

# IK GUJRAL PUNJAB TECHNICAL UNIVERSITY

## Scheme and Syllabus of Master of Technology (EPDT)

Batch 2016

Semester-I								
Course Code	Course Title	L	T	P	Marks Distribution		Total Marks	Credits
					Internal	External		
MTRM-101	Research Methodology	3	1	0	50	100	150	4
MTET-102	Advanced Digital system Design	3	1	0	50	100	150	4
MTET-103	Electronic Product Design	3	1	0	50	100	150	4
MTET-104	Advanced Microcontroller Embedded System	3	1	0	50	100	150	4
MTET-105	Designing with Power Devices	3	1	0	50	100	150	4
MTET-106	Lab – I	0	0	4	100		100	2
<b>Total</b>		<b>15</b>	<b>5</b>	<b>4</b>	<b>350</b>	<b>500</b>	<b>850</b>	<b>22</b>

Semester-II								
Course Code	Course Title	L	T	P	Marks Distribution		Total Marks	Credits
					Internal	External		
MTET-201	Embedded System Design	3	1	0	50	100	150	4
MTET-202	Computer Integrated Manufacturing Systems	3	1	0	50	100	150	4
MTET-203	Advanced Digital Signal Processing	3	1	0	50	100	150	4
MTET-	Elective-I	3	1	0	50	100	150	4
MTET-	Elective-II	3	1	0	50	100	150	4
MTET-204	Lab – II	0	0	4	100		100	2
<b>Total</b>		<b>15</b>	<b>5</b>	<b>4</b>	<b>350</b>	<b>500</b>	<b>850</b>	<b>22</b>

Semester-III								
Course Code	Course Title	L	T	P	Marks Distribution		Total Marks	Credits
					Internal	External		
MTET-	Elective-III	3	1	0	50	100	150	4
MTET-	Elective-IV	3	1	0	50	100	150	4
MTET-301	Project	0	0	4	100	50	150	4
MTET-302	Seminar	0	0	2	50	-	50	1
MTET-303	Dissertation(Synopsis)	0	0	6	-	-	-	S/US
<b>Total</b>		<b>6</b>	<b>2</b>	<b>12</b>	<b>250</b>	<b>250</b>	<b>500</b>	<b>13</b>

Semester-IV								
Course Code	Course Title	L	T	P	Marks Distribution		Total Marks	Credits
					Internal	External		
MTET-303	Dissertation	0	0	20	-	-	-	S/US
<b>Total</b>		<b>0</b>	<b>0</b>	<b>20</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>

S-Satisfactory, US-Unsatisfactory

**LIST OF ELECTIVES**

**Elective-I**

MTET-205 Microelectronic Technology

MTET-206 Medical Instrumentation

MTET-207 Industrial Automation

**Elective-II**

MTET 208 Machine Vision Systems

MTET 209 Soft Computing Techniques

MTET 210 Sensor Data Fusion

**Elective-III**

MTET-304 Embedded System for Wireless & Mobile Communication

MTET-305 Embedded Wireless Sensor Network

MTET-306 Mechatronic Systems

MTET-307 Autotronics

**Elective-IV**

MTET-308 Electronic and Packaging

MTET-309 Advanced Sensors and Actuator

MTET-310 Sensor Technology and MEMS

MTET-311 Data Communication and Networks

**MTRM-101 RESEARCH METHODOLOGY**

<b>Internal Marks:</b>	<b>50</b>	<b>L</b>	<b>T</b>	<b>P</b>
<b>External Marks:</b>	<b>100</b>	<b>3</b>	<b>1</b>	<b>0</b>
<b>Total Marks:</b>	<b>150</b>			

**METHODS OF RESEARCH:** Nature and Objectives of research; historical, descriptive and experimental. Study and formulation of research problem. Scope of research and formulation of hypotheses; Feasibility, preparation and presentation of research proposal.

**INTRODUCTION TO STATISTICAL ANALYSIS:** Measures of central tendency and dispersion: mean, median, mode, range, mean deviation and standard deviation. Regression and correlation analysis. Probability and probability distributions; Binomial, Poisson, Geometric, Negative binomial, Uniform, Exponential, Normal and Log-normal distribution. Basic ideas of testing of hypotheses; Tests of significance based on normal, t and Chi-square distributions. Analysis of variance technique.

**DESIGN OF EXPERIMENTS:** Basic principles, study of completely randomized and randomized block designs. Edition and tabulation of results, presentation of results using figures, tables and text, quoting of references and preparing bibliography. Use of common softwares like SPSS, Mini Tab and/or Mat Lab. For statistical analysis.

**BOOKS RECOMMENDED:**

- Borth Wayne C., The Craft of Research, Chicago Guides to Writing Edition and Publishing.
- Johnson R.A., Probability and Statistics, PHI, New Delhi.
- Meyer P.L., Introduction to Probability and Statistical, Applications, Oxford, IBH.
- Hogg, R.V. and Craig A.T., Introduction to Mathematical Statistics, MacMillan.
- Goon, A.M., Gupta, M.K. and Dasgupta, Fundamentals of Statistics, Vol. I: World Press.
- Gupta, S.C. and Kapoor V.K., Fundamentals of Mathematical Statistics, Sultan Chand and Sons.

**MTET-102 ADVANCED DIGITAL SYSTEM DESIGN**

<b>Internal Marks:</b>	<b>50</b>	<b>L</b>	<b>T</b>	<b>P</b>
<b>External Marks:</b>	<b>100</b>	<b>3</b>	<b>1</b>	<b>0</b>
<b>Total Marks:</b>	<b>150</b>			

**INTRODUCTION TO DIGITAL DESIGN**

Number Systems, Signed, Unsigned number, 1's Complement, 2's Complement, Binary Operations - Addition, Subtraction using 1's & 2's Complement etc., Code converters-Excess-3, Gray Code.

**LOGIC CIRCUIT DESIGN**

Universal Gates, Karnaugh Maps, Minimization of Logic Functions- Sum of Products, Product of Sum, Minimization of Logic Circuit.

**HARDWARE DESCRIPTION LANGUAGES**

Introduction to VHDL, Design Units, Modeling styles- Behavioral, Structural and Concurrent, VHDL based digital design flow, Data objects, Data types, Delay models- Delta, Inertial, & Transport, Concurrent statements, Sequential statements, Process statements, Conditional & Selective signal assignments, Generate statements, Signal and Variable assignments, Synthesis of statements, Loops- for loop, while loop, Subprograms – Functions, Procedures, Generic, Package, IEEE standard logic library, Test bench, Component declaration, Instantiation, Configuration- declaration & specification.

**FINITE STATE MACHINES (FSMS)**

Review of Moore and Mealy state machines, Finite state machines, Representation, Design steps, FSM code structure, Synthesis of FSMs

**ASYNCHRONOUS SEQUENTIAL CIRCUITS**

Analysis & Synthesis of asynchronous digital circuits, State Reduction, State Assignment, Hazards.

**TESTING OF DIGITAL CIRCUITS**

Introduction, Types of faults, Fault modeling, Path sensitization, Testing algorithms-D-frontier and PODEM, Linear Feedback Shift Register, Built in Self Test.

**FPGA Prototyping**

Introduction, Elements of FPGA, FPGA Implementation of following circuits –Full Adder, Subtractor, Decoder, Encoder, Data Selector, Ripple Carry Adder, Arithmetic Logic Unit, ROM, 4X4 Key board controller.

**BOOKS RECOMMENDED:**

- Fundamentals of Digital Logic with VHDL design – Stephen Brown, Zvonko Vranesic – Tata McGraw Hill.
- Digital Design Principles – Fletcher.
- Logic and Computer Design Fundamentals – Morris Mano
- VHDL Primer – J. Bhasker – Pearson Education.

**REFERENCE :**

- Digital System Design Using VHDL – Charles H. Roth.
- Digital System Design – John Wakerley.
- VHDL – 3rd Edition – Douglas Perry – Tata McGraw Hill
- VHDL – Zainalabedin Navabbi

**MTET-103 ELECTRONIC PRODUCT DESIGNING**

<b>Internal Marks:</b>	<b>50</b>	<b>L</b>	<b>T</b>	<b>P</b>
<b>External Marks:</b>	<b>100</b>	<b>3</b>	<b>1</b>	<b>0</b>
<b>Total Marks:</b>	<b>150</b>			

**System Reliability Concepts**

Introduction to concepts of reliability, nature of reliability problems in electronic equipment, series configuration, Parallel Configuration, Mixed Configuration, Methods of Solving Complex Systems, Mean Time to Failure (MTTF) and Mean Time between Failure (MTBF) of Systems. Maintainability, Availability Concepts, System Downtime, Mean time to Repair (MTTR), Fault Tree Analysis- Concepts and Procedures, Rules for Fault Tree Construction.

**Ergonomics and Aesthetics in Electronic Product Design:** Overview of Electronic Product Design, Top-Down and Bottom-Up Approach, Considering Power Supply Design as an example, Ergonomic and Aesthetics definition with Example, issues in Designing Electronic Products, Design of Controls and Display w.r.t. Ergonomic and Aesthetics Consideration.

**Control Panel Design and thermal consideration:** Types of Controls, Design and Organization of Control Panel, Engineering Considerations, Layout of Components, Selection of Materials, Sheet metals and plastic, Structural Design and Control Cabinets Fabrication. Thermal management of electronic equipment, Thermal design considerations, Component level, board level, system level, Fans and system operating characteristics, Heat Sink design.

**Computer Aided design:** Introduction to Computer Aided Design, Applications and Examples, Finite Element Methods (FEM) and Analysis, Techniques for Surface Modelling, Rendering and Shading, Sources of New Ideas, Creativity Techniques, Form factor, Shape, Colour, Graphics etc.

**Packaging**

Standardization and modulation, Design considerations for interconnection, Types of interconnections, Wires, cables, connector, Treatment of Vibration.

**BOOKS:**

- Ralph Remsburg, “Advanced Thermal Design of Electronic Equipment”, Springer
- V.S.Bagad, “Electronic Product Design”, Technical Publications.
- Dave S. Steinberg, “Cooling techniques for electronic equipment”, Wiley, 1991
- Ernest Paul DeGarmo, J. T. Black, Ronald A. Kohser “Materials and Processes in Manufacturing”, John Wiley & Sons.
- Military Handbook, Electronic

**REFERENCES**

- Ergonomics at work, David J. Osborne, Pub. Wiley (Text)
- SAMEER Notes on Product Design, Thermal Design
- Product Design of Electronic Equipment, SAMEER
- SAMEER Notes on Ergonomics and Human Interface

**MTET-104 ADVANCED MICROCONTROLLER EMBEDDED SYSTEM**

<b>Internal Marks:</b>	<b>50</b>	<b>L</b>	<b>T</b>	<b>P</b>
<b>External Marks:</b>	<b>100</b>	<b>3</b>	<b>1</b>	<b>0</b>
<b>Total Marks:</b>	<b>150</b>			

**The PIC18 Microcontrollers:** History and Features, PIC18 Architecture ,Assembly Language Programming: Branch, Call and Time Delay Loop PIC18 I/O Port Programming Arithmetic, Logic Instructions and Programs, Bank Switching, Table Processing, Macros, and Modules, PIC18 Programming in C,PIC18 Hardware Connections and ROM Loaders, PIC18 Interfacing: PIC18 Timer Programming in Assembly and C, Serial Port Programming in Assembly and C Interrupt Programming in Assembly and C, LCD and Keyboard Interfacing, ADC, DAC, and Sensor Interfacing, SPI Protocol and DS1306 RTC Interfacing, Motor Control: Relay, PWM, DC, and Stepper Motors

**ARM Processors:** Introduction, History of ARM Processors, Basic Architecture and organization of Cortex-M3 processor, ARM Processor (Cortex-M3) Fundamentals: Registers, Application Program Status Register: Current Program Status Register, Pipeline (3-stage pipeline ARM organization, 5-stage pipeline ARM organization), ARM instruction execution, Exceptions, Interrupts and Vector Table.

**Cortex\_M3 Instruction Set:** Introduction, Exceptions, Conditional execution, Branch and Branch with Link (B, BL) and exchange (BX, BLX), ARM instructions, Software Interrupt (SWI), Unused instruction space, Thumb Instruction Set

**Support for System Development** Memory faults, The ARM memory interface, The Advanced Microcontroller Bus Architecture (AMBA), The JTAG boundary scan test architecture, The ARM debug architecture, Signal processing support.

**TEXT BOOKS**

- PIC Microcontroller by Muhammad Ali Mazidi, Rolin D. McKinlay, Danny Causey Pearson Education
- Daniel W Lewis, "Fundamentals of Embedded Software with the ARM Cortex-M3". Upper Saddle River, NJ: Prentice Hall, 2012
- Ledin, Embedded Control Systems in C/C++: An Introduction for Software Developers Using MATLAB,Elsevier, 2004
- W.Bosshart, Design & Fabrication of PCB

**REFERENCE BOOKS**

- John B. Peatman, "Design with PIC Micro controller", Pearson Education, 1988
- Andrew N. Sloss, Donimic Symes, Chris Wright, "ARM System Developer's Guide",
- Steave Furber, "ARM system - on - chip architecture", Addison Wesley, 2000
- Joseph Yiu "The Definitive Guide to the ARM Cortex-M3". 2nd edition. Netherlands: Newnes, 2009
- jonathan W Valvano "Embedded Systems: Introduction to ARM Cortex™-M3 Microcontroller" Volume 1. CreateSpace Independent Publishing Platform, 2012

**MTET-105 DESIGNING WITH POWER DEVICES**

<b>Internal Marks:</b>	<b>50</b>	<b>L</b>	<b>T</b>	<b>P</b>
<b>External Marks:</b>	<b>100</b>	<b>3</b>	<b>1</b>	<b>0</b>
<b>Total Marks:</b>	<b>150</b>			

**POWER SEMICONDUCTOR DEVICES**

General characteristics of Power devices such as GTOs, Power BJT ,Power MOSFET,IGBT,MCT

**TRANSFORMER DESIGN**

Fundamentals, Selection of core material, Insulating material and wires, Design Methodology of pulse transformers, High Frequency transformers, Design of Transformers for PWM converters

**COILS**

Fundamentals, Selection of core material, Insulating materials and wires, Design of inductors for power frequency, Radio frequency & High frequency

**SWITCH MODE POWER SUPPLIES**

Basic regulators-Buck, Boost, Buck Boost, Derived topologies-flyback, forward, Pushpull, half & full bridge converter, Special converters like Cuk" converter, PWM control techniques, Study of PWM control ICs Design of base derive circuits, Design of input section, output section & control section, Thermal design concepts, EMI/EMC considerations, Protection circuit design for power supplies.

**UPS AND OTHER POWER SUPPLIES**

Concept of Uninterrupted power supplies, Inverter preferred (online UPS), Line preferred UPS system (offline UPS system),Line interactive UPS system, Reliability of UPS system, Solar cells as power source devices & their characteristics.

**BOOKS:**

- George Chrysis, „High frequency switching power supplies: theory & design” McGraw Hill Book Co. 1984 (Text)

**REFERENCES:**

- K.Kitsum, “ Switch mode power conversion –basic theory and design” Marcel Deckker Inc 1984.
- N.Radhakrishnan and S.R.Bhat, “Design and technology of low power transformers and inductors” CEDT, July 1998



**MTET-106 LAB-I**

<b>Internal Marks:</b>	<b>100</b>	<b>L</b>	<b>T</b>	<b>P</b>
<b>External Marks:</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>4</b>
<b>Total Marks:</b>	<b>100</b>			

**MODULE-I**

- Design and Implementation of following features in Counter:-Counter with Asynchronous reset & clear signal, Synchronous Counter, Mod 10 Counter, FSM.
- Design and Implementation of ALU with following features:-Addition, Subtraction, Multiplication, Division, Square, Factorial, AND, OR, EXOR, EXNOR, Increment, Decrement, 1's Complement, 2's Complement etc.
- Design and Implementation of 8 X 8 Key board controller.
- Design and Implementation of Shift Register with following features:-Parallel in Serial out, Serial in Parallel out, Parallel in Parallel out, Serial in Serial out, Universal Shift Register.
- Design and Implementation of Hardware Multiplier.
- Design and Implementation of Universal Asynchronous Transmitter & Receiver.

**MODULE-II**

- Simple programs for sorting a list of numbers in ascending and descending order.
- Sorting a list without destroying the original list.
- Code conversion - Binary to Gray/Gray to Binary.
- Program for addition of BCD numbers.
- Interface an LED array and 7-segment display
- Interfacing of PIC18 with LCD
- Interfacing of PIC18 with Keyboard Interfacing
- Interfacing of PIC18 with ADC,DAC
- Interfacing of PIC18 with temperature Sensor
- Interfacing of PIC18 with DS1306 RTC
- Interfacing of PIC18 with DC Motor Control
- Interfacing of PIC18 with Stepper Motors

## **MTET-201 EMBEDDED SYSTEM DESIGN**

<b>Internal Marks:</b>	<b>50</b>	<b>L</b>	<b>T</b>	<b>P</b>
<b>External Marks:</b>	<b>100</b>	<b>3</b>	<b>1</b>	<b>0</b>
<b>Total Marks:</b>	<b>150</b>			

### **INTRODUCTION AND EXAMPLES OF EMBEDDED SYSTEMS**

Concept Of Embedded System Design: Design challenge, Processor technology, IC technology, Design technology, Trade-offs

### **CUSTOM SINGLE PURPOSE PROCESSOR HARDWARE, GENERAL PURPOSE PROCESSOR**

Introduction, basic architecture, operation, super-scalar and VLSIIW architecture, application specific instruction set processors (ASIPS), microcontrollers, digital signal processors, selecting a microprocessor.

### **MEMORY**

Introduction, Memory writes ability, Storage performance, Tradeoff s, Common memory types Memory hierarchy and cache

### **AVR 8515 MICROCONTROLLER**

Architecture and Programming in assembly and C. Interfacing Analog and digital blocks: Analog-to-Digital Converters (ADCs), Digital to-Analog, Converters (DACs)., Communication basics and basic protocol concepts, Microprocessor interfacing: I/O addressing, Port and Bus based, I/O, Memory mapped I/O, Standard I/O interrupts, Direct memory access, Advanced communication principles parallel, serial and wireless, Serial protocols I2C, Parallel protocols PCI bus, Wireless protocol IrDA, blue tooth.

### **DIFFERENT PERIPHERAL DEVICES**

Buffers and latches, Crystal, Reset circuit, Chip select logic circuit, timers and counters and watch dog timers, Universal asynchronous receiver, transmitter (UART), Pulse width modulators, LCD controllers, Keypad controllers. Design tradeoffs due to thermal considerations and Effects of EMI/ES etc.

### **SOFTWARE ASPECT OF EMBEDDED SYSTEMS**

Challenges and issues in embedded software development, Co-design

### **EMBEDDED SOFTWARE DEVELOPMENT ENVIRONMENTS**

Real time operating systems, Kernel architecture: Hardware, Task/process control subsystem, Device drivers, File subsystem, system calls, Embedded operating systems, Task scheduling in embedded systems: task scheduler, first in first out, shortest job first, round robin, priority based scheduling, Context switch: Task synchronization: mutex, semaphore, Timers, Types of embedded operating systems, Programming languages: assembly languages, high level languages

### **DEVELOPMENT FOR EMBEDDED SYSTEMS**

Embedded system development process, Determine the requirements, Design the system architecture, Choose the operating system, Choose the processor, Choose the development platform, Choose the programming language, Coding issues, Code optimization, Efficient input/output, Testing and debugging, Verify the software on the host system, Verify the software on the embedded system

**BOOKS:**

- Frankvahid/Tony Givargis, “Embedded System Design- A unified Hardware/software Introduction”.
- David E Simon, " An embedded software primer ", Pearson education Asia, 2001.
- Dreamteach Software team, ” Programming for Embedded Systems” AVR 8515 manual
- J.W. Valvano, "Embedded Microcomputer System: Real Time Interfacing"
- Jack Ganssle, "The Art of Designing Embedded Systems", Newnes, 1999.

**MTET-202 COMPUTER INTEGRATED MANUFACTURING SYSTEMS**

<b>Internal Marks:</b>	<b>50</b>	<b>L</b>	<b>T</b>	<b>P</b>
<b>External Marks:</b>	<b>100</b>	<b>3</b>	<b>1</b>	<b>0</b>
<b>Total Marks:</b>	<b>150</b>			

**INTRODUCTION**

Objectives of a manufacturing system-identifying business opportunities and problems classification production - systems-linking manufacturing strategy and systems-analysis of manufacturing operations.

**COMPUTER AIDED PLANNING AND CONTROL**

Production planning and control-cost planning and control-inventory management-Material requirements planning - (ERP)-shop floor control-Factory data collection system-Automatic identification system-barcode technology automated data collection system.

**COMPUTER MONITORING**

Types of production monitoring systems-structure model of manufacturing process-process control & strategies direct digital control-supervisory computer control-computer in QC –contact inspection methods non-contact inspection method - computer-aided testing –integration of CAQC with CAD/CAM.

**INTEGRATED MANUFACTURING SYSTEM**

Definition - application - features - types of manufacturing systems-machine tools-materials handling system computer control system - DNC systems manufacturing cell. Flexible manufacturing systems (FMS) - the FMS concept-transfer systems - head changing FMS – variable mission manufacturing system - CAD/CAM system - human labour in the manufacturing system- computer integrated manufacturing system benefits. Rapid prototyping - Artificial Intelligence and Expert system in CIM.

**BOOKS:**

- Groover, M.P., "Automation, Production System and CIM", Prentice-Hall of India, 1998.

**REFERENCES:**

- David Bedworth, "Computer Integrated Design and Manufacturing", TMH, New Delhi, 1998.
- Yorem Koren, "Computer Integrated Manufacturing Systems", McGraw Hill, 1983.
- Ranky, Paul G., "Computer Integrated Manufacturing", Prentice Hall International, 1986.
- R.W. Yeomamas, A. Choudry and P.J.W. Ten Hagen, "Design rules for a CIM system", North Holland Amsterdam, 1985.
- W.Bosshart, Design & Fabrication of PCB

## MTET-203 ADVANCED DIGITAL SIGNAL PROCESSING

<b>Internal Marks:</b>	<b>50</b>		<b>L</b>	<b>T</b>	<b>P</b>
<b>External Marks:</b>	<b>100</b>		<b>3</b>	<b>1</b>	<b>0</b>
<b>Total Marks:</b>	<b>150</b>				

**Transformations:** Review of Fourier Transforms, Z-Transforms, Discrete Fourier Transform, Fast Fourier Transform, Convolution and Correlation.

**Design of digital filters:** introduction to filter design, types of digital filters, choosing between, fir and iir filters, filter design steps, effect of finite register length in filter design, realization of iir digital filters and fir digital filter, design of iir filters from continuous time filters, design of fir filters by windowing.

**Spectrum estimation:** non-parametric methods correlation method, co-variance estimator, performance analysis of estimators, consistent estimators, ar, ma, ARMA signal modeling parameter estimation using Yule-walker method.

**Linear estimation and predication:** maximum likelihood criterion efficiency of estimator, least mean squared error criterion, recursive estimators, and linear predications.

**Multirate digital signal processing:** Mathematical description of change of sampling rate, interpolation and decimation, continuous time model, direct digital domain approach, interpolation and decimation by an integer factor, single and multistage realization, applications of sub band coding.

**Adaptive Filters:** Applications Of Adaptive Filters, Adaptive Direct Form FIR Filters: The LMS Algorithm, Adaptive Lattice Ladder Filters, Recursive Least Squares Lattice Ladder Algorithms.

**DSP Chips:** Introduction to fixed point and floating point processors, ADSP21xx and TMS320Cxx-Architecture, Memory, Addressing Modes, Interrupts, Applications. Comparison of ADSP21xx and TMS320Cxx series.

### BOOKS:

- Emmanuel C.Ifeachor Barrie W.Jervis, "Digital Signal Processing", Pearson Education Asia
- Proakis, Manolakis," Digital Signal Processing principles, algorithms, and applications", Prentice Hall India
- "Digital Signal Processing", by S.K. Mitra, -Tata-Mcgraw Hill.
- ADSP 2181 manuals
- Keshab K. Parhi, " VLSI DSP Systems; Design & implementation" , Wiley Inter Science Publishers
- John G. Proakis, Charles M. Rader, Fuyun Ling, Chrysostomos L. Nikias, Marc Moonen, Ian k. Proudler, "
- Algorithms for statistical signal processing", Pearson Education Asia.

**MTET 204 LAB-II**

<b>Internal Marks:</b>	<b>100</b>	<b>L</b>	<b>T</b>	<b>P</b>
<b>External Marks:</b>		<b>0</b>	<b>0</b>	<b>4</b>
<b>Total Marks:</b>	<b>100</b>			

**Module I**

- 2D drawing and drafting using sketcher workbench – 2 drawings
- 3D modeling and drafting using 3D features – 5 models
- Assembling and drafting of 2 assemblies
- Surface modeling – 4 exercises

**Module II**

- Design (schematic and layout) and fabricate DC +5v power supply using full wave rectifier, dc adapter using Eagle/ Orcad.
- Design and fabricate ICSP for AVR/PIC microcontroller using Eagle/Orcad.
- Design and fabricate 555 TIMER circuit in mono stable mode Eagle/Orcad.
- Design and fabricate serial communication circuit with max232 using Eagle/Orcad.
- Design and fabricate basic interfacing kit for AVR/PIC microcontroller using Eagle/Orcad.

**Module III**

- Filter implementation using MATLAB
- Powering up and programming the DSP kit; Familiarization with Hardware & Software
- DFT, IDFT and FFT implementation using DSP kit
- Digital filter design using DSP kit
- Implementation of adaptive filters using DSP kits.

**MTET-205 MICROELECTRONIC TECHNOLOGY**

<b>Internal Marks:</b>	<b>50</b>	<b>L</b>	<b>T</b>	<b>P</b>
<b>External Marks:</b>	<b>100</b>	<b>3</b>	<b>1</b>	<b>0</b>
<b>Total Marks:</b>	<b>150</b>			

**Introduction:** I.C. fabrication, Scales of integration from SSI to ULSI.

**Crystal Growth:** Single Crystal growth of Silicon and Gallium Arsenide. Substrath slicing and polishing. Zen refining of Semiconductor crystals.

**Oxidation:** Oxide layer growth on Silicon wafer surface. Oxidation in the presence of dry oxygen & wet oxygen. Oxide layer growth along various crystal directions.

**Diffusion:** Solution to Fick's Laws Junction formation. Diodes, transistors and MOSFETs.

**Epitaxy :**VPE, LPE and MBE: Individual epitaxial units, their operation and quality of film growth.

**Ion Implantation:** The process and techniques for formation of ion-implanted doped layers and their characteristics.

**Thin film deposition:** Growth of thin metallic films. Normal and ultra-high vacuum systems. Thickness monitors .

**Chemical vapour deposition:** Growth of CVD films. Growth Mechanism and characterization. MOCVD.

**Standard bipolar NMOS and CMOS circuit:** Processing and fabrication using circuit layout. Process evaluation.

**BOOKS:**

- Fundamentals of semiconductor Fabrication- S. M Sze, G May
- Physics of semiconductor devices- S.M Sze
- VLSI Fabrication Technology ,B.Raj & Singh , Laxmi Publications
- Sorab K. Gandhi, "The Theory and Practice of Microelectronics", JohnWiley & Sons
- B.G Streetman, "VLSI Technology" , Prentice Hall, 1990.
- A.S Grove, "Physics and Technology of semiconductor devices", John Wiley & Sons

**REFERENCES:**

- Microelectronics: Theory Design and Fabrication by Edward kiodzan
- Microelectronics –Jacob Millman

**MTET-206 MEDICAL INSTRUMENTATION**

<b>Internal Marks:</b>	<b>50</b>	<b>L</b>	<b>T</b>	<b>P</b>
<b>External Marks:</b>	<b>100</b>	<b>3</b>	<b>1</b>	<b>0</b>
<b>Total Marks:</b>	<b>150</b>			

**Human Body Subsystems:** Brief description of neuronal, muscular, cardiovascular and respiratory systems; their electrical, mechanical and chemical activities.

**Cardiovascular System:** Measurement of blood pressure, blood flow, cardiac output, cardiac rate, heart sounds; Electrocardiograph, Phonocardiograph, Plethysmograph.

**Respiratory System:** Measurement of gas volume, flow rate, carbon-dioxide and oxygen concentration in exhaled air.

**Electrical activity in Neuromuscular System and Brain:** Neuron potential, muscle potential, electromyography, brain potentials, electroencephalograph.

**Medical Imaging:** Fundamentals of imaging, Computed tomography, MRI, Nuclear Medicine, Single photon emission computed tomography, PET, Ultrasonography, Electrical Impedance, Tomography.

**Medical Safety:** Electrical Safety, Electrical safety codes and standards; Radiation safety, Chemical safety, Biological safety, Fire and explosive safety, Environmental Safety.

**Assisting and Therapeutic Equipments:** Pacemakers, Defibrillators, Ventilators, Nerve and Muscle stimulators, Diathermy, Heart-Lung machine, Infant incubators, Audio meters, Dialyzers.

**Text Books:**

- Webster JG (Ed.), "Medical Instrumentation, Application and Design," Wiley India
- Carr JJ and Brown JM, "Introduction to Biomedical Equipment Technology," Pearson Education

**Reference Books:**

- Waugh A and Grant A, "Ross and Wilson Anatomy and Physiology in Health and Illness," Elsevier
- Webster JG (Ed.), "Encyclopedia of Medical Devices and Instrumentation," Vols. 1-4, Wiley
- Bronzino JD (Ed.), "The Biomedical Engineering Handbook," CRC Press



**MTET-207 INDUSTRIAL AUTOMATION**

<b>Internal Marks:</b>	<b>50</b>	<b>L</b>	<b>T</b>	<b>P</b>
<b>External Marks:</b>	<b>100</b>	<b>3</b>	<b>1</b>	<b>0</b>
<b>Total Marks:</b>	<b>150</b>			

**Computer Based Control:** Implementing control system using computer or microprocessor; computer based controller: hardware configuration and software requirements.

**Distributed Control System:** Meaning and necessity of distributed control; hardware components of DCS; DCS software.

**Introduction Programmable Logic Controller (PLC):** What is PLC?, PLC versus microprocessor/microcontroller/computer, advantages and disadvantages of PLC, architecture and physical forms of PLC.

**Basic PLC functions:** Registers: holding, input and output registers; Timers and timer functions; counters and counter functions

**Intermediate PLC functions:** Arithmetic functions: addition, subtraction, multiplication, division and other arithmetic functions; Number comparison and conversion.

**Data Handling Functions of PLC:** Skip function and applications; master control relay function and applications; jump with non-return and return; data table, register and other move functions.

**Bit Functions of PLC:** Digital bit functions and applications; sequencer functions and applications.

**Advanced Functions of PLC:** Analog input and output functions, analog input and output modules, analog signal processing in PLC; PID control function, network communication function.

**PLC programming:** PLC programming languages, ladder programming, mnemonic programming and high level language programming.

**SCADA:** Supervisory control versus distributed control; Layout and parts of SCADA system, detailed block schematic of SCADA system; Functions of SCADA system: data acquisition, monitoring, control, data collection and storage, data processing and calculation, report generation; MTU: functions, single and dual computer configurations of MTU; RTU: functions, architecture / layout; MTU-RTU communication and RTU-field device communication.

**BOOKS:**

- Johnson CD, "Process Control Instrumentation Technology," Prentice Hall
- Chemsmond CJ, "Basic Control System Technology," Viva Books

**REFERENCES:**

- Webb JW and Reis RA, "Programmable Logic Controllers," Prentice Hall
- Hackworth JR and Hackworth FD, "Programmable Logic Controllers," Pearson Edition
- Boyer SA, "Supervisory Control and Data Acquisition (SCADA)," International Society of Automation

**MTET-208 MACHINE VISION SYSTEMS**

<b>Internal Marks:</b>	<b>50</b>	<b>L</b>	<b>T</b>	<b>P</b>
<b>External Marks:</b>	<b>100</b>	<b>3</b>	<b>1</b>	<b>0</b>
<b>Total Marks:</b>	<b>150</b>			

**Introduction Machine Vision**

Principles of Machine Vision, Vision and factory automation, Human Vision Vs. Machine Vision, Economic Considerations, Machine Vision – System Overview, Image acquisition – Illumination, Image formation and Focusing, Image Detection – Introduction, Types of Cameras; Image Processing and Presentation.

**Image Processing Techniques and Transformations**

Fundamental Concepts of Image Processing, Pixel, Pixel Location. Gray Scale, Quantizing Error and Measurement Error and Histograms. Basic Machine Vision Processing Operators – Monadic one Point Transformations: Identity operator, Inverse Operator, Threshold operator and other operators viz: Inverted Threshold operator, Binary Threshold operator, Inverted Binary Threshold Operator, Gray Scale Threshold and Inverted Gray Scale Threshold Operators; Dyadic Two Point Transformations – Image Addition, Image Subtracting, Image Multiplication; Convolution and Spatial Transformations

**Edge Enhancement Techniques and Image Analysis:**

Introduction, Digital Filters – Low pass and High Pass filters; Edge Enhancement Operators – Laplacian, Roberts Gradient, Sobel and other Local operators. Image Analysis: Thresholding, Pattern Matching and Edge Detection, Back-Propagation Algorithm.

**BOOKS:**

- Harley R. Myler, Fundamentals of Machine Vision, Prentice - Hall
- Louis J Galbiati, Image Processing Fundamentals, Prentice - Hall
- Ramesh Jain et.al, Machine Vision, McGraw-Hill
- Milan sonka et.al, Image Processing Analysis and Machine Vision, Vikas Publisher
- G.J. Awcock & R. Thomas Applied Image Processing, Macmillan
- Alexander Hornberg, Handbook on Machine Vision, Wiley – VCH, 2008

**MTET-209 SOFT COMPUTING TECHNIQUES**

<b>Internal Marks:</b>	<b>50</b>	<b>L</b>	<b>T</b>	<b>P</b>
<b>External Marks:</b>	<b>100</b>	<b>3</b>	<b>1</b>	<b>0</b>
<b>Total Marks:</b>	<b>150</b>			

**Introduction:** Neural networks characteristics, History of development in neural networks principles, Artificial neural net terminology, Model of a neuron, Topology, Learning, types of learning, Supervised, Unsupervised, Reinforcement learning. Knowledge representation and acquisition.

**Supervised learning:** Basic Hop field model, Basic learning laws, Unsupervised learning, Competitive learning, K-means clustering algorithm, Kohonen`s feature maps.

**Radial basis function:** Basic learning laws in RBF nets, Recurrent back propagation, Introduction to counter propagation networks, CMAC network, and ART networks.

**Counter Propagation Network:** Applications of neural nets such as pattern recognition, Optimization, Associative memories, speech and decision-making. VLSI implementation of neural networks.

**Fuzzy Logic:** Basic concepts of fuzzy logic, Fuzzy vs. Crisp set, Linguistic variables, Membership functions, Operations of fuzzy sets, Fuzzy IF- THEN rules, Variable inference techniques, De-Fuzzification, Basic fuzzy inference algorithm, Fuzzy system design, FKBC & PID control, Antilock Breaking system (ABS), Industrial applications.

**Support Vector Machines:** Introduction, Support Vector classification, Support Vector regression, applications.

**Basics of Genetic Algorithms:** Evolution of Genetic and Evolutionary Algorithms, Applications

**BOOKS:**

- Berkin R and Trubatch, Fuzzy System Design Principles, Prentice Hall
- Cristianini N and Taylor JS, An Introduction to Support Vector Machines (and other Kernel based learning methods), Cambridge University Press
- Kosko B, Neural Networks and Fuzzy Logic, Prentice Hall
- Haykin S, Neural Networks, Pearson Education
- Anderson JA, An Introduction to Neural Networks, Prentice Hall
- Sivanandam S and Deepa SN, Principles of Soft Computing, Wiley India

**MTET-210 SENSOR DATA FUSION**

<b>Internal Marks:</b>	<b>50</b>	<b>L</b>	<b>T</b>	<b>P</b>
<b>External Marks:</b>	<b>100</b>	<b>3</b>	<b>1</b>	<b>0</b>
<b>Total Marks:</b>	<b>150</b>			

**Introduction:** Sensors and sensor data, Limitations of single sensor, Advantages of multisensor data fusion, Multi sensor data fusion applications, Data fusion models, Generic fusion architectures

**Algorithms for Data Fusion:** Taxonomy of algorithms for multi-sensor data fusion. Learning of fusion models: Learning Bayesian classifier, Rule learning from decision tree algorithms.

**Estimation:** Kalman filtering, practical aspects of Kalman filtering, extended Kalman filters, particle filter, Decision level identify fusion. Knowledge based approaches.

**Advanced Filtering:** Data information filter, extended information filter. Decentralized and scalable decentralized estimation. Sensor fusion and approximate agreement. Optimal sensor fusion using range trees recursively. Distributed dynamic sensor fusion.

**High Performance Data Structures:** Tessellated, trees, graphs and function. Representing ranges and uncertainty in data structures. Designing optimal sensor systems within dependability bounds. Implementing data fusion system, Application of multisensor data fusion for mobile robot mapping and Navigation.

**BOOKS:**

- Das SK, "High-level Data Fusion," Artech House
- Hall DL, "Mathematical techniques in Multisensor data fusion," Artech House

**Reference Books**

- Brooks RR and Iyengar SS, "Multi-Sensor Fusion," Prentice Hall
- Gelb A, "Applied Optimal Estimation," MIT Press
- Candy JV, "Signal Processing," McGraw-Hill
- Liggins.II, "Handbook of Multisensor Data Fusion", Taylor & Francis

## MTET-304 EMBEDDED SYSTEM FOR WIRELESS & MOBILE COMMUNICATION

<b>Internal Marks:</b>	<b>50</b>	<b>L</b>	<b>T</b>	<b>P</b>
<b>External Marks:</b>	<b>100</b>	<b>3</b>	<b>1</b>	<b>0</b>
<b>Total Marks:</b>	<b>150</b>			

**Introduction to wireless technologies:** WAP services, Serial and Parallel Communication, Asynchronous and synchronous Communication, FDM, TDM, TFM, Spread spectrum technology.

**Introduction to Bluetooth:** Specification, Core protocols, Cable replacement protocol Bluetooth Radio: Type of Antenna, Antenna Parameters, Frequency hopping

**Bluetooth Networking:** Wireless networking, wireless network types, devices roles and states, adhoc network, scatter net Connection establishment procedure, notable aspects of connection establishment, Mode of connection, Bluetooth security, Security architecture, Security level of services, Profile and usage model: Generic access profile (GAP), SDA, Serial port profile, Secondary bluetooth profile

**Hardware:** Bluetooth Implementation, Baseband overview, packet format, Transmission buffers, Protocol Implementation: Link Manager Protocol, Logical Link Control Adaptation Protocol, Host control Interface, Protocol Interaction with layers

**Programming with Java:** Java Programming, J2ME architecture, Javax. bluetooth package Interface, classes, exceptions, Javax.

**Obex Package:** interfaces, classes bluetooth services registration and search application, bluetooth client and server application. Overview of IrDA, HomeRF, Wireless LANs, JINI

### BOOKS:

- Bluetooth Technology by C.S.R. Prabhu and A.P. Reddi; PHI
- Rappaport. T.S., "Wireless communications", Pearson Education, 2003. Mobile communication by Schiller
- Andreas.F. Molisch, "Wireless Communications", John Wiley - India, 2006.
- Simon Haykin & Michael Moher, "Modern Wireless Communications", Pearson Education, 2007.
- Gordon L. Stuber, "Principles of Mobile Communication", Springer International Ltd., 2001.

**MTET-305 EMBEDDED WIRELESS SENSOR NETWORKS**

<b>Internal Marks:</b>	<b>50</b>	<b>L</b>	<b>T</b>	<b>P</b>
<b>External Marks:</b>	<b>100</b>	<b>3</b>	<b>1</b>	<b>0</b>
<b>Total Marks:</b>	<b>150</b>			

**Issues in Ad Hoc Wireless Networks:** Medium Acces Scheme-Routing-Multicasting-Transport Layer Protocols-Self Organization-Security-Addressing and Service Discovery Energy management-Scalability-Deployment Considerations, Ad Hoc Wireless Internet. Sensor Networks Comparison with Adhoc wireless networks- Challenges for WSNs - Difference between sensor networks and Traditional sensor networks – Types of Applications –Enabling Technologies for Wireless Sensor Networks –Single Node Architectures –Hardware Components – Energy Consumption of Sensor Nodes, Issues in Designing a Multicast Routing Protocol. OS for WSN.

**Sensor Network Architecture :**Data Dissemination-Flooding and Gossiping-Data gathering Sensor Network Scenarios –Optimization Goals and Figures of Merit –Design Principles for WSNs- Gateway Concepts – Need for gateway – WSN to Internet Communication – Internet to WSN Communication – WSN Tunneling.

**MAC Protocols MAC Protocols for Sensor Networks :**Location Discovery-Quality of Sensor Networks-Evolving Standards-Other Issues- Low duty cycle and wake up concepts- The IEEE 802.15.4 MAC Protocols Energy Efficiency -Geographic Routing

**Routing Gossiping and Agent based Unicast Forwarding:** Energy Efficient Unicast- Broadcast and Multicast Geographic Routing-Mobile nodes-Security-Application Specific Support - Target detection and tracking-Contour/ edge detection-Field Sampling.

**BOOKS:**

- Wireless Communication and Networking – William Stallings, 2003, PHI
- Holger Karl and Andreas Willig Protocols and Architectures for Wireless Sensor Networks wiley (ISBN: 0-470-09510-5)
- Wireless Sensor Networks: An Information Processing Approach by Feng Zhao and Leonidas J. Guibas (Morgan Kaufmann, 2004)
- Ad Hoc Wireless Networks: Architectures and Protocols by C. Siva Ram Murthy and B. S. Manoj (Prentice Hall, 2004)

**MTET-306 MECHATRONIC SYSTEMS**

<b>Internal Marks:</b>	<b>50</b>	<b>L</b>	<b>T</b>	<b>P</b>
<b>External Marks:</b>	<b>100</b>	<b>3</b>	<b>1</b>	<b>0</b>
<b>Total Marks:</b>	<b>150</b>			

**Introduction:** Definition of Mechatronics, Mechatronics in manufacturing, Products, and design. Comparison between Traditional and Mechatronics approach.

**Review of fundamentals of electronics:** Data conversion devices, sensors, microsensors, transducers, signal processing devices, relays, contactors and timers. Microprocessors controllers and PLCs.

**Drives:** stepper motors, servo drives. Ball screws, linear motion bearings, cams, systems controlled by camshafts, electronic cams, indexing mechanisms, tool magazines, transfer systems.

**Hydraulic systems:** flow, pressure and direction control valves, actuators, and supporting elements, hydraulic power packs, pumps. Design of hydraulic circuits. Pneumatics: production, distribution and conditioning of compressed air, system components and graphic representations, design of systems. Description.

**Controllers:**

Description of PID controllers, CNC machines and part programming. Industrial Robotics

**BOOKS:**

- HMT ltd. Mechatronics, Tata Mcgraw-Hill, New Delhi, 1988.
- G.W. Kurtz, J.K. Schueller, P.W. Claar . II, Machine design for mobile and industrial applications, SAE, 1994.
- T.O. Boucher, Computer automation in manufacturing - an Introduction, Chappman and Hall, 1996.
- R. Iserman, Mechatronic Systems: Fundamentals, Springer, 1st Edition, 2005
- Musa Jouaneh, Fundamentals of Mechatronics, 1st Edition, Cengage Learning, 2012.

**MTET-307 AUTOTRONICS**

<b>Internal Marks:</b>	<b>50</b>	<b>L</b>	<b>T</b>	<b>P</b>
<b>External Marks:</b>	<b>100</b>	<b>3</b>	<b>1</b>	<b>0</b>
<b>Total Marks:</b>	<b>150</b>			

**FUNDAMENTAL OF AUTOMOTIVE ELECTRONICS:** Current trends in modern automobiles, Open loop and closed loop systems, Components for electronic engine management, Electronic management of chassis system, Vehicle motion control.

**SENSORS AND ACTUATORS:** Introduction, basic sensor arrangement, types of sensors such as - oxygen sensors, Crank angle position sensors - Fuel metering / vehicle speed sensor and detonation sensor - Altitude sensor, flow sensor. Throttle position sensors, solenoids, stepper motors, and relays.

**ELECTRONIC FUEL INJECTION AND IGNITION SYSTEMS:** Introduction, Feed back carburetor systems (FBC) Throttle body injection and multi-port or point fuel injection, Fuel injection systems, injection system controls, Advantages of electronic ignition systems, Types of solid state ignition systems and their principle of operation, Contact less electronic ignition system, Electronic spark timing control.

**AUTOMOTIVE ELECTRIC AND ELECTRONIC SYSTEMS:** Electrical circuit components: wiring circuits, Printed circuits circuit breaker, symbols and wiring diagrams, Basic electrical Diagnosis and tests.

**LIGHTS, SAFETY, DRIVER INFORMATION AND CONTROL DEVICES:** Fiber-optic and Computer controlled Lighting, Horn and Horn relay, Vehicle Security systems: seat belts, Air bags, Driver Information and controls: instrument panel, speedometer and odometer Speed Control, Head Up Display, Networks and Multiplexing, Electronic Navigation systems, Cruise control systems.

**BOOKS:**

- William B. Ribbens, "Understanding Automotive Electronics", 6th Edition, SAMS/Elsevier Publishing
- Robert Bosch Gambh, Automotive Electrics Automotive Electronics Systems and Components, 5th edition, John Wiley & Sons Ltd.
- Crouse. W.H., " Automobile Electrical equipment ", McGraw Hill Book Co Inc., New York, 1955.
- Bechtold., " Understanding Automotive Electronic ", SAE, 1998.



**MTET-308 ELECTRONIC AND PACKAGING**

<b>Internal Marks:</b>	<b>50</b>	<b>L</b>	<b>T</b>	<b>P</b>
<b>External Marks:</b>	<b>100</b>	<b>3</b>	<b>1</b>	<b>0</b>
<b>Total Marks:</b>	<b>150</b>			

**OVERVIEW OF ELECTRONIC SYSTEMS PACKAGING**

Definition of a system and history of semiconductors, Products and levels of packaging, Packaging aspects of handheld products, Definition of PWB, Basics of Semiconductor and Process flowchart, Wafer fabrication, inspection and testing, Wafer packaging; Packaging evolution; Chip connection choices, Wire bonding, TAB and flip chip.

**SEMICONDUCTOR PACKAGES**

Single chip packages or modules (SCM), Commonly used packages and advanced packages; Materials in packages; Thermal mismatch in packages; Multichip modules (MCM)-types; System-in-package (SIP); Packaging roadmaps; Hybrid circuits; Electrical Design considerations in systems packaging, Resistive, Capacitive and Inductive Parasitics, Layout guidelines and the Reflection problem, Interconnection.

**CAD FOR PRINTED WIRING BOARDS**

Benefits from CAD; Introduction to DFM, DFR & DFT, Components of a CAD package and its highlights, Beginning a circuit design with schematic work and component, layout, DFM check, list and design rules; Design for Reliability, Printed Wiring Board Technologies: Board-level packaging aspects, Review of CAD output files for PCB fabrication; Photo plotting and mask generation, Process flow-chart; Vias; PWB substrates; Surface preparation, Photoresist and application methods; UV exposure and developing; Printing technologies for PWBs, PWB etching; PWB etching; Resist stripping; Screen-printing technology, through-hole manufacture process steps; Panel and pattern plating methods, Solder mask for PWBs; Multilayer PWBs; Introduction to, microvias, Microvia technology and Sequential build-up technology process flow for high-density, interconnects

**SURFACE MOUNT TECHNOLOGY AND THERMAL CONSIDERATIONS**

SMD benefits; Design issues; Introduction to soldering, Reflow and Wave Soldering methods to attach SMDs, Solders; Wetting of solders; Flux and its properties; Defects in wave soldering, Vapour phase soldering, BGA soldering and Desoldering/Repair; SMT failures, SMT failure library and Tin Whisker, Tin-lead and lead-free solders; Phase diagrams; Thermal profiles for reflow soldering; Lead free Alloys, Lead-free solder considerations; Green electronics; RoHS compliance and e-waste recycling, Issues, Thermal Design considerations in systems packaging (L. Umanand, Thermal Design considerations in systems packaging

**EMBEDDED PASSIVES TECHNOLOGY**

Introduction to embedded passives; Need for embedded passives; Design Library; Embedded resistor processes, Embedded capacitors; Processes for embedding capacitors; Case study examples.

**BOOKS:**

- Rao R. Tummala, "Fundamentals of Microsystems Packaging", McGraw Hill, NY, 2001
- Robert Bosch William D. Brown, "Advanced Electronic Packaging", IEEE Press, 1999.
- William D. Brown, Advanced Electronic Packaging, IEEE Press, 1999.

**MTET-309 ADVANCE SENSORS AND ACTUATOR**

<b>Internal Marks:</b>	<b>50</b>	<b>L</b>	<b>T</b>	<b>P</b>
<b>External Marks:</b>	<b>100</b>	<b>3</b>	<b>1</b>	<b>0</b>
<b>Total Marks:</b>	<b>150</b>			

**MEASUREMENT TERMINOLOGY:** Input and output, range, accuracy, precision, resolution, sensitivity, linearity, repeatability, reproducibility, calibration and traceability, Testing, quality assurance and safety.

**TRANSDUCERS AND SENSORS:** Sensors and transducers: Temperature sensors, resistive sensors, capacitive sensors, electrostatic sensors, piezoelectric sensors, ultrasonic sensors, radiological sensors and MEMS. Optical sensing techniques: Common electromagnetic sensors, IR sensors, passive IR sensors, photo-resistive sensors, photovoltaic sensors, photodiodes, photoelectric detectors, solid state lasers, CCD and CMOS sensors.

**SMART SENSORS:** Primary Sensors, Excitation, Amplification, Filters, Converters, Compensation, Information Coding/Processing, Data Communication, Standards for Smart Sensor Interface, The Automation Sensors Applications: On-board Automobile Sensors (Automotive Sensors), Home Appliance Sensors, Aerospace Sensors, Sensors for Manufacturing, Sensors for environmental Monitoring.

**ACTUATORS:** Pneumatic and Hydraulic Actuation Systems, Actuation systems, Pneumatic and hydraulic systems, Directional Control valves, Pressure control valves, Cylinders, Servo and proportional control valves, Process control valves, Rotary actuators Mechanical Actuation Systems. Electrical Actuation Systems, Electrical systems, Solid-state switches Solenoids, D.C. Motors, A.C. motors, Stepper motors.

**EMERGING TOPICS:** Introduction to sensor networks, sensor fusion, soft and intelligent sensors. System on module, Virtual instrumentation, Intelligent instrumentation, Fault tolerance, Real time systems introduction, reference model, scheduling approaches.

**BOOKS:**

- D. Patranabis – “Sensors and Transducers” –PHI Learning Private Limited.
- W. Bolton – “Mechatronics” –Pearson Education Limited.
- Sensors and Actuators – D. Patranabis – 2nd Ed., PHI, 2013.
- Micro sensors, MEMS and Smart devices Julian W. Gardner, Vijay K. Varadan John Wiley & Sons.
- Smart Sensor Systems Edited by Gerard C.M. Meijer © 2008 John Wiley & Sons, Ltd.
- Ristic L (ed), “Sensor Technology and Devices”, Artech House, London, 1994.
- Sze S.M. (ed), “Semiconductor Sensors”, John Wiley, New York, 1994
- K.D. (Guest Editor) “Integrated Sensors, Microp-actuators and micro-systems
- MEMS, Special Issue of proceedings of IEEE, Vol. 86, No.8, August 1998.

**MTET-310 SENSOR TECHNOLOGY AND MEMS**

<b>Internal Marks:</b>	<b>50</b>	<b>L</b>	<b>T</b>	<b>P</b>
<b>External Marks:</b>	<b>100</b>	<b>3</b>	<b>1</b>	<b>0</b>
<b>Total Marks:</b>	<b>150</b>			

**Introduction**

Historical Development of Microelectronics, Evolution of Micro sensors, Evolution of MEMS, Emergence of Micro machines, Sensor Systems, Sensors types and classification, Mechanical Sensors, Acoustic Sensors, Magnetic Sensors, Thermal Sensors, Optical sensors Chemical Sensors, Radiation Sensors and Biosensors. Micro sensors, Sensors based on surface-acoustic wave devices. Review Of Fabrication Techniques (Lithography, PVD,CVD,RIE)

**Micromachining techniques**

Introduction to Bulk Micromachining, Isotropic and Orientation-Dependent Wet Etching, Dry Etching, Buried Oxide Process, Silicon Fusion Bonding, Sacrificial Layer Technology, Surface Micromachining using Plasma Etching, ,Combined IC Technology and Anisotropic Wet Etching, Processes Using Both Bulk and Surface Micromachining, Adhesion Problems in Surface Micromachining, Surface Versus Bulk Micromachining

**Smart Sensors and Modeling**

Introduction to Smart Sensors, Integrated Smart sensors and smart systems, MEMS and NEMS devices, Elastic structures in MEMS and NEMS, Modeling of Thermal Elastic systems, Electrostatic- elastic systems, magnetically actuated systems, Microfluidics (Membrane Pumps, Nanolithography, Nano jets)

**BOOKS:**

- Modeling MEMS and NEMS John A. Pelesko and David H. Bernstein Chapman & Hall/CRC
- MEMS Fundamental Technology and Applications vikas Choudhary and Krzysztof Iniewski CRC press
- Micro sensors, MEMS and Smart devices Julian W. Gardner ,Vijay K. Varadan John Wiley & Sons, Ltd
- Smart Sensor Systems Edited by Gerard C.M. Meijer © 2008 John Wiley & Sons, Ltd.
- Ristic L ( ed), "Sensor Technology and Devices", Artech House, London, 1994.
- Sze S.M. (ed), "Semiconductor Sensors", John Wiley, New York, 1994 Wise
- K.D. (Guest Editor) "Integrated Sensors, Microp-actuators and micro-systems
- MEMS, Special Issue of proceedings of IEEE, Vol. 86, No.8, August 1998.

**MTET-311 DATA COMMUNICATION AND NETWORKS**

<b>Internal Marks:</b>	<b>50</b>	<b>L</b>	<b>T</b>	<b>P</b>
<b>External Marks:</b>	<b>100</b>	<b>3</b>	<b>1</b>	<b>0</b>
<b>Total Marks:</b>	<b>150</b>			

**INTRODUCTION:** Components of network, Topologies, WAN / LAN, OSI – ISO layered Architecture, Modulation and Demodulation, Bit error rates, Line coding, Error correcting codes.

**DATA LINK LAYER:** Design issues, CRC technique and sliding window techniques, Performance analysis of sliding window techniques, Framing formats, Case Study, HDLC protocols, Medium access control, CSMA / CD, Token ring and token bus, FDDI, Wireless LAN, Performance analysis of MAC protocols, Bridges

**NETWORK LAYER:** Circuit switching, packet switching, Design issues, IP addressing and IP diagram, Routers and gateways, Routing, Sub netting, CIDR, ICMP, ARP, RARP, Ipv6, QoS.

**TRANSPORT LAYER:** TCP and UDP, Error handling and flow control, Congestion control, TCP Retransmission, Timeout, Socket Abstraction.

**APPLICATION LAYER:** Simple Mail Transfer Protocol (SMTP), File Transfer Protocols (FTP), telnet, World Wide Web (WWW), Hypertext Transfer Protocol (HTTP), Domain name service (DNS), Security, Multimedia applications.

**Text Books**

- Behrouz A. Forouzan,: Data Communication and Networking, 4th Edition Tata McGraw-Hill, 2006
- Alberto Leon-Garcia and IndraWidjaja: Communication Networks - Fundamental Concepts and Key architectures, 2nd Edition Tata McGraw-Hill, 2004.
- William Stallings: Data and Computer Communication, 8th Edition, Pearson Education, 2007.
- Larry L. Peterson and Bruce S. Davie: Computer Networks – A Systems Approach, 4th Edition, Elsevier, 2007.
- Nader F. Mir: Computer and Communication Networks, Pearson Education, 2007.