Rayat Shikshan Sanstha’s

YASHAVANTRAO CHAVAN INSTITUTE OF SCIENCE, SATARA

(An Autonomous College)

Reaccredited by NAAC with ‘A+’ Grade

New Syllabus For

Master of Science

Part - II

ELECTRONICS

Syllabus

to be Implemented from June, 2022 onward

M. Sc. Part I Semester I

Course Code	Title of the Course	Credits	Teaching Scheme		Evaluation Scheme		
			L	P	ISE	ESE	Total
M.Sc. Part I - Semester I							
MET101	Foundation of Semiconductor Devices	4	4	-	40	60	100
MET102	Instrumentation and Measurement Techniques	4	4	-	40	60	100
MET103	Computer Organization	4	4	-	40	60	100
MET104	Advanced Digital System Design	4	4	-	40	60	100
MEP105	Lab I	4	-	12	40	60	100
MEP106	Lab II	4	-	12	40	60	100
	Total	**24**	**16**	**24**	**240**	**360**	**600**
M.Sc. Part I - Semester II							
MET201	8-bit Microcontrollers and Applications	4	4	-	40	60	100
MET202	Applied Electromagnetics and Microwaves	4	4	-	40	60	100
MET203	Power Electronics	4	4	-	40	60	100
MET204	Fiber Optic Communication Systems	4	4	-	40	60	100
MET205	Computer Networks	4	4	-	40	60	100
MEP206	Lab III	4	-	12	40	60	100
MEP207	Lab IV	4	-	12	40	60	100
	Total	**28**	**20**	**24**	**280**	**420**	**700**
M.Sc. Part II – Semester III							
MET301	Control Systems	4	4	-	40	60	100
MET302	Analog Circuit Design	4	4	-	40	60	100
MET303	Digital Signal Processing	4	4	-	40	60	100
MET304	Elective I	4	4	-	40	60	100
MET305	Elective I	4	4	-	40	60	100
MEP306	Lab V	4	-	12	40	60	100
MEP307	Lab VI	4	-	12	40	60	100
	Total	**28**	**20**	**24**	**280**	**420**	**700**
M. Sc. Part II - Semester IV							
MET401	Elective II	4	4	-	40	60	100
MET402	Elective II	4	4	-	40	60	100
MEP403	Lab VII	4	-	12	40	60	100
MEP404	Internship	4	-	12	40	60	100
	Total	**16**	**8**	**24**	**160**	**240**	**400**
	Grand Total	**96**	**64**	**96**	**960**	**1440**	**2400**

SEMESTER III

Course X: MET301: Control Systems

- **Course Objectives:** Students will be able to
  1. Study of theory to complex real-world problems in order to obtain models that are expressed using differential equations, transfer functions, and state space equations.
  2. Study of system behavior based on the mathematical model of that system where themodel may be expressed in time or frequency domain.
     Understand the behavior of closed loop systems using various methods.
  3. Understand controllers using classical PID methods, root locus methods, and frequencydomain methods.

Credits=4	**SEMESTER – III** **MET301: Control Systems**	**No. of hours per unit/ credits**
Credit –I **UNIT I**	**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 Mathematical modeling of linear mechanical and Electrical systems Electrical analogy, Block reduction techniques, Signal flow graph, Mason’s gain formula.	
Credit –1 **UNIT II**	**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.	
Credit –1 **UNIT III**	**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.	
Credit –1 UNIT IV	**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.	

- **Course Outcomes:** Student should be able to:

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

- **Reference Books:**

1. U. A. Bakshi, V. U. Bakshi "Control System Engineering", First Edition 2008, Technical Publications, Pune
2. I. J. Nagrath, M. Gopal "Control Systems Engineering", 5th Edition, New Age International Publication
3. Ogata Katsuhiko, "Modern Control Engineering", 4th Edition, PHI.
4. Kuo B.C. Automatic Control System, PHI, New Delhi, Third Edition
5. Schaum's Series book "Feedback 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.

Course XI: MET 302 - Analog Circuit Design

- **Course Objectives:** Students will be able to
  1. Study of art of applying basic concepts for designing electronic systems.
  2. Imbibe good design practices for robust design of electronic systems.
  3. Study of importance and significance of customer specifications requirements.
  4. Understand electronic circuit function verification with an EDA tools.

Credits=4	SEMESTER-III **MET 302 - Analog Circuit Design**	No. of hours per unit/ credits
Credit –I UNIT I	**Power Supply Designing**	**(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. Concept of PCB Designing.	
Credit –1 UNIT II	**Frequency Response of Amplifiers**	**(15)**
	BJT models and modeling parameters, equivalent circuits for CE, CB and CC configurations, single stage amplifier, small signal analysis, distortion. Design of single stage RC-coupled amplifier with frequency response (f1 and f2) Frequency Response: Low and High frequency equivalent circuit, bode plots, Miller effect, square wave testing, and frequency response of multistage amplifiers, different coupling schemes and gain of multistage amplifiers	
Credit –1 UNIT III	**Tuned Amplifier and Oscillators**	**(15)**
	Tuned amplifier design, multistage tuned amplifiers: synchronous and stagger tuning cascade configuration, large signal tuned amplifier Oscillators: design and analysis of LC and RC oscillators, Hartley, Colpitt's, Miller oscillators, phase shift and Wien-bridge oscillators, crystal oscillators and applications Circuit Design and Analysis using PSPICE – Schematics, attributes and types of analysis in PSPICE.	
Credit –1	**Operational Amplifiers and their Applications**	**(15)**

UNIT IV		
	Practical consideration in op-amp based circuit design, op-amp parameters: dc and low frequency parameter and their significance in design of op-amp, closed loop stability analysis and frequency compensation. Inverting and non-inverting amplifiers with design aspects input and output impedance, common mode errors and limitations, bandwidth. Bridge and instrumentation amplifier, Practical design aspect of integrator and differentiators, Active Filters: transfer functions poles and zeros, V to I and I to V Conversion, V to F and F to V Conversion, Electrostatic Shielding and Grounding.	

- **Course Outcomes:** students should be able to:
  1. Design Power Supply System
  2. Analyze the frequency responses of various amplifiers.
  3. Construct various oscillator circuits.
  4. Evaluate applications of operational Amplifiers.

- **Reference Books:**

1. G. K. Mittal, Electronic Devices and Circuits, Khanna Publishers (2009)
2. Ron Lenk, John Wiley & Sons, Practical design of power supplies", 2005, ISBN: 978-0-08-097138-4
3. Hank Zumbahlen "Linear Circuit Design Handbook, Elsevier Inc, 2008, ISBN 978-0- 7506-8703-4
4. Arthur Williams, Fred Taylor "Electronic Filter Design Handbook", 4E, McGraw-Hill, 2006
5. S. Salivahanan, N. Suresh Kumar, Electronic Devices and Circuits, 3rd Edn, McGraw Hill.
6. Sergio Franco, Design with Operational Amplifiers and Linear IC, 3rd Edn, TMH.
7. Malvino and Bates, Electronic Principles, McGraw Hill.
8. Mohammad H. Rashid Microelectronic Circuits: Analysis and Design, PWS Publishing Company.
9. Allen Motershed, Electronic devices, PHI.

Course XII: MET303 - Digital Signal Processing

- **Course Objectives:** Student will able to

1. Study of concepts of discrete-time signals and systems
2. Study of comprehension of the Z- and their inverse
3. Understand the principles behind the discrete Fourier transform (DFT)and its fast computation
4. Understand the MATLAB programme to digital processing problems andpresentations

Credits=4	**SEMESTER – III** **MET303 - Digital Signal Processing**	**No. of hours per unit/ credits**
Credit –1 UNIT I	**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.	
Credit –1 UNIT II	**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.	
Credit –1 UNIT III	**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.	
Credit –1 UNIT IV	**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.	

- **Course Outcomes:** students should be able to
  1. Calibrate and resolving different frequencies existing in any signal.
  2. Understand use of different transforms and analyze the discrete time signals and systems.
  3. Use of LTI filters for filtering different real world signals.
  4. 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
  2. Robert J. Schilling, Sandra L. Hariris Digital Signal Processing using MATLAB
  3. Salivahanam, A Vallavaraj, C. Guanapriya, Digital Signal Processing, 1st Edition, Tata McGrawHill, New Dehli
  4. Dr. Shaila d Apte second edition,
  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.

Semester III

Course XV:	**MET304:** Elective I
Course XVI:	**MET305:** Elective I

LAB –V

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

- **Course Objectives:** Students will be able to

1. Develop programming logic and algorithm writing.
2. Develop Hardware designing skills.
3. Develop Analog circuit-based applications
4. Develop simple applications of real-life using structures and files.

Credits=4	SEMESTER – III MEP306: Control Theory, Analog circuit Design and Digital signal processing (Hardware and Simulation)	No. of hours per unit (60)/ Credits
UNIT I	**Analog Circuit Design**	
	1) Design a series and shunt regulated power supply using transistor. 2) To study the signal flow of variable voltage regulator 317/347 3) Design a SMPS power supply 4) Design Oscillator using Schmitt trigger 5) Design a solar power system 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 an Instrumentation amplifier	
UNIT II	**Control System and Digital Signal Processing**	
	1) Design and analysis of first order control system (Simulink) 2) Design and analysis of second order control system (Simulink) 3) To obtain step response of the given system and evaluate the effect P, PD, PI and PID controllers 4) BODE & NYQUIST PLOT USING MAT LAB 5) To study and analysis of fast Fourier transform (FFT) 6) To study and analysis of discrete Fourier transform (DFT) 7) Deign a FIR filter (MATLAB) 8) Deign a IR filter (MATLAB) 9) Study and analysis of LTI systems in Z domain. 10) Simulation of transfer function using Poles and Zeros	

- **Course Outcomes:** Students should be able to
  1. Avail the programming skill using MATLAB
  2. Design and develop the microcontroller-based systems.
  3. Design and develop the embedded products.
  4. 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

LAB –VI

MEP307: Antenna, Microcontroller system design and ARM Architecture (Hardware and Simulation)

- **Course Objectives:** Students will be able to
  1. Develop programming logic and algorithm writing.
  2. Develop skills for design and development of antenna
  3. Develop and microcontroller-based system
  4. Develop simple applications of real-life using structures and files.

Credits=4	SEMESTER – III MEP307: Antenna, Microcontroller system design and ARM Architecture (Hardware and Simulation)	No. of hours per unit (60) / Credits
UNIT I	**Antenna Design**	
	1) Study of Simple Dipole (3 /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	
UNIT II	**Microcontroller System Design and ARM**	
	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/PID mode 10) Study and generate waveforms using ARM Microprocessor	

- **Course Outcomes:** Students should be able to
  1. Design and develop the control systems for various parameters
  2. Make use of EDSIM-51/ Keil for programming
  3. Design and develop the Antennas
  4. 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.

SEMESTER III

Elective I: MET 30X - Microcontroller System Design and ARM Architecture

- **Course Objectives:** Students will be able to
  1. Understand the applications of Microprocessors & Microcontrollers.
  2. Understand architecture and features of typical Microcontroller.
  3. Study interfacing of real world input and output devices
  4. Study various hardware & software tools for developing applications

Credits=4	**SEMESTER-III** **MET 30X - Microcontroller System Design and ARM Architecture**	**No. of hours per unit/ credits**
Credit –I UNIT I	**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.	
Credit –1 UNIT II	**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.	
Credit –1 UNIT III	**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, Software development.	
Credit –1 UNIT IV	**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.	

- **Course Outcomes:** Students should be able to
  1. Present the organization of PIC and AVR controller
  2. Design and develop the controller based systems
  3. Interface outside world to microcontroller

4. Present the architecture of ARM controller

- **Reference Books:**

1. Datasheets and application notes of 8051 (P89C51RD2), AVR (ATMEGA32), PIC (16F877) and TI MSP430 microcontrollers.
2. K.J. Ayala, The 8051 Microcontroller, Thomson Press (India) Ltd.
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.
6. ARM System-on-chip Architecture, Steve Furber, Addison Wesley.

Semester III

Elective –I: MET 30x: Wireless Sensor Networks

- **Course Objectives:** Students will be able to

1. Study of different wireless techniques such as mobile, radio, satellite etc
2. Understand modern wireless Sensor Networks
3. study of wireless systems on the basis of performance features
4. Understand architecture, structure and security as well as privacy aspects in IoT

Credits=4	**SEMESTER-III** **MET 30x: Wireless Sensor Networks**	**No. of hours per unit/ credits**
Credit –I **UNIT I**	**Introduction to Wireless Communication System:**	**(15)**
	Evolution of mobile communications, Mobile Radio System around the world, Types of Wireless communication System, Comparison of Common wireless system, Trend in Cellular radio and personal communication. Second generation Cellular Networks, Third Generation (3G) Wireless Networks, Wireless Local Loop (WLL),Wireless Local Area network(WLAN), Bluetooth and Personal Area Networks, satellite communication including GPS, wireless local loop, cordless phone, paging systems, RFID.	
Credit –1 **UNIT II**	**Recent wireless technologies**	**(15)**
	Multicarrier modulation, OFDM, MIMO system, diversity multiplexing trade-off, MIMO- OFDM system, smart-antenna; beam forming and MIMO, cognitive radio, software defined radio, communication relays, spectrum sharing. **Wireless Systems:** GSM system architecture, Radio interface, Protocols, Localization and calling, Handover, Authentication and security in GSM, GSM speech coding, Concept of spread spectrum, Architecture of IS-95 CDMA system, Air interface, CDMA forward channels, CDMA reverse channels, Soft handoff, CDMA features, Power control in CDMA, Performance of CDMA System, RAKE Receiver, CDMA2000 cellular technology, GPRS system architecture	
Credit –1 **UNIT III**	**Wireless Sensor Networks**	**(15)**
	History and context, WSN Architecture, the node, Connecting nodes, Networking Nodes, Securing Communication WSN specific IoT applications Challenges: Security, QoS, Configuration, Various integration approaches, Data link layer protocols, routing protocols and infrastructure	

	establishment.	
Credit –1 UNIT IV	**Applications of WSN and IoT technologies**	**(15)**
	Applications of WSN, Identification of IoT Objects and Services, Structural Aspects of the IoT, Environment Characteristics, Traffic Characteristics, Scalability, Interoperability, Security and Privacy, Open Architecture, Key IoT Technologies, Device Intelligence, Communication Capabilities, Mobility Support, Device Power, Sensor Technology, RFID Technology, Satellite Technology, RFID: Introduction, Principle of RFID, Components of an RFID system, Issues EPC Global Architecture Framework: EPCIS & ONS, Design issues, Technological challenges, Security challenges, IP for IoT, Web of Things.	

- **Course Outcomes:** student should be able to

1. Evaluate different wireless techniques such as mobile, radio, satellite etc
2. Deploy modern wireless Sensor Networks
3. Explore wireless systems on the basis of performance features
4. Design and configure RFID and WSN networks considering security issues

- **Reference Books:**

1. Wireless Communication, Theodore S. Rappaport, Prentice hall
2. Wireless Communications and Networking,Vijay Garg, Elsevier
3. Wireless digital communication, Kamilo Feher, PHI
4. Mobile Communications Engineering, William C. Y. Lee, Mc Graw Hill Publications
5. Mobile and personal Communication system and services by Rajpandya, IEEE press (PHI). 6 Wireless Communications-T.L.Singh-TMH 7 Adhoc Mobile Wireless network, C.K.Toh Pearson**.**
6. Daniel Minoli, “Building the Internet of Things with IPv6 and MIPv6: The Evolving World ofM2M Communications”, ISBN: 978-1-118-47347-4, Willy Publications
7. Bernd Scholz-Reiter, Florian Michahelles, “Architecting the Internet of Things”, ISBN 978-3-642-19156-5 e-ISBN 978-3-642-19157-2, Springer
8. Parikshit N. Mahalle& Poonam N. Railkar, “Identity Management for Internet of Things”, River Publishers, ISBN: 978-87-93102-90-3 (Hard Copy), 978-87-93102-91-0 (ebook).
9. Hakima Chaouchi, “ The Internet of Things Connecting Objects to the Web” ISBN : 978-1- 84821-140-7, Willy Publications
10. Olivier Hersent, David Boswarthick, Omar Elloumi, The Internet of Things: Key Applicationsand Protocols, ISBN: 978-1-119-99435-0, 2 nd Edition, Willy Publications

Semester III

Elective I: MET30x: Advances in Digital Communication

- **Course Objectives:** Students will be able to
  1. Understand the coding techniques for digital communication
  2. Study the communication through channels
  3. Understand spread spectrum signals for digital communication
  4. Study Digital communication through fading multi-path channels

Credits=4	**SEMESTER - III** **MET30x: Advances in Digital Communication**	**No. of hours per unit/ credits**
Credit –1 **UNIT I**	**Overview of digital communication**	**(15)**
	Principles, base-band and band-pass digital modulation demodulation schemes. **Coding techniques:** Information measures, Coding techniques for discrete and analog sources. Channel capacity, error detection and correction codes - Linear block codes, cyclic convolutional codes.	
Credit –1 **UNIT II**	**Communication through band limited linear filter channels**	**(15)**
	Optimum receiver for channels with ISI and AWGN, Linear equalization, Decision feedback equalization, Iterative equalization and decoding, Adaptive equalization.	
Credit –1 **UNIT III**	**Spread Spectrum signals for digital communication**	**(15)**
	Model of spread spectrum digital communication system, Direct sequence spread spectrum (DSSS), Frequency hopped spread spectrum (FHSS), CDMA, Time hopping Spread Spectrum (THSS), Synchronization of spread spectrum systems.	
Credit –1 **UNIT IV**	**Digital communication through fading multi-path channels**	**(15)**
	Characterization of fading multipath channels, The effect of signal characteristics on the choice of a channel model, Frequency nonselective, Slowly fading channel, Diversity techniques for fading multipath channels, Digital signals over a frequency selective, Slowly fading channel.	

- **Course Outcomes:** students should be able to:
  1. Explore various coding techniques for digital communications
  2. Visualize the different Digital modulation and spread spectrum techniques.
  3. Apply different types of coding techniques to design the optimum receiver for

different channels.

4. Design and develop the different types of modulation techniques, equalizer to improve the performance under fading channels for various applications.

- **Reference Books:**

1. John G. Proakis and Masoud Salehi, “Digital Communications”, Tata McGraw Hill, 5th Edition.
2. Bernard Sklar and Pabitra Kumar Ray, “Digital Communications: Fundamentals and Applications”, Pearson Education Asia, 2nd Edition.
3. John R. Barry, Edward A. Lee and David G. Messerschmitt, “Digital Communication”, Springer 2003, 3rd edition.
4. Andrew J. Viterbi, “CDMA: Principles of Spread Spectrum Communications”, Prentice Hall

Semester III

Elective I: MET30x: Mechatronics

- **Course Objectives:** Students will be able to
  1. Understand different components or blocks in any mechatronic system
  2. Study mechatronic systems using system models and dynamic responses using transformation methods
  3. Understand different sensing and actuating mechanisms used in mechatronics and robotic systems
  4. Study different control mechanisms used in robotic systems

Credits=4	**SEMESTER - III** **MET30x: Mechatronics**	**No. of hours per unit/ credits**
Credit –I **UNIT I**	**Introduction**	**(15)**
	Basics of mechatronic systems: sensors and transducers: digital sensors for motion measurement, torque and tactile sensors, vibration sensors, control systems Brief history of robots, types of robots– components and structure, kinematic arrangements (configurations), classification of robots based on various methods of classification such as control method, power source, applications and coordinate systems, Application areas of robots Solid state switches- diodes, thyristors, BJTs and MOSFETs and their applications as switches and driver circuits, solenoids DC Motor-: types, basic construction and working, brushed and brushless DC motor driver circuits, and speed control AC motors- basic idea of single phase and three phase motors and their speed control Stepper motors- types, construction, features, specifications, control of drives.	
Credit –1 **UNIT II**	**Systems, Responses and transformations**	**(15)**
	Basic system models: Mechanical (translational and rotational) system building blocks, electrical system building blocks, electrical and mechanical analogies and their use in analysis Dynamic responses of systems: modeling dynamic systems, terminology of first order and second order system, performance measures for second order system, system identification Transformations: Rigid Motions: Rotations – coordinate transformations relating to representation of a point in two different frames, composition law for rotational transformations, rotation about an arbitrary axis, representing an arbitrary rotation using only three independent quantities using axis/angle representation, Euler angle representation and roll-pitch-yaw representation Homogeneous transformation matrices, skew symmetric	

	matrices, angular velocity and angular acceleration, addition of angular velocities	
Credit –1 UNIT III	**Mechanical and electrical actuation systems**	**(15)**
	Mechanical actuation systems: mechanisms and their role in mechatronic systems, translational and rotational motion – degrees of freedom, kinematic chains – examples of links, toggle linkage, slider- crank etc. cams, gears – types, gear trains, gear ratios, uses of rotation-to-translational motion – rack and pinion, ball screw and links, Ratchet and pawl, belt and chain drives, bearings– types and uses, consideration of moment of inertia and torque for motor selection Electrical actuation systems: Relays and applications with driver circuits,	
Credit –1 UNIT IV	**Dynamics and Robot Control**	**(15)**
	Dynamics: deriving dynamical equations of a manipulator by deriving Euler–Lagrange equations by forming Lagrangian of a system Trajectory planning and generation, joint space schemes, Joint space schemes with via points. Cartesian straight line motion and circular motion, trajectory planning for orientation, difficulties in trajectory planning Independent Joint Control: basic structure of feedback control system, dynamics of PMDC motor, DC motor control system, set-point tracking using PD and PID compensator, Drive- train dynamics, trajectory interpolation Force control– static force / torque relationships, natural and artificial constraints, stiffness and compliance	

- **Course Outcome:** Students should be able to

1. Explore 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. Mechatronics by W.Bolton, 4th Edition, Pearson.
2. Mechatronics System Design, by DevdasShetty and Richard Kolk, 2nd Edition, Cengage Learning.
3. Robotics Engineering – An integrated approach. By Richard W. Klafter, Thomas A. Chmielewski and Michael Negin, PHI Learning Pvt. Ltd.
4. Robot Dynamics and Control, Spong and M. Vidyasagar, Wiley Student Edition
5. Robotics: Fundamental Concepts and Analysis, Ashitava Ghoshal, Oxford Higher Education
6. Robotic Engineering: An integrated approach, Richard D. Klafter, Thomas A. Chmielewski and Michael Negin, Prentice-Hall India Learning Outcomes

Semester III

Elective I: MET 30X – Nanoelectronics

- **Course Objectives:** Students will be able to
  1. Understand the Nano-CMOS Devices.
  2. Study the applications of nanotechnology in electronics.
  3. Understand the various MEMS controls.
  4. Study different types of MEMS transducers.

Credits=4	**SEMESTER – III** **MET30x: Nanoelectronics**	**No. of hours per unit/ credits**
Credit –I **UNIT I**	**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.	
Credit –1 **UNIT II**	**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.	
Credit –1 **UNIT III**	**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.	
Credit –1 UNIT IV	**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.	

- **Course Outcome:** students should be able to
  1) Explore 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) Demonstrate the Nano-CMOS Devices.
  4) Present 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.
  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 III

Elective I: MET 30X – Antennas

- **Course Objectives:** Students will be able to
  1. Study of modern antenna concepts, and practical antenna design for various applications.
  2. Study the theory of diverse types of antennas used in communication systems.
  3. Study various types of antennas including the planar printed antennas.
  5. Understand smart antenna concept.

Credits=4	SEMESTER – III MET30x: Antennas	No. of hours per unit/ credits
Credit –I UNIT I	**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.	
Credit –1 UNIT II	**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	
Credit –1 UNIT III	**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	
Credit –1 UNIT IV	**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	

- **Course Outcome:** students should be able to
    1. Explore 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
    2. Constantine A. Balanis, Antenna Theory Analysis and Design, Wiley India P. Ltd, 2010

M. Sc. II Semester IV

Course XV: MET401: Elective II
Course XVI: MET402: Elective II

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

- **Course Objectives:** Students will be able to
  1. Develop Ladder programming logic and algorithm writing.
  2. Develop skills for design and development of Automation systems
  3. Study Real Time systems.
  4. Study real time system in electronic modules.

Credits=4	SEMESTER – IV MEP403: Industrial Automation, ARM Programming and Embedded Communication Protocol (Hardware and Simulation)	No. of hours per unit (60) / Credits
UNIT I	**Industrial Automation**	
	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)	
UNIT II	**ARM Programming and Embedded Communication Protocol**	
	1) Bit LED and Switch Interface 2) Buzzer Relay and Stepper Motor Interface 3) Time delay program using built in Timer / Counter feature 4) 4x4 Matrix Keypad Interface 5) Displaying a message in a 2-line x 16 Characters LCD display 6) ADC and Temperature sensor LM 35 Interface 7) I2C Interface – 7 Segment display 8) I2C Interface – Serial EEPROM 9) Transmission from Kit and reception from PC using Serial Port 10) Generation of PWM Signal	

- **Course Outcomes:** Students should be able to
  1. Design and develop the Automation systems
  2. Develop programming skill using PLC
  3. Design and develop embedded product
  2. 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.
3. Overview and use of the SPI PIC micro–Serial Peripheral Interface, Microchip Inc. http://www.microchip.com.
4. Robert Bosch GmbH, CAN Specification, 1997.
5. John W. Webb and Ronald A. Reiss, Programmable Logic Controllers – Principle and Applications, Fifth Edition, PHI
6. JR. Hackworth and F.D Hackworth Jr., Programmable Logic Controllers – Programming Method and Applications. – Pearson, 2004.
7. L. Umanand, Power Electronics Essentials and Applications, Wiley.

Semester IV

Elective II: MET 40X - ARM Programming and Embedded Communication Protocols

- **Course Objectives:** Students will be able to
  1. Study instruction set of ARM controller
  2. Study interfacing techniques for I2C
  3. Understand serial interfacing techniques
  4. Understand embedded protocols

Credits=4	**SEMESTER – IV** **MET 40X - ARM Programming and Embedded Communication Protocols**	**No. of hours per unit/ credits**
Credit –I **UNIT I**	**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.	
Credit –1 **UNIT II**	**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.	
Credit –1 **UNIT III**	**Serial peripheral interface (SPI)**	**(15)**
	Introduction, Specifications, master slave configuration, applications - microcontroller interfacing examples for SPI EEPROM, RTC, ADC and digital temperature sensors.	
Credit –1 **UNIT IV**	**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.	

- **Course Outcome:** Students should be able to
  1. Implement instruction set of ARM for programming
  2. Design interfacing system for various sensors
  3. Design Serial interfacing system
  4. 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)
5. PIC/AVR datasheets for I2C, SPI functions. (Unit II, III)
6. Overview and use of the SPI PIC micro Serial Peripheral Interface, Microchip Inc. http://www.microchip.com.(Unit III)
7. Robert Bosch GmbH, CAN Specification, 1997. (Unit IV)

Semester IV

Elective –II MET 30X - Satellite Communications

- **Course Objectives:** Students will be able to
  1. Study of satellites and satellite services
  2. Study of satellite orbits and launching.
  3. Understand of earth segment and space segment components
  4. Study of satellite access by various users.

Credits=4	**SEMESTER – IV** **MET 30X - Satellite Communications**	**No. of hours per unit/ credits**
Credit –I UNIT I	**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	
Credit –1 UNIT II	**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.	
Credit –1 UNIT III	**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	
Credit –1 UNIT IV	**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	

- **Course Outcome:** Students should be able to
  1. Compute the coverage angle and angle of visibility and consequently determine the coverage area.
  2. Explore coverage area with the beam width of satellite antenna.
  3. Present orbital effects in communications system performance.
  4. 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
  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

Semester IV

Elective II: MET 40X - Cellular Mobile Communications

- **Course Objectives:** Students will be able to
  1. Understand basic cellular concept
  2. Study analog and digital communication systems
  3. Understand the multiple access technique
  4. Study communication system module

Credits=4	**SEMESTER – IV** **MET 40X - Cellular Mobile Communications**	**No. of hours per unit/ credits**
Credit –I **UNIT I**	**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	
Credit –1 **UNIT II**	**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	
Credit –1 **UNIT III**	**Switching Systems**	**(15)**
	Handoffs and dropped calls, operational techniques and Technologies, switching and traffic	
Credit –1 **UNIT IV**	**Introduction to Digital Communication**	**(15)**
	Introduction to digital systems, Digital cellular systems, Intelligent cell construction and Applications, Features of handset, SMS, Security	

- **Course Outcomes:** Students should be able to
  1. Explore infrastructure to develop mobile communication system
  2. Design electronics systems
  3. Present the knowledge of switching systems
  4. 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

- **Course Objectives:** Students will be able to
  1. Study of fundamentals of control systems.
  2. Study of environment of control system.
  3. Understand Ladder programming language.
  4. Understand design the automation systems.

Credits=4	**SEMESTER – IV** **MET 40X - Industrial Automation**	**No. of hours per unit/ credits**
Credit –I UNIT I	**Controller Principles**	**(15)**
	Process Characteristics - process equation, process load, process lag, self regulation Control system parameters- Error, variable range, control parameter range, control lag, dead time, cycling, Controller Modes: Discontinuous- two position, multi position, floating control. Continues – proportional, integral, derivative & composite modes Control	
Credit –1 UNIT II	**Analog Controllers**	**(15)**
	Introduction, General Features, Electronic Controllers: Error Detector, Single Mode, Composite Controller Modes, Pneumatic Controllers: General Features, Mode Implementation, Design Considerations.	
Credit –1 UNIT III	**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	
Credit –1 UNIT IV	**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	

- **Course Outcomes:** Students should be able to
  1. Implement control system in electronics systems
  2. Design System using ladder codes
  3. Design Digital control system
  4. Develop control system for automation

- **Reference book**

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

Semester IV

Elective II: MET 40X - Advanced Microcontroller and RTOS

- **Course Objectives:** Students will be able to
  1. Study the architecture of PIC uC
  2. Understand the interfacing I/O port with the external peripherals.
  3. Study the fundamentals of operating system
  4. Study management aspects of Real time operating system

Credits=4	**SEMESTER – IV** **MET 40X - Advanced Microcontroller and RTOS**	**No. of hours per unit/ credits**
Credit –I UNIT I	**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.	
Credit –1 UNIT II	**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.	
Credit –1 UNIT III	**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.	
Credit –1 UNIT IV	**Memory Organization**	**(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	

- **Course Outcomes:** Students should be able to
  1. Develop Hardware and programming skills
  2. Design electronics systems
  3. Develop codes for various applications
  4. Explore MPLAB tools
- **Reference book**

  1. Ajay V Deshmukh, Microcontrollers: theory and applications, TMH.
  2. Myke Predko, Programming & Customizing PICmicro Microcontrollers, TMH.
  3. Qing Li, Caroline Yao, Real-Time Concepts for Embedded Systems, CMP Books.
  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.
  7. David E. Simon, An Embedded Software Primer, Addison-Wesley.
  8. Raj Kamal, Embedded Systems: Architecture, Programming and Design, 2ndEdition, McGraw-Hill Education, ISBN-10: 00701253

Semester IV

Elective II: MET 40X - Real Time Operating Systems

- **Course Objectives:** Students will be able to
  1. Study of principles of many real-time operating systems, and their use in the development of embedded multitasking application software.
  2. Study of architecture of real-time operating systems.
  3. Understand the Process Management and Inter-Process Communication
  4. Understand the memory management in RTOS

Credits=4	**SEMESTER – IV** **MET 40X - Real Time Operating Systems**	**No. of hours per unit/ credits**
Credit –I **UNIT I**	**Introduction**	**(15)**
	Introduction to Operating System: Computer Hardware Organization, BIOS and Boot Process, Multi-threading concepts, Processes, Threads, Scheduling.	
Credit –1 **UNIT II**	**Basics Of Real-Time Concepts**	**(15)**
	Terminology: RTOS concepts and definitions, real-time design issues, examples, Hardware Considerations: logic states, CPU, memory, I/O, Architectures, RTOS building blocks, Real-Time Kernel	
Credit –1 **UNIT III**	**Process Management and Inter-Process Communication**	**(15)**
	Concepts, scheduling, IPC, RPC, CPU Scheduling, scheduling criteria, scheduling algorithms Threads: Multi-threading models, threading issues, thread libraries, synchronization Mutex: creating, deleting, prioritizing mutex, mutex internals	
Credit –1 **UNIT IV**	**Pipes, Memory Management**	**(15)**
	Messages, Buffers, mailboxes, queues, semaphores, deadlock, priority inversion, Process stack management, run-time buffer size, swapping, overlays, block/page management, replacement algorithms, real-time garbage collection CASE STUDIES: Case study Linux POSIX system, RTLinux / RTAI, Windows system, Vxworks, uItron Kernel Design Issues: structure, process states, data structures, inter-task communication mechanism, Linux Scheduling	

- **Course Outcomes:** Students should be able to
  1. Explore the concepts of operating systems
  2. Analyze the concepts of real-time operating systems.
  3. Evaluate Process Management And Inter-Process Communication
  4. Formulate and illustrate designing issues in kernel design

- **Reference book**

1. J. J Labrosse, “MicroC/OS-II: The Real –Time Kernel”, Newnes, 2002.
2. Jane W. S. Liu, “Real-time systems”, Prentice Hall, 2000.
3. W. Richard Stevens, “Advanced Programming in the UNIX® Environment”, 2nd Edition, Pearson Education India, 2011.
4. Philips A. Laplante, “Real-Time System Design and Analysis”, 3rd Edition, John Wley& Sons, 2004
5. Doug Abbott, “Linux for Embedded and Real-Time Applications”, Newnes, 2nd Edition, 2011.