M.Sc.II(Electronics)
Program Structure

Course Code	Title of the Course	Credits	Teaching Scheme (h/w)		Evaluation Scheme (marks)			
			L	P	ISE I	ISE II	ESE	Total
M.Sc. Part I - Semester I								
MET101	Signals and Systems	4	4	-	10	10	80	100
MET102	Foundations of Microwave Technology	4	4	-	10	10	80	100
MET103	Computer Organization	4	4	-	10	10	80	100
MET104	Foundations of Power Electronics	4	4	-	10	10	80	100
MEP105	Lab – I	4	-	12	-	-	85+15 (Pro)	100
MEP106	Lab – II	4	-	12	-	-	85+15 (Pro)	100
	Total	**24**	**16**	**24**	**40**	**40**	**520**	**600**
M.Sc. Part I - Semester II								
MET201	Digital Communication	4	4	-	10	10	80	100
MET202	Advanced Microwave Technology	4	4	-	10	10	80	100
MET203	Advanced Power Electronics	4	4	-	10	10	80	100
MET204	Optoelectronics	4	4	-	10	10	80	100
MET205	Computer Networks	4	4	-	10	10	80	100
MEP206	Lab – III	4	-	12	-	-	85+15 (Pro)	100
MEP207	Lab – IV	4	-	12	-	-	85+15 (Pro)	100
	Total	**28**	**20**	**24**	**50**	**50**	**600**	**700**
M.Sc. Part II - Semester III								
MET301	Control Theory	4	4	-	10	10	80	100
MET302	Analog and Digital Circuit Design	4	4	-	10	10	80	100
MET303	Digital Signal Processing	4	4	-	10	10	80	100
MET304	Elective I	4	4	-	10	10	80	100
MET305	Elective I	4	4	-	10	10	80	100
MEP306	Lab – V	4	-	12	-	-	85+15 (Pro)	100
MEP307	Lab – VI	4	-	12	-	-	85+15 (Pro)	100
	Total	**28**	**20**	**24**	**50**	**50**	**600**	**700**
M.Sc. Part II - Semester IV								
MET401	Elective – II	4	4	-	10	10	80	100
MET402	Elective – II	4	4	-	10	10	80	100
MEP403	Lab – VII	4	-	12	-	-	85+15 (Pro)	100
	Internship	4	-	12	-	-	85+15 (Pro)	100
	Total	**16**	**8**	**24**	**20**	**20**	**360**	**400**
	Grand Total	**96**	**64**	**96**	**160**	**160**	**2080**	**2400**

STRUCTURE OF COURSE:

1. THIRD SEMESTER

	Semester III									
		Internal Exam		Practical						
	ESE	ISE-I	ISE-II		Exam	Journal	Project Part-II	Day to day perform-ance	Total	Grand Total
Paper X	80	10	10	Lab-V	70	10	15	5	100	
Paper XI	80	10	10							
Paper XII	80	10	10	Lab-VI	70	10	15	5	100	
Paper XIII	80	10	10							
Paper XIV	80	10	10							
Total	**400**	**50**	**50**		**140**	**20**	**30**	**10**	-	**700**

2. FOURTH SEMESTER

	Semester IV								
		Internal Exam		Practical					Total
	ESE	ISE-I	ISE-II		Exam	Journal	Project Part-IV	Day to day perform-ance	
Paper XVI	80	10	10	Lab VII	70	10	15	5	
Paper XVII	80	10	10	Internship	80		15	5	
Total	**160**	**20**	**20**		**160**		**30**	**10**	**400**

3. Structure and Title of Papers of M. Sc. Course:

- **M. Sc. II Semester III**

Paper X: Control Theory
Paper XI: Analog and Digital Circuit Design
Paper XII: Digital Signal Processing
Paper XIII: Elective I
Paper XIV: Elective I

- **M. Sc. II Semester IV**

Paper XV : Elective II
Paper XVI : Elective II

Course Code	Elective -I	Course Code	Elective –II
MET30x	Microcontroller System Design and ARM Architecture	MET40x	ARM Programming and Embedded Communication Protocols
MET30x	Satellite Communications	MET40x	Cellular Mobile Communications
MET30x	Instrumentation	MET40x	Industrial Automation
MET30x	Antennas	MET40x	Mechatronics (Robotics)
MET30x	Nanoelectronics	MET40x	Advanced Microcontroller and RTOS

M.Sc. Part II: **Electronics**

Semester III

Paper X

MET301: Control Theory

- **Learning Objectives:**

1. Apply systems theory to complex real world problems in order to obtain models that are expressed using differential equations, transfer functions, and state space equations.
2. Predict system behavior based on the mathematical model of that system where the model may be expressed in time or frequency domain.
3. Analyze the behavior of closed loop systems using tools such as root locus, Routh Hurwitz, Bode, Nyquist, and Matlab.
4. Design controllers using classical PID methods, root locus methods, and frequency domain methods.
5. Devise a safe and effective method of investigating a system identification problem in the lab.

Unit 1: Introduction to Control Theory **15**

Basic Concepts of Control System, Open loop and Closed loop systems, Classifications, effect of feedbacks on Control System performance. Transfer function modeling and representation of Control system, pole & zero concept, Linear mathematical physical systems, Electrical analogy, Block reduction techniques, Signal flow graph, Mason's gain formula.

Unit 2: Time Domain Analysis and stability **15**

Type and Order of Control system, Typical tests signal, Time Response of first and second order systems to unit step input, Steady state errors, Time Domain Specifications of Second Order System, Dominant Closed loop Poles of Higher Order Systems. Concept of Stability: absolute, relative and marginal, nature of system response, stability analysis using Hurwitz's criterion, Routh's criterion, Basic properties of Root Loci, construction of Root loci, Angle and magnitude condition for stable systems, concept of inverse root locus and root contour.

Unit 3: Frequency Domain and State Variable Analysis **15**

Steady state response of a system to sinusoidal input, Relation between time and frequency response for second order systems, Frequency response specifications, Stability Analysis with Bode Plots, Polar Plots, conformal mapping, Nyquist stability criterion. Introduction to state space analysis, State space representation for i) Electrical Network ii) nth order differential equation iii) Transfer function. State model from transfer function using: Direct, parallel, cascade, decomposition method.

Unit 4: Control system components and controllers **15**

Modeling and transfer function of control system components- Potentiometer, DC and AC Servomotors, gear trains, tacho-generators. Design concepts of P, PI, PD, PID controllers, Compensator Networks-lag and lead.

