"Education through self-help is our motto."

Rayat Shikshan Sanstha's

YASHAVANTRAO CHAVAN INSTITUTE OF SCIENCE, SATARA

(An Autonomous College)

Lead College, Karmaveer Bhaurao Patil University, Satara

Reaccredited by NAAC with 'A+' Grade.

Syllabus for Master of Science

Part - II

ELECTRONICS

to be Implemented from June 2024 onward
(As per NEP-2020 Guidelines)

Rayat Shikshan Sanstha's

Yashavantrao Chavan Institute of Science, Satara

(Autonomous Institute)

Department of Electronics

Revised Syllabus for **Master of Science (Electronics) Part I**

as per NEP 2020 wef June 2024- 25

1. **SUBJECT:** Electronics
2. **YEAR OF IMPLEMENTATION:** New Syllabi for the M.Sc. II Electronics will be implemented from June 2024 onwards.
3. **PREAMBLE:**

Master of Science is an integrated academic degree in faