digital filters for specific applications.

Graduate Attributes (as per NBA):

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. **Digital signal processing** – **Principles Algorithms & Applications**, Proakis & Monalakis, Pearson education, 4th Edition, New Delhi, 2007.
2. **"Signals and Systems",** Simon Haykin and Barry Van Veen John Wiley & Sons, 2001.

Reference Books:

1. **Discrete Time Signal Processing**, Oppenheim & Schaffer, PHI, 2003.
2. **Digital Signal Processing**, S. K. Mitra, Tata Mc-Graw Hill, 2nd Edition, 2004.
3. **Digital Signal Processing**, Lee Tan: Elsivier publications, 2007
4. Alan V Oppenheim, Alan S, Willsky and A Hamid Nawab, "Signals and Systems" Pearson Education Asia / PHI, 2nd edition, 1997. Indian Reprint 2002
5. H. P Hsu, R. Ranjan, "Signals and Systems", Scham's outlines, TMH, 2006
6. B. P. Lathi, "Linear Systems and Signals", Oxford University Press, 2005.
7. Ganesh Rao and Satish Tunga, "Signals and Systems", Sanguine Technical Publishers, 2004.

AUTOMOTIVE ELECTRONICS AND HYBRID VEHICLES

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

Subject Code	**15MT81**	**IA Marks**	**20**
Number of Lecture Hours/Week	**04**	**Exam Marks**	**80**
Total Number of Lecture Hours	**50**	**Exam Hours**	**03**

CREDITS – 04

Course objectives: Students will be able to

- gain Knowledge of developing basic skills necessary to diagnose automotive electrical problems, to include electrical principles, use of basic electrical test equipment.
- understand the advanced automotive electrical systems, to include body electrical accessories, and basic computer control.
- diagnosis the problem automotive batteries, starting, and charging, lighting systems, body electrical accessories, and basic computer control.

Modules	Hours Teaching	Revised Bloom's Taxonomy(RBT) Level
Module -1		
Automotive Fundamentals Overview: Four Stroke Cycle, Engine Control, Ignition System, Spark plug, Spark pulse generation, Ignition Timing, Drive Train, Transmission, Brakes, Steering System, Battery, Starting System.**Air/Fuel Systems** Fuel Handling, Air Intake System, Air/ Fuel Management	**10 Hours**	
Module -2		
Sensors – Oxygen (02/EGO) Sensors, Throttle Position Sensor (TPS), Engine Crankshaft Angular Position (CKP)Sensors, Hall effect Position Sensor, Shielded Field Sensor, Optical Crankshaft Position Sensor, Manifold Absolute Pressure (MAP) Sensor – Strain gauge and Capacitor capsule, Engine Coolant Temperature (ECT) Sensor, Intake Air Temperature (IAT) Sensor, Knock Sensor, Airflow rate sensor, Throttle angle Sensor. **Actuators:** Fuel Metering Actuator, Fuel Injector, Ignition Actuator. Exhaust After-Treatment Systems – AIR, Catalytic Converter, Exhaust Gas Recirculation (EGR), Evaporative Emission Systems.	**10 Hours**	
Module -3		
Automotive Instrumentation and Communication: Sampling, Measurement & Signal Conversion of various parameters (Speed, fuel, pressure). Serial Data, Communication Systems, Protection, Body and Chassis is Electrical Systems,	**10 Hours**	

Remote Keyless Entry, GPS		
Module -4		
Vehicle Motion Control: Cruise control, Chassis, Power Brakes, Antilock Brake System (ABS), Electronic Steering Control, Power Steering, Traction Control, Electronically controlled suspension. **Automotive Diagnostics –**Timing Light, Engine Analyzer, On-board diagnostics, Off-board diagnostics, Expert Systems. **Future Automotive Electronics Systems: Alternative** Fuel Engines, Collision Avoidance Radar warning Systems, Low tire pressure warning system, Radio navigation, Advance Driver Information System	**10 Hours**	
Module -5		
Introduction to Alternative Vehicles: Electric Vehicle, Hybrid Electric vehicle, Electric Hybrid Vehicle, Vehicle components, Electric and Hybrid history EV/CEV Comparison. **Alternative Vehicle Architecture:** Electric Vehicles, Hybrid Electric Vehicles, Plug-in Hybrid Electric Vehicles, Power Train component Sizing, Mass Analysis & Packaging, Vehicle Simulation.	**10 Hours**	

Course outcomes: On completion of the course the student will

CO1: have knowledge of automotive electronics domain of various Engine parts, Sensor, Actuator, Communication and Measurement System.

CO2: understanding the engine parameters and a critical awareness of current problems within the automotive electronics domain using Various Measurement Technology.

CO3: determine the extent and nature of electronic circuitry in automotive systems including monitoring and control circuits for engines, transmissions, brakes, steering, suspension, climate control, instrumentation and radios and accessories involved in Automotive Industry.

Graduate Attributes (as per NBA):

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) **Willliam B. Ribbens:** Understanding Automotive Electronics, 6th Edition, SAMS/Elsevier Publishing
2) Iqbal Husain "Electric and Hybrid Vehicles: Design fundamentals". CRC Press, 2011.

Reference Books:

1. **Robert Bosch GmbH:** Automotive Electronics Systems and Components 5th Edition, John Wiley & Sons Ltd., 2007
2. James Laminie and John Lowry. "Electric Vehicle Technology – Explained', CRC Press 2010.
3. Society of Automobile Engineers, "Hybrid Electric vehicles", CRC Press, 2011.

COMMUNICATION SYSTEM

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

Subject Code	**15MT81**	**IA Marks**	**20**
Number of Lecture Hours/Week	**04**	**Exam Marks**	**80**
Total Number of Lecture Hours	**50**	**Exam Hours**	**03**

CREDITS – 04

Course objectives: Students will be able to

- gain the Knowledge Of different modulation techniques, analog and digital modulation and demodulation, different wave form code techniques and spread spectrum
- understand the concept of methods of generating modulated and demodulated signals, encoding and decoding techniques, multiplexing and demultiplexing of signals

Modules	Hours Teaching	Revised Bloom's Taxonomy(RBT) Level
Module -1		
Introduction To Communication Systems: Information, Transmitter, chanel-noise, Receiver, modulation, need for modulation, band width requirements, sine wave and Fourier series review, frequency spectra of non sinusoidal waves. Basic signal processing operations in digital communication. Sampling Principles: Sampling Theorem	**10 Hours**	
Module -2		
Amplitude Modulation: Introduction AM Time-Domain description, Frequency – Domain description. Generation of AM wave: square law modulator, switching modulator. Detection of AM waves: square law detector, envelop detector. Double side band suppressed carrier modulation (DSBSC): Time-Domain description, Frequency-Domain representation, Generation of DSBSC waves: balanced modulator, ring modulator. Coherent detection of DSBSC modulated waves. Costas loop.	**10 Hours**	
Module -3		
Angle Modulation & Demodulation: Basic definitions, FM, narrow band FM, wide band FM, transmission bandwidth of FM waves, generation of FM waves: indirect FM and direct FM, Demodulation of FM waves, FM stereo multiplexing, Phase-locked loop, Nonlinear model of the phase – locked loop, Linear model of the phase – locked loop, Nonlinear effects in FM systems.	**10 Hours**	
Module -4		

Waveform Coding Techniques: PAM, TDM. Waveform Coding Techniques, PCM, Quantization noise and SNR, robust quantization. DPCM, DM, applications. Line Codes : Unipolar RZ& NRZ, Polar RZ& NRZ, Bi-Polar RZ & NRZ ,Manchester	**10 Hours**	
Module -5		
Spread Spectrum Modulation: Pseudo noise sequences, notion of spread spectrum, direct sequence spread spectrum, coherent binary PSK, frequency hop spread spectrum, applications. Digital Multiplexers: FDM ,TDM ,Classification of Multiplexers ,T1 Carrier System	**10 Hours**	

Course outcomes: On completion of the course the student will

CO 1: have Knowledge Of different modulation techniques, analog and digital modulation and demodulation, different wave form code techniques and spread spectrum

CO 2: understand the concept of generation modulated and demodulated signals, encoding and decoding techniques multiplexing and demultiplexing of signals

Graduate Attributes (as per NBA):

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. Communication Systems, Simon Haykins, 3rd Edition, John Willey, 1996.
2. An Introduction to Analog and Digital Communication, Simon Haykins, John Wiley, 2003
3. Digital communications, Simon Haykin, John Wiley, 2003.