- **Learning Outcomes:**

At the end of this course, students will be able to:

1. Carry out modeling of discrete systems in state space
2. Evaluate programming strategies in the domain of control systems
3. Design modern control systems with computer simulation
4. Design various control systems

- **Reference Books:**

1. I.J. Nagrath, M.Gopal "Control Systems Engineering", 5th Edition, New Age International Publication (Unit-I , II, III, IV)
2. Ogata Katsuhiko, "Modern Control Engineering", 4th Edition, PHI. (Unit-I,II,III,IV)
3. Kuo B.C. Automatic Control System, PHI, New Delhi, Third Edition (Unit-I,II,III)
4. U.A.Bakshi, V.U.Bakshi "Control System Engineering", First Edition2008, Technical Publications, Pune (Unit-I, II, III,IV)
5. Schaum's Series book "Feed back Control Systems".
6. Les Fenical "Control Systems", 1st Edition, Cengage Learning India.
7. Samarjeet Ghosh, "Control Systems Theory & Applications", 1st Pearson education.
8. S.K. Bhattacharya, "Control Systems Engineering", 1st edition, Pearson education.
9. Norman S. Nise, "Control System Engineering", 5th Edition, Wiley.

Semester III
Paper XI
MET 302 - Analog and Digital Circuit Design

- **Learning Objectives:**
  1. To teach the student, the art of applying basic concepts for designing electronic systems.
  2. To imbibe good design practices for robust design of electronic systems .
  3. To highlight the importance and significance of customer specifications/requirements .
  4. To teach electronic circuit function verification with an EDA tool.

Unit I: Design of Power Supply & PCB **15**

Typical specifications, Concept of ideal power supply & Voltage regulation, Rectifier and filter design, Heat-sink selection, Three terminal IC regulator & Variable Regulator. Zener series and shunt regulators, transistors as series and shunt regulators, regulator design with discrete components and IC 741/78xx, current sources and their design with discrete components and ICs, SMPS design. Design of Solar Power System: Load Power Calculations & Component Selection & design, Solar Panel Selection, Battery Types & Selection Criteria, Charge Control unit Design, Buck/Boost Convertor Design. Types of PCB, PCB artwork components (pads, vias, tracks, footprints) and their metrics, Netlists, Power planes, High frequency considerations, Power considerations, Design Artwork (double sided PTH), Carry out signal integrity analysis.

Unit II: Design of Data Acquisition Systems (DAS) **15**

Need of DAQ, Block diagram of DAQ, Application Areas of DAQ, Performance parameters of DAQ, Selection of Sensor, Transducers, and Actuator, Interfacing of sensor, Need of signal conditioners, Design of signal conditioning circuits, Selection criteria for ADC and DAC, Selection Criteria of Microcontrollers, RS-232 PC Interfacing using serial communication, Overview of storage interface (like SD-Card, Serial EEPROM), LCD Display interfaces.

Unit III: Digital Logic **15**

CMOS-TTL and TTL-CMOS interfaces, design of counter using FF and counter ICs, Oscillator design using Schmitt trigger (7414), inverter and NAND gate, MMV using gates and ICs (74/54121, 74221), design of binary to gray code converter, design of BCD to excess-3, excess- 3 to BCD converter, design of full adder using MUX, design of 16-1 using 4 4-1 MUXs, design of parity checker, memory interfacing, RAM ROM and EEPORM. Introduction to VHDL: Introduction , Library, Entity, Architecture, Modeling Styles, Concurrent and sequential statements, Data objects and Data types, attributes. Design Examples for combinational circuits.

Unit IV: Design using Internet of Things **15**

IoT overview and architecture, Overview of wireless sensor networks and design examples. Various wireless connectivity: NFC, ZigBee, Bluetooth , Bluetooth Low Energy , Adding Wi-Fi capability to the Microcontroller , Wi-Fi MCUs (e.g., CC3200).

- **Learning Outcomes:**

At the end of this course, students will be able to:

1. Design Power Supply System
2. Design data acquisition system
3. Design Digital System
4. Design IOT system

- **Reference Books:**

1. Practical design of power supplies" , Ron Lenk, John Wiley & Sons, 2005, ISBN: 978-0-08-097138-4 (Unit-I,II,III,IV)
2. "Intuitive Analog Circuit Design A Problem-Solving Approach using Design Case Studies", Marc T. Thompson, Elsevier Inc, 2006,ISBN-10: 0-7506-7786-4 (Unit-I,II,III,IV)
3. "Linear Circuit Design Handbook", Hank Zumbahlen, Elsevier Inc, 2008 , ISBN 978-0-7506-8703-4 (Unit-I,II,)
4. "The Circuit Designers Companion", Peter Wilson, Elsevier Ltd, 2012
5. "Switching Power Supply Design," 3E, Abraham I. Pressman et. al, McGraw-Hill, 2009 (Unit I.)
6. "Measurement, Instrumentation, and Sensors Handbook", John G. Webster, CRC Press, 1999
7. "Electronic Filter Design Handbook", 4E, Arthur Williams, Fred Taylor, McGraw-Hill, 2006

Semester III
Paper XII

MET303 - Digital Signal Processing

- **Learning Objectives:**

1. To give the students a comprehension of the concepts of discrete-time signals and systems and bout the most important issues in sampling and reconstruction
2. To give the students a comprehension of the Z- and and their inverse
3. To provide the knowledge about the principles behind the discrete Fourier transform (DFT) and its fast computation
4. To be able to apply the MATLAB programme to digital processing problems and presentations

Unit 1: Discrete Time Signals and Systems **15**

Discrete Time Signals: Representation, Standard Discrete Time Signals, Classification of Discrete Time Signals and systems, Simple Manipulations of Discrete Time Signals, Sampling of Analog signals, Aliasing, Sampling Theorem. Discrete Time System: Block diagram representation of Discrete Time Systems, Convolution Sum, Causality and Stability condition in terms of the Impulse Responses.

Unit 2: Z Transform and Analysis of Discrete Time System **15**

Z transform and ROC, Inverse Z transform, Analysis of LTI Systems in Z domain: System Function of LTI system, Transient and Steady state responses, Causality and Stability of System. Solution of difference Equations, Frequency Domain Sampling: Discrete Fourier Transform, IDFT, The DFT as Linear Transformation, Properties of the DFT, Use of DFT in linear filtering, FFT Algorithms: Radix2 DIT and DIF algorithms to compute DFT and IDFT.

Unit 3: Design and Realization of Digital Filters **15**

FIR Filter Structure and Design: Direct and cascade forms, frequency sampling and linear phase structure. Windowing method, Frequency sampling method of design, IIR Filter structure and Design: Direct form, Cascade form, Parallel form. Impulse invariance, Bilinear Transformation method of design.

Unit 4: DSP Architecture **15**

Architectural features of DSP processors: Multiplier and Multiplier Accumulator (MAC), Modified Bus Structures and Memory Access schemes in DSP, Multiple access memory, Multiport Memory, Pipelining, Special addressing modes, On-chip Peripherals, Different generation of DSP Processors, Fixed point and floating point numeric representation and Arithmetic, Introducing the TI 6000 platform, Features of TMS320C62X Processors, EDMA, Port Interface, External Memory Interface (EMIF), Interrupts, Timers, Basic Interfacing Techniques.

- **Learning Outcomes:**

After successfully completing the course students will be able to

1. The student will be capable of calibrating and resolving different frequencies existing in any signal.
2. The student will be in position to understand use of different transforms and analyze the discrete time signals and systems.
3. The student will realize the use of LTI filters for filtering different real world signals.
4. The student will be in a position to design and implement multistage sampling rate converter.

- **Reference Books:**

1. John G Prokis, Manolakis, Digital Signal Processing-Principles, Algorithms and Application, 4th Edition, Pearson Education Publication(Unit I, II, III)
2. Robert J.. Schilling,Sandra L.Hariris Digital Signal Processing using MATLAB (Unit I, III)
3. Salivahanam, A Vallavaraj, C. Guanapriya, Digital Signal Processing, 1st Edition, Tata McGrawHill, New Dehli (Unit I, II)
4. Dr. Shaila d Apte second edition, (Unit I, II, III, IV)
5. P. Ramesh Babu, Digital Signal Processing, 4th Edition, Scitech Publication.
6. A. Ambardar, Digital Signal Processing: A Modern Introduction, Cengate Learning India Pvt Ltd, New Dehli
7. P. Pirsch, Architectures for Digital Signal Processing, John Wiley publication, New Delhi
8. Phil Lapsley, DSP Processor Fundamentals: architectures and Features, Wiley publication
9. S.K. Mitra,Digital Signal Processing Computer Based Approach, TMH. New Dehli. 2009
10. M. Bhaskar, Digital Signal Processors Architecture, programming and applications, TMH, New Dehli.

M. Sc. II Semester III

LAB –V

MEP306: Control Theory, Analog and Digital circuit and Digital signal processing (Hardware and Simulation)

- **Learning Objectives:**

1. To develop programming logic and algorithm writing.
2. To develop Hardware designing skills.
3. To develop microcontroller based system.
4. To develop simple applications of real life using structures and files.

Practical Set

Group A

1) To study the signal flow of variable voltage regulator 317/347
2) Design and analysis of first order control system(Simulink)
3) Design and analysis of second order control system(Simulink)
4) To obtain step response of the given system and evaluate the effect P,PD,PI and PID controllers
5) BODE & NYQUIST PLOT USING MAT LAB
6) To study the OP-AMP as V to I converter
7) To study the OP-AMP as I to V converter
8) Study of operation of LM 331 as V to F converter
9) Study of operation of LM 331 as f to v converter
10) Design a full adder using Mux

Group B

1) Design Oscillator using Schmitt trigger IC 7414
2) Design a SMPS power supply
3) Design a series and shunt regulated power supply using transistor.
4) Design a solar power system
5) Design a IOT based system using Zig Bee / Bluetooth /NFC/Wi-Fi
6) To study and analysis of fast Fourier transform (FFT)
7) To study and analysis of discrete Fourier transform (DFT)
8) Deign a FIR filter (MATLAB)
9) Deign a IR filter (MATLAB)
10) Study and analysis of LTI systems in Z domain.

- **Learning Outcomes:**
  1. To avail the programming skill using MATLAB
  2. To able to design and develop the microcontroller based systems.
  3. To able to design and develop the embedded products.
  4. To be able to develop simple applications of real life using structures and files.

- **Reference Books:**

1. I.J. Nagrath, M.Gopal "Control Systems Engineering", 5th Edition, New Age International Publication
2. Kuo B.C. Automatic Control System, PHI, New Delhi
3. Norman S. Nise, "Control System Engineering", 5th Edition, Wiley.
4. Practical design of power supplies" , Ron Lenk, John Wiley & Sons, 2005, ISBN: 978-0-08-097138-4
5. "Intuitive Analog Circuit Design A Problem-Solving Approach using Design Case Studies", Marc T. Thompson, Elsevier Inc, 2006,ISBN-10: 0-7506-7786-4
6. "Linear Circuit Design Handbook", Hank Zumbahlen, Elsevier Inc, 2008 , ISBN 978-0-7506-8703-4
7. "The Circuit Designer‟s Companion", Peter Wilson, Elsevier Ltd, 2012
8. "Switching Power Supply Design," 3E, Abraham I. Pressman et. al, McGraw-Hill, 2009
9. "Measurement, Instrumentation, and Sensors Handbook", John G. Webster, CRC Press, 1999
10. "Electronic Filter Design Handbook", 4E, Arthur Williams, Fred Taylor, McGraw-Hill, 2006
11. John G Prokis, Manolakis, Digital Signal Processing-Principles, Algorithms and Application, 4th Edition, Pearson Education Publication
12. Salivahanam, A Vallavaraj, C. Guanapriya, Digital Signal Processing, 1st Edition, Tata McGrawHill, New Dehli

M. Sc. II Semester III

LAB –VI (Elective)

MEP307: Antenna, Microcontroller **system design and ARM Architecture**

(Hardware and Simulation)

- **Learning Objectives:**

1. To develop programming logic and algorithm writing.
2. To develop skills for design and development of antenna
3. To develop and microcontroller based system
4. To develop simple applications of real life using structures and files.

Practical Set

Group A

1) Study of Simple Dipole (3l/2) antenna
2) Study of Yagi-UDA 7 Element Simple dipole antenna
3) Study of Hertz antenna
4) Study of l/2 Phase Array (End fire) antenna
5) Study of Combined Co-linear Array antenna
6) Study of Log Periodic antenna
7) Study of Cut Paraboloid Reflector antenna
8) Study of Rhombus antenna
9) Study of Ground Plane antenna
10) Study of Helix antenna

Group B

1) Interfacing using EDSIM- 51(ADC,DAC)
2) Interfacing using EDSIM-51 (LED, Sven Segment)
3) Interfacing using EDSIM-51 (LCD)
4) Interfacing using EDSIM-51 (Traffic light control)
5) Interfacing using EDSIM-51 (stepper motor)
6) Interfacing using EDSIM-51 (Liquid level /Weight)
7) Design and development of microcontroller board (8051/PIC 18F)
8) Design a 89c51 system to control temperature, pressure using ON/OFF mode
9) Design a 89c51 system to control temperature, pressure using p and PID mode
10) Study and generate waveforms using ARM Microprocessor

- **Learning Outcomes:**
  1. To able to design and develop the control systems for various parameters
  2. To avail the programming skill using EDSIM-51/ Kiel
  3. To able to design and develop the Antennas
  4. To be able to develop simple applications of real life using structures and files.

- **Reference Books:**

1. John D.Kraus, Antennas, New Delhi: Tata McGraw-Hill Publishing Company Ltd, 1999
2. Constantine A.Balanis,Antenna Theroy Analysis and Design, Wiley India P. Ltd, 2010

3. Datasheets and application notes of 8051 (P89C51RD2), AVR (ATMEGA32), PIC (16F877) and TI MSP430 microcontrollers.
4. K.J. Ayala, The 8051 Microcontroller, Thomson Press (India) Ltd.
5. Microprocessors application in Process control – S.I. Ahson, TMH.
6. Transducer Interfacing Handbook, D.H. Sheingold, Analog Devices Technical Handbook Norwood, USA.
7. ARM System-on-chip Architecture, Steve Furber, Addison Wesley.

M. Sc. II Semester IV

MET401: Paper XV: Elective II
MET402: Paper XVI: Elective II

LAB –VII (Elective)
MEP403: Industrial Automation, ARM Programming and Embedded Communication Protocol
(Hardware and Simulation)

- **Learning Objectives:**

1. To develop Ladder programming logic and algorithm writing.
2. To develop skills for design and development of Automation systems
3. To develop Real Time systems.
4. To implement real time system in electronic modules.

Practical Set

Group A

1) Study of PLC timers and Counters
2) Programming PLC for Bottle filling plants
3) Programming PLC for Automatic parking Gate
4) Programming PLC for Elevator control
5) Programming PLC for Traffic Light Control
6) Programming PLC for Speed Control of DC motors
7) Programming PLC for conveyor control
8) Study and programming of sorting system using PLC (2403B ITS)
9) Study and programming of Pallitizer system using PLC (2403B ITS)
10) Study and programming of Automatic warehouse using PLC (2403B ITS)

Group B

1) Bit LED and Switch Interface
2) Buzzer Relay and Stepper Motor Interface
3) Time delay program using built in Timer / Counter feature
4) External Interrupt
5) 4x4 Matrix Keypad Interface
6) Displaying a message in a 2 line x 16 Characters LCD display
7) ADC and Temperature sensor LM 35 Interface
8) I2C Interface – 7 Segment display
9) I2C Interface – Serial EEPROM
10) Transmission from Kit and reception from PC using Serial Port
11) Generation of PWM Signal

- **Learning Outcomes:**

1. To able to design and develop the Automation systems
2. To avail the programming skill using PLC
3. To able to design and develop embedded product
4. To avail to use automation in electronic systems.

- **Reference Books:**

1. David Seal, ARM Architecture reference manual, Addison-Wesley Professional; 2nd Edition, 2001. SBN-10: 0201737191
2. Steve Furber, ARM System-on-chip Architecture, Addison Wesley. (2nd Edition) 2000 ISBN-10: 0201675196
3. The I2C-bus specification, http://www.semiconductors.philips.com/i2c, Philips semiconductor, 2000.
4. PIC/AVR datasheets for I2C, SPI functions.
5. Overview and use of the SPI PICmicro Serial Peripheral Interface, Microchip Inc. http://www.microchip.com.
6. Robert Bosch GmbH, CAN Specification, 1997.
7. John W. Webb and Ronald A. Reiss, Programmable Logic Controllers – Principle and Applications, Fifth Edition, PHI
8. JR. Hackworth and F.D Hackworth Jr ., Programmable Logic Controllers – Programming Method and Applications. – Pearson, 2004.
9. L. Umanand, Power Electronics Essentials and Applications, Wiley.

Semester III

Elective –I

MET 30X - Microcontroller System Design and ARM Architecture

- **Learning Objectives:**
  1. To understand the applications of Microprocessors & Microcontrollers.
  2. To understand need of microcontrollers in embedded system.
  3. To understand architecture and features of typical Microcontroller.
  4. To learn interfacing of real world input and output devices
  5. To study various hardware & software tools for developing applications

Unit 1: Introduction **15**

Review of microcontroller solutions for control/measurement systems, their analog and digital features (8051, PIC, AVR, MSP430): architectural benefits, Key characteristics, Digital I/O, interrupts, timer/counters, RTC, analog comparator, ADC, PWM, UART, I2C, clock oscillators, low power operating modes, watchdog timer, ISP/IAP techniques.

Unit 2: System Design **15**

Minimum system with 89C51/PIC microcontrollers to monitor frequency, voltage, displacement, liquid level, weight, speed, traffic light control system with software development for above.

Isolation Techniques:

Realys, opto-couplers and their specifications, Interfacing of Relays and opto-couplers with microcontrollers, isolation methods for heavy and a.c. loads.

Signal Transmission:

V to I and I to V Conversion, V to F and F to V Conversion, Electrostatic Shielding and Grounding.

Unit 3: Interfacing **15**

Transducers and digital sensors for temperature, pressure and speed, signal conditioning, Instrumentation Amplifiers for RTD, thermocouple, bridge and LVDT, System design with 89C51 for measurement and control of temperature, pressure, speed using ON/OFF, Proportional and PID modes, stability aspects of the system, s/w development.

Unit 4: ARM Architecture **15**

Introduction to ARM microprocessor and its features, Architecture, Programming model, Processor Operating States, registers, Exceptions, ARM organization – 3-stage/5-stage pipelined ARM organization.

- **Learning Outcomes:**

1) To understand the organization of PIC and AVR controller
2) Able to design and develop the controller based systems
3) Able to interface outside world to microcontroller
4) To understand the architecture of Arm controller

- **Reference Books:**

1. Datasheets and application notes of 8051 (P89C51RD2), AVR (ATMEGA32), PIC (16F877) and TI MSP430 microcontrollers.(Unit I)
2. K.J. Ayala, The 8051 Microcontroller, Thomson Press (India) Ltd. (Unit I)
3. Microcontrollers: theory and applications By Ajay V Deshmukh, TMH.
4. Microprocessors application in Process control – S.I. Ahson, TMH.
5. Transducer Interfacing Handbook, D.H. Sheingold, Analog Devices Technical Handbook Norwood, USA.(Unit III)
6. ARM System-on-chip Architecture, Steve Furber, Addison Wesley.(Unit IV)

Semester III

Elective –I
MET 30X - Satellite Communications

- **Learning Objectives:**
    1. To enable the student to become familiar with satellites and satellite services
    2. Study of satellite orbits and launching.
    3. Study of earth segment and space segment components
    4. Study of satellite access by various users.

Unit 1 : Satellite Systems **15**

History of satellite communications, Orbital mechanics, Look angle determination, Orbital perturbations, Satellite subsystems – AOCS, TTC and M, power systems, communications subsystems, satellite antennas, Satellite frequency bands, satellite Multiple access formats

Unit 2 : Modulation, Encoding and Decoding **15**

Analog modulation, Digital Encoding, Spectral shaping, Digital decoding, Error correction Encoding, Block Waveform Encoding, Digital Throughput.

The Satellite Channel Electromagnetic field propagation, Antennas, Atmospheric losses, receiver Noise, Carrier to Noise ratios, satellite link analysis, Frequency Reuse by dual polarization, Spot beams in satellite downlinks.

Unit 3 : The Satellite Transponder **15**

The transponder model, the satellite front end, RF filtering of digital carriers, Satellite signal processing, Transponder Limiting, Non linear satellite amplifiers, Effect of non linear amplification on digital carriers. Satellite Ranging System Ranging system, Component Range Codes, Tone Ranging Systems

Unit 4 : Multiple access formats **15**

FDMA - FDMA system, Nonlinear amplification with multiple FDMA Carriers, FDMA, FDMA Nonlinear analysis, FDMA characterization, AM/PM conversion with FDMA, Satellite switched FDMA.

TDMA -The TDMA system, preamble design, Satellite Effects on TDMA performance, Network synchronization, SS TDMA.

CDMA - Direct Sequence CDMA system, Performance of DS CDMA, satellite systems, Frequency Hopped CDMA, Antijam advantages of spectral spreading, Code Acquisition and Tracking

- **Learning Outcome:**

After successfully completing the course students will be able to

1. How to compute the coverage angle and angle of visibility and consequently determine the coverage area.
2. How to relate the coverage area with the beam width of satellite antenna.
3. Understand orbital effects in communications system performance.
4. How to calculate the received carrier power at the input of earth station receiver or satellite transponder.

- **Reference Books**

1. Robert M. Gagliardi, Satellite Communications, New Delhi : CBS Publishers and Distributors, 2000
   (Unit I, II, III, IV**)**
2. Timothy Pratt, Charles W. Bostian, Jeremy E. Allnutt, Satellite Communications, Singapore : John Wiley and Sons Inc. 2003
3. Dennis Roddy, Satellite Communications. New York : McGraw-Hill, 2001
   (Unit I,IV)

Semester III

Elective –I
MET 30X - Instrumentation

- **Learning Objectives:**
  1. To understand the configurations and functional descriptions of measuring instruments
  2. To understand the basic performance characteristics of instruments
  3. To understand the working principles of various types of sensors and transducers and their use in measuring systems
  4. To understand the techniques involved in various types of instruments
  5. To understand the relevance of electronics with other disciplines

Unit-1: Introduction to Measurement and Measurement Systems 15

Definition and significance of measurement, Classification of Instruments and types of measurement applications, Elements of an instrument/ measurement system, Active and passive transducers, Analog and digital modes of operation, Null and deflection methods, Input-output configuration of instruments and measurement systems, Methods of correction of instruments and measurement systems

Generalized performance characteristics of instruments: Static characteristics and static calibration, Meaning of static calibration, True value, basic statistics, Least–squares calibration curves, Calibration accuracy versus installed accuracy, Combination of components errors in overall system accuracy calculations, Theory validation by experimental testing

Unit-2: Motion Measurement 15

Methods of transduction, Primary sensing elements and transducers, Electrical transducers, Classification of transducers

Motion and dimensional measurement: Fundamental standards, Relative displacement- translational and rotational, Calibration, Resistive potentiometers, Resistance strain gauge, Differential transformers, Variable –inductance and variable – reluctance pickups, Eddy current non contacting transducers, Capacitance pickups, Piezoelectric transducers, Digital displacement transducers (translational and rotary encoders), Ultrasonic transducers. Detailed discussion of Strain Gauges, LVDT and Synchros

Relative velocity: translational and rotational, Calibration, Average velocity from measured x and t, Tachometer encoder methods, Laser based methods, Stroboscopic methods, Translational–velocity transducers (moving coil and moving magnet pickups)

Relative acceleration measurements: Seismic-(absolute -) displacement pickups, Seismic-absolute-) velocity pickups, Seismic-(absolute-) acceleration pickups (accelerometers)

Unit-3: Process Parameter Measurements **15**

Force, Torque and Shaft power: Standards and Calibration, Basic methods of, bonded strain gauge, differential transformer, Piezoelectric, variable reluctance/ FM oscillator Digital system, Torque measurement on rotating shafts

Pressure and Sound Measurement: Standards and calibration, Dead weight gauges and manometers, Low pressure measurement: McLeod gauge, Knudsen gauge, Viscosity, Thermal conductivity, Ionization, Sound level meter, microphone, capacitor microphone Flow measurement: Pitot-static tube, Yaw tube, hot wire and hot film Anemometers, Laser Doppler anemometer. Gross Volume Flow Rate: Rotameters, urbine, Ultrasonic flow meter, Electromagnetic flow meters.

Temperature and Heat measurement transducers: Standards and Calibration, bimetallic thermometers, Liquid in glass thermometers, pressure thermometers, RTD, Thermocouples, Thermistors, Semiconductor based temperature sensors. Detailed discussion on basics of thermocouples, Laws of thermocouples, cold junction compensation; thermistor types, materials used, application circuits, LM35

Radiation fundamentals: detectors, optical pyrometers, IR imaging systems, Heat flux sensing: Slug type sensors, Gorden gauge.

Unit-4: Special Amplifiers, Signal Analyzers and telemetry **15**

Instrumentation Amplifiers, Need for choppers, chopper stabilized and carrier amplifiers.

Signals and signal analysis: Basic wave analyzer, harmonic distortion analyzer, Spectrum analyzer, Digital Fourier analyzer

Wheatstone bridge, Q meter, LCR bridges, RF Output power meters, Field strength meter, Phase meter, Vector impedance meter (direct reading)

Telemetry: Methods of data transmission, General Telemetry system, Types of Telemetry system: Voltage telemetry, current telemetry system

Introduction to recorders

- **Learning Outcomes**

1) Able to measure the measurement of measuring systems
2) Able to design active and passive transduces
3) Able to design temperature based sensors
4) To analyze telemetry systems

- **Reference Books:**

1. Measurement Systems, Applications and Design by Ernest O. Doeblin and Dhanesh N. Manik, 5th Edition, Tata McGraw Hill(Unit I, II, III)
2. A Course in Electrical and Electronic Measurements and Instrumentation by A.K.Sawhney, (Unit I, II)
3. Electronic Instrumentation, Kalsi, TMH (Unit I , II, III)
4. Measurements and instrumentation, U. A Bakshi and A.V Bakshi, 3rd Edition
5. Modern Electronic Instrumentation and measurements technique, Cooper and Helfrick, PHI

Semester III

Elective –I
MET 30X – Antennas

- **Learning Objectives:**

1. To provide an in-depth understanding of modern antenna concepts, and practical antenna design for various applications.
2. The course will explain the theory of different types of antennas used in communication systems.
3. Starting from the basic antenna parameters, the course will discuss various types of antennas including the planar printed antennas. An in-depth study will be made for the analysis and design of arrays.
4. A brief introduction of smart antenna concept will be given at the end with a view that the student can further explore the topic, if interested.

Unit 1 :Basic Antenna Concepts 15

Radiation pattern, Beam area, Radiation power density, Radiation intensity, Directivity, Gain, Aperture concept, Antenna efficiency, Half power beamwidth, Beam efficiency, Bandwidth, Polarization, Input impedance, Antenna radiation efficiency, Antenna vector effective length and effective areas, Maximum directivity and maximum effective area, Effective height, Friss transmission formula, Duality of antennas, Antenna temperature.

Unit 2: Radiation Integrals and Auxiliary potential functions, Linear wire antennas 15

Vector potential for an electric current source, Vector potential for magnetic current source, Electric and magnetic fields for electric and magnetic current sources, Solution of the inhomogeneous vector potential wave equation, Far field radiation, Infinitesimal dipole, Small dipole, Region Separation, Finite length dipole, Half-wavelength dipole, Linear elements near or on infinite perfect conductors, Ground effects

Unit 3 :Point Sources and arrays of point sources 15

Power theorem and its application to an isotropic source, Radiation Intensity, Source with Hemispheric, unidirectional cosine, bidirectional cosine, sine(doughnut), sine- squared (doughnut), unidirectional cosine-squared power patterns, Directivity, Source with arbitrary shape Gain, Field patterns, Arrays of two isotropic point sources, Nonisotropic but similar point sources and the principle of pattern multiplication, pattern synthesis by pattern multiplication, Nonisotropic and dissimilar point sources, Linear arrays of n isotropic point sources of equal amplitude and spacing, Null directions

Unit 4 :Loop, Traveling wave, broadband and other types of antennas 15

Small circular loop, Circular loop of constant current, Circular loop with nonuniform current, Ground and Earth curvature effects, Polygonal loop antennas, V antenna, Rhombic antenna, Helical antenna, electric-magnetic dipole, Yagi-Uda array of linear elements, Yagi-Uda array of loops, basics of microstrip antennas, Plane reflector, Corner reflector

- **Learning Outcome:**

After successfully completing the course students will be able to
1. Explain the radiation through antenna and identify different types of antennas.
2. Identify and measure the basic antenna parameters
3. Design and analyze wire and aperture antennas
4. Design and analyze matching and feeding networks for antennas

- **Reference Books**

1. John D.Kraus, Antennas, New Delhi: Tata McGraw-Hill Publishing Company Ltd, 1999(Unit I , III, IV)
2. Constantine A.Balanis,Antenna Theroy Analysis and Design, Wiley India P. Ltd, 2010(**U**unit I, II, III)

Semester III

Elective –I
MET 30X – Nanoelectronics

- **Learning Objectives:**
    1. To understand the Nano-CMOS Devices.
    2. To learn the applications of nanotechnology in electronics.
    3. To understand the various MEMS controls.
    4. To learn different types of MEMS transducers.

Unit -1 Introduction **15**

Review of energy bands in materials. Metal, Semiconductor and Insulator. Doping in Semiconductors, Defects: Point, Line, Schottky and Frenkel. Single Crystal, Polycrystalline and Amorphous Materials. Czochralski technique for Silicon Single Crystal Growth. Definition of Nano-Science and Nano Technology, Applications of Nano-Technology.

Quantum Theory for Nano Science**:** Time dependent and time independent Schrodinger wave equations. Particle in a box, Potential step: Reflection and tunneling (Quantum leak). Penetration of Barrier, Electron trapped in 2D plane (Nano sheet), Quantum confinement effect in nano materials.

Quantum Wells, Wires and Dots**:** Preparation of Quantum Nanostructure; Size and Dimensionality effect, Fermi gas; Potential wells; Partial confinement; Excitons; Single electron Tunneling, Infrared detectors; Quantum dot laser Superconductivity.

Unit-2 Growth Techniques of Nanomaterials **15**

Synthetic aspects: bottom up and top down approaches, Lithograpahic and Nonlithograpahic techniques, Sputtering and film deposition in glow discharge, DC sputtering technique (p-CuAlO2 deposition). Thermal evaporation technique, E-beam evaporation, Chemical Vapour deposition(CVD), Synthesis of carbon nano-fibres and multi-walled carbon nanotubes, Pulsed Laser Deposition, Molecular beam Epitaxy, Sol-Gel Technique (No chemistry required), Synthesis of nanowires/rods, Electro deposition, Chemical bath deposition, Ion beam deposition system, Vapor-Liquid – Solid (VLS) method of nanowire.

Unit -3 Semiconductor Devices **15**

Review of p-n Junction diode, Metal-Semiconductor junction, Metal-Oxide-Semiconductor (MOS) capacitor and its C-V characteristics, MOSFET (enhancement and depletion mode) and its high Frequency limit. Microwave Devices: Tunnel diode. Memory Devices: Volatile Memory: Static and Dynamic Random Access Memory (RAM), Complementary Metal Oxide Semiconductor (CMOS) and NMOS, Non-Volatile - NMOS (MOST, FAMOS), Ferroelectric Memories, Optical Memories, Magnetic Memories, Charge Coupled Devices (CCD).

Micro Electro-Mechanical System (MEMS): Introduction to MEMS, Materials selection for MEMS Devices, Selection of Etchants, Surface and Bulk Micromachining, Sacrificial Subtractive Processes, Additive Processes, Cantilever, Membranes. General Idea MEMS based Pressure, Force, and Capacitance Transducers, Microfluidics.

Carbon nanotubes, nano cuboids, graphene, carbon quantum dots: Fabrication, structure. electrical, mechanical, and vibrational properties and applications. Use of

nano particles for biological application, drug delivery and bio-imaging, Impact of nanotechnology on the environment.

Unit -4 Methods of Measuring Properties and Characterization techniques 15

Microscopy: Scanning Probe Microscopy (SPM), Atomic Force Microscopy (AFM), Field Ion Microscopy, Scanning Electron Microscopy (SEM), Transmission Electron Microscopy (TEM) including energy dispersive X-ray (EDX) analysis, low energy electron diffraction (LEED), reflection high energy electron diffraction (RHEED) Spectroscopy: Infra-red and Raman Spectroscopy, X-ray Spectroscopy, Magnetic resonance, Optical and Vibrational Spectroscopy

Characterization and application like biopolymer tagging and light emitting semiconductor quantum dots.

- **Learning Outcome:**

After successfully completing the course students will be able to

1) Explain the properties of Nano particles and Nano tube with their applications in electronics.
2) Identify the suitable MEMS transducer for a given electronic system
3) To be avail To understand the Nano-CMOS Devices.
4) To be able to learn the applications of nanotechnology in electronics.

- **Reference Books**

1. Nanoscale Science and Technology, Robert W. Kelsall, Ian W. Hamley and Mark Geoghegan, John Wiley & Sons, Ltd., UK, 2005.(Unit I, II, III, IV**)**
2. Introduction to Nanotechnology, Charles P. Poole Jr and Frank J. Owens, Wiley Interscience, 2003. .(Unit I, III, IV)
3. Nano: The Essentials: Understanding Nanoscience and Nanotecnology, T.Pradeep, Tata McGraw-Hill Publishing Company Limited, New Delhi, 2008. .(Unit I, III)
4. Fundamentals of Semiconductor Fabrication, S.M. Device and G. S. May, John- Wiley and Sons, Inc.(Unit II, III**)**
5. Nanomaterials: synthesis, properties and applications, Institute of Physics, 1998.
6. Electron Microscopy and analysis, 2nd ed. Taylor and Francis, 2000.
7. Bio-Inspired Nanomaterials and Nanotechnology, Edited by Yong Zhou, Nova Publishers.

Semester IV

Elective – II

MET 40X - ARM Programming and Embedded Communication Protocols

- **Learning objective**
  1) To learn instruction set of ARM controller
  2) To learn interfacing techniques for I^2C
  3) To learn serial interfacing techniques
  4) To learn embedded protocols

Unit 1: The ARM instruction set: 15

Introduction, exceptions, conditional execution, Branch and branch with link, software interrupt, data processing instructions, multiply instructions, data transfer instructions. Architectural support for HLLs: Data types, Expressions, Conditional statements, loops.

Unit 2: Inter-Integrated Circuit (I2C) BUS 15

I2C bus specification, general characteristics, bus signals, Address mechanism, Applications – microcontroller interfacing examples for I2C EEPROM, RTC, ADC, and digital temperature sensors.

Unit 3: Serial peripheral interface (SPI) 15

Introduction, Specifications, master slave configuration, applications - microcontroller interfacing examples for SPI EEPROM, RTC, ADC and digital temperature sensors.

Unit 4: Recent embedded protocols 15

Controller Area Network (CAN): Specifications, basic concepts, Frame types, bus signals, Error handling, Addressing. Introduction to Button devices, 1-wire protocol.

- **Learning Outcomes :**
  1) Able to implement instruction set of ARM for programming
  2) Able to design interfacing system for various sensors
  3) Able to design Serial interfacing system
  4) Design and develop embedded protocols

- **Reference books:**

1. David Seal, ARM Architecture reference manual, Addison-Wesley Professional; 2nd Edition, 2001. SBN-10: 0201737191(Unit I)
2. Steve Furber, ARM System-on-chip Architecture, Addison Wesley. (2nd Edition) 2000 ISBN-10: 0201675196 P(Unit I)
3. The I2C-bus specification, http://www.semiconductors.philips.com/i2c, Philips semiconductor, 2000.(Unit II)
4. PIC/AVR datasheets for I2C, SPI functions. (Unit II, III)
5. Overview and use of the SPI PICmicro Serial Peripheral Interface, Microchip Inc. http://www.microchip.com.(Unit III)
6. Robert Bosch GmbH, CAN Specification, 1997. (Unit IV)

Semester IV

Elective –II

MET 40X - Cellular Mobile Communications

- **Learning Objectives:**
  1) To understand basic cellular concept
  2) To learn analog and digital communication systems
  3) To understand the multiple access technique
  4) To learn to build communication system module

Unit 1 : Introduction to Cellular communication **15**

Introduction to Cellular mobile systems, Elements of Cellular radio system Design, specifications of analog systems, Cell coverage for signal and traffic

Unit 2 : Cellular Communication Channel **15**

Cell-site antennas and mobile antennas, Co-channel interference reduction, Types of non co-channel interference, Frequency management and channel assignment

Unit 3 : Switching Systems **15**

Handoffs and dropped calls, operational techniques and Technologies, switching and traffic

Unit 4 : Introduction to Digital Communication **15**

Introduction to digital systems, Digital cellular systems, Intelligent cell construction and Applications, Features of handset, SMS, Security

- **Learning Outcomes:**

  1) To able to understand the infrastructure to develop mobile communication system
  2) Able to design electronics systems
  3) To avail the knowledge of switching systems
  4) To be avail to learn to build communication system module

- **Reference Books**

1. William C.Y. Lee, Mobile Cellular Telecommunications : Analog and Digital Systems, Singapore : McGraw-Hill, 1995(Unit I, II,III,IV)
2. William C.Y. Lee, Mobile Communication Engineering, McGraw-Hill (Unit I, III, IV)

Semester IV

Elective – II
MET 40X - Industrial Automation

- **Learning Objectives:**
  1) To learn fundamentals of control systems.
  2) To learn environment of control system.
  3) To learn Ladder programming language.
  4) To learn design the automation systems.

Unit 1: Process Models **15**

Static model dynamic models, Step response methods- two parameter model, three parameter model & four parameter model. Models for oscillatory system, method of moments. Disturbance models- measuring noise characteristics. Controller Principles :- Process Characteristics - process equation, process load, process lag, self regulation Control system parameters- Error, variable range, control parameter range, control lag, dead time, cycling.

Unit 2: Tuning of Controllers **15**

Control modes: - Discontinuous- two position, multi position, floating control Continues – proportional, integral, derivative & composite modes Control paradigms-Cascade control., Criteria for controller tuning-specified decay ratio, minimum integral of absolute error (IAE), minimum integral of time & absolute error. (ITAE) closed loop response methods: ultimate method damped oscillation method Process reaction curve & open loop tuning.

Unit 3: Programmable Controllers and SCADA **15**

PLC Basics: Programmable Controllers – functional diagram, operation, programming. PLC system, I/O modules and interfacing, CPU processor, programming equipment, programming formats, construction of PLC ladder diagrams, devices connected to I/O modules.

PLC Programming. Ladder diagrams for process control: Ladder diagrams and sequence listings, ladder diagram construction and flow chart for spray process system. PLC Registers Introduction to SCADA

Unit 4: Digital Controller design: **15**

Controller Design techniques, Bode diagram method, PID controller, Root Locus Method – Root locus Plot, Controller design, State Space Method – Controllability Observability , Full-state feedback Regulators Tracker, Regulator design by pole placement, Controlling Voltage, Controlling Current, Control of Induction Motor

- **Learning Outcomes:**
  1) Able to implement control system in electronics systems
  2) Able to Design System using ladder codes
  3) Able to Design Digital control system
  4) Able to design and develop control system for automation

- **Reference book**

1. L. Umanand, Power Electronics Essentials and Applications, Wiley (Unit IV).
2. John W. Webb and Ronald A. Reiss, Programmable Logic Controllers – Principle and Applications, Fifth Edition, PHI(Unit IV, II, III,IV).
3. JR. Hackworth and F.D Hackworth Jr ., Programmable Logic Controllers – Programming Method and Applications. – Pearson, 2004. **(**Unit III).

Semester IV

Elective – II
MET 40X – Mechatronics

- **Learning Objectives:**

1. To provide multidisciplinary knowledge
2. Expose Role of Controls in Mechatronics.
3. Aims to develop understanding of Mechatronics Components.
4. To make students aware about Logic system, Software & Data acquisition.
5. Apply Mechatronics Engineering technical expertise to industry-related fields.
6. Get awareness on advance technologies like MEMS.

Unit I : Overview of Mechatronics and Self Optimizing Systems 15

Key Elements, Mechatronics Design Approach, Functions of Mechatronics system, Division of functions between Mechanics and Electronics, Stepwise Design Procedure, Modeling Procedure. Mechanical Components and systems: Bearings and Bushings, Belts and Pulleys, Brakes and clutches, Chains and Sprockets, Couplings and joints, gears, Pulleys and Belts, Solenoids, springs, Switches. Self-Optimization, Challenges during the development of self-optimizing systems, Specification of the principle solution, Partial models, Interrelations between the partial models, Particularities within the specification of self-optimizing systems,. Conceptual design of selfoptimizing systems, The role of the principle solution during the concretization.