Reference Books:

1. Modern digital and analog Communication systems B. P. Lathi, 3rd ed 2005 Oxford University press.
2. Communication Systems, Harold P.E, Stern Samy and A Mahmond, Pearson Edn, 2004.
3. Communication Systems: Singh and Sapre: Analog and
4. Digital and analog communication systems & An introduction to Analog and Digital Communication, K. Sam Shanmugam, John Wiley, 1996. 2.Simon Haykin, John Wiley, 2005

PRODUCT DESIGN & DEVELOPMENT

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

Subject Code	**15MT831**	IA Marks	20
Number ofLecture Hours/Week	03	Exam Marks	80
Total Number of Lecture Hours	40	Exam Hours	03

CREDITS – 03

Course objectives: Students will be able to

1. gain knowledge of Product life-cycle , Product design process, Product analysis
2. understand the value engineering, product design tools and Reverse Engineering

Modules	Hours Teaching	RevisedBloom's Taxonomy(RBT) Level
Module -1		
·**Product life-cycle:** Product policy of an organization. Selection of a profitable product, Product design process, Product analysis.	**8 Hours**	
Module -2		
· **Value engineering in product design:** Advantages, Applications in product design, Problem identification and selection, Analysis of functions, Anatomy of function. Primary versus secondary versus tertiary/unnecessary functions, Functional analysis: Functional Analysis System Technique (FAST), Case studies.	**8 Hours**	
Module -3		
Introduction to product design tools: QFD, Computer Aided Design, Robust design, DFX, DFM, DFA, Ergonomics in product design	**8 Hours**	
Module -4		
Product design for manual assembly: Design guidelines for metallic and non metallic products to be manufactured by different processes such as casting, machining, injection molding etc., Rapid prototyping, needs, advantages,	**8 Hours**	
Module -5		
Reverse engineering: Functionality- dimensional- developing technical data - digitizing techniques - construction of surface model - solid-part material-characteristics evaluation -software and application prototyping – verification	**8 Hours**	

Course outcomes:

On completion of course students will

CO1: have knowledge of Product life-cycle , Product design process, Product analysis .

CO2: understand the value engineering, product design tools and Reverse Engineering

Graduate Attributes (as per NBA):

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. **Product Design** and **Development** by Karl T. Ulrich and Steven D. Eppinger (McGraw-Hill 1995, 2000, 2004, 2008)
2. Reverse Engineering, Katheryn, A. Ingle, McGraw-Hill, 1994

Reference Books:

1. "**Engineering Design**", George E.Dieter, Linda C.Schmidt, McGraw-Hill International Edition, 4th Edition, 2009, ISBN 978-007-127189-9

2. "**Product Design and Development** ", Anita Goyal, Karl T Ulrich, Steven D Eppinger, 4th Edition, 2009, Tata McGraw-Hill Education, ISBN-10-007-14679-9

3. "**Product Design**", Kevin Otto, Kristin Wood, Indian Reprint 2004, Pearson Education,ISBN 9788177588217

4. "**Engineering Design Process**", Yousef Haik, T. M. M. Shahin, 2nd Edition Reprint, Cengage Learning, 2010, ISBN 0495668141

5. "**Engineering Design: A Project-based Introduction**", Clive L.Dym, Patrick Little, 3rd Edition, John Wiley & Sons, 2009, ISBN 978-0-470-22596-7

ANALOG AND DIGITAL ELECTRONICS LAB

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

Subject Code	15MTL38	IA Marks	20
Hours/Week	03	Exam Marks	80
Total Number of Lecture Hours	-	Exam Hours	03

CREDITS – 02

Course objectives:

1) Is to understand the characteristics and working of analog and digital components.
2) Is to design and develop analog and digital applications

Laboratory Experiments:	**Revised Bloom's Taxonomy (RBT) Level**
1. Clipper circuits and Clamper circuits using diodes. 2. Single stage RC coupled amplifier using BJT and its frequency respons. 3. Invering Amplifier, Non inverting Amplifier, voltage Follower using Opamp. 4. Astable and Monostable multivibrator using timer 555. 5. RC phase shift Oscillator using BJT. 6. Simplification and realization of Boolean expression using logic gates/ universal gates. 7. Half adder and Full Adder using logic gates. 8. Decoder and Encoders 9. Multiplexers and demultiplexers. 10. Design and development of counters.	

Course outcomes:

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

CONTROL SYSTEMS

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

Subject Code	15MT34	IA Marks	20
Number ofLecture Hours/Week	04	Exam Marks	80
Total Number of Lecture Hours	50	Exam Hours	03

CREDITS – 04

Course objectives:
The main objective of this course is to teach the fundamental concepts of Control systems, mathematical modeling of the system and to study the concept of time response and frequency response of the system and teach the basics of stability analysis of the system.

Modules	Hours Teaching	RevisedBloom'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**	
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**	
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. Construction of root loci. Stability analysis using Root locus Technique Numerical problems on all topics.	**10 Hours**	
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	**10 Hours**	

analysis using Polar plot. Numerical problems on all		
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 Nonhomogeneous state equations. Properties of state transition matrix, computation of state transition matrix by matrix exponential and Laplace transform method. Numerical problems	**10 Hours**	

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):

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