Unit II : Control Systyems, Computer and logic System 15

Role of controls in Mechatronics, Key elements of controlled Mechatronics system, Integrated Modeling, design and control implementation, Case study: Design of a mobile Robot, Modern examples of Mechatronics systems in action, Special Requirements of Mechatronics that Differentiate from Classic Systems and Control Design, State space analysis controller examples. The Mechatronics use of computers, concept of real time, System interfaces, Terminology and Definitions (Serial vs. Parallel, Bit Rate vs. Baud Rate, Synchronous 16 vs. Asynchronous, Data Flow-Control, Handshaking, Communication Protocol, Error Handling, Simplex, Half- Duplex, Full-Duplex, Unbalanced vs. Balanced Transmission, Point-to-Point vs. Multi-Point, Serial Asynchronous Communications, the Universal Asynchronous Receiver Transmitter (UART)), TIA/EIA Serial Interface Standards RS- 232 Serial Interface, Functional Description of Selected Interchange Circuits, IEEE 488- The General Purpose Interface Bus (GPIB) CNC machines, PLC.

Unit III: Software and Data Acquisition 15

Data logging functional requirement: Acquisition, Sensors, Signal Connectivity, Signal Conditioning, Conversion, Online Analysis, Logging and Storage, Offline Analysis, Display, Report Generation, Data Sharing and Publishing; Data-Logging Systems Different applications of Mechatronics as Case study

Unit IV: Introduction to MEMS 15

MEMS: Introduction and Fundamentals , mechanical properties of MEMS materials, modeling and simulation of MEMS, materials involved in designing and fabricating MEMS devices, various fabrication and manufacturing methods, including LIGA and macromolding, X-ray based fabrication.Applications:-inertial sensors, micromachined pressure sensors, surface micromachined devices, microscale vacuum pumps, reactive control for skin-friction reduction, and microchannel heat sinks.

- **Learning Outcomes**

After successfully completing the course students will be able to Work in interdisciplinary field.

1. Describe how to optimize Mechatronics system.
2. Implement software for control of Mechatronics systems.
3. Interpret and apply current or emerging knowledge from inside and outside Mechatronics
4. Use relevant mathematics and computer science concepts as tools.

- **Reference Books**

1. Robert H. Bishop - The Mechatronics Handbook-CRC Press (2002) (Unit I, II, III)
2. David G. Alciatore, Michael B. Histand - Introduction to Mechatronics and Measurement Systems, Fourth Edition (2011, McGraw-Hill Science_Engineering_Math)**(** Unit I, II, III)
3. William. Bolton, Mechatronics, fourth Edition, New Delhi : Pearson Education in South Asia, 2011(Unit I,II,III)
4. [The Mechanical engineering handbook series] Mohamed Gad-el-Hak - The MEMS Handbook (2002, CRC Press)

Semester IV

Elective –II

MET 40X - Advanced Microcontroller and RTOS

- **Learning Objectives:**

1) To understand the architecture of PIC uC
2) To know how to interface the I/O port with the external peripherals.
3) To learn the fundamentals of operating system
4) To understand management aspects of Real time operating system

Unit 1: Introduction and Architecture of PIC 15

Introduction to microchip PIC microcontroller: PIC microcontroller features, scaling of PIC MCU families, overview of baseline, midrange, enhanced midrange, and high-end core devices.

Core architecture: PIC Architecture, Program memory, Addressing Modes, Instruction set.

MPLAB IDE overview: Using MPLAB, Toolbars, Select Development Mode And Device Type, Project, Text Editor, Assembler, MPLAB Operations.

Unit 2: PIC MCU Hardware 15

PIC MCU Hardware: reset, clock, control registers, register banks, program memory paging, Ports, interrupts, Timer and Counter, watchdog timer, power up timer, sleep mode, state machine programming.

Overviews of PIC tools – Development software, compilers, debug tools.

Unit 3: Introduction RTOS 15

Introduction to RTOS, Scheduler, objects, services. Tasks, task states and scheduling, synchronization, communication and concurrency.

Kernel objects: Semaphores, queues, pipes, event registers, signals, and condition variables. Exceptions and interrupts: Introduction, Exception v/s Interrupt, Applications of exceptions and interrupts.

Unit 4: Memory Organisation 15

Timer and timer services: Introduction, Real-time clock and system clock, Programmable interval timers, Timer ISRs, Timing wheels, soft timers.

I/O subsystem: Basic I/O concepts, The I/O subsystem.

Memory Management: Introduction, Dynamic memory allocation in Embedded systems, Fixed-size memory allocation, blocking v/s non-blocking memory functions, H/W memory management

- **Learning Outcomes:**

1) To avail the Hardware and programming skills
2) Able to design electronics systems
3) Able to write code
4) To avail the MPLAB tools

- **Reference Books:**

1. Ajay V Deshmukh, Microcontrollers: theory and applications, TMH.(Unit I, II)
2. Myke Predko, Programming & Customizing PICmicro Microcontrollers, TMH. (Unit I,II)
3. Qing Li, Caroline Yao, Real-Time Concepts for Embedded Systems, CMP Books. (Unit III, IV)
4. Tim Wilmshurst, Designing Embedded Systems with PIC Microcontrollers, Newnes.
5. David W Smith,PIC in Practice, Newnes.

6. John Morton, PIC: Your Personal Introductory Course, Newnes.(Unit II)
7. David E. Simon, An Embedded Software Primer, Addison-Wesley.
8. Raj Kamal , Embedded Systems: Architecture, Programming and Design, 2nd Edition, McGraw-Hill Education, ISBN-10: 00701253
9. Jean J. Labrosse, MicroC OS II: The Real Time Kernel, Publisher: CMP Books, ISBN- 10: 9787820103

Nature of Question Paper:

1. **ISE-I : Marks =10:**
   Unit 1&2: Multiple choice questions: Online Examination: (1X10)
2. **ISE-II: Marks =10:**
   Unit 3 & 4: Written Test/ Open book test/Home Assignment / Viva voce / Presentation (Seminar)/
3. **ESE: Marks =80+20=100:**
   Unit 1 to 4:

   (**ISE**-Internal Semester Examination, **ESE** – End Semester Examination)

4. Nature of ESE:

Rayat Shikshan Sanstha's
Yashavantrao Chavan Institute of Science, Satara (Autonomous)
M. Sc (Part I) ELECTRONICS (Semester - I/II/III/IV) CBCS
Examination, Oct/Nov - Mar/Apr------
Subject Code: Paper Title

Day &Date: ---------- **Total Marks: 80**
Time: 11.00 Am to 2.00 Pm

Instructions:-

1) All questions are compulsory carries equal marks.
2) Draw a neat labeled diagram whenever necessary.
3) Use of log table, and scientific calculator are allowed.

Q. 1 Select most correct alternative from given bellow. (1X16=16)

I] ----------

A. ---------- B. ---- --------
C. ---------- D. ---- ------

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.
.

XVI] ----------

A. ---------- B. ---- --------
C. ---------- D. ---- ------

Q. 2 Attempt any One (1X16 = 16)

I. ----------
II. ----------

Q. 3) Attempt any two (2X8 = 16)

I. ----------
II. ----------
III. ----------

Q.4) Attempt Any Two (2x8=16)

I. ----------
II. ----------
III. ----------

Q. 5) Attempt any four (4X4=16)

I. ----------

II. ----------

III. ----------

IV. ----------

V. ----------

Mr. J. A. Wagh
Chairman
B.O.S. (Electronics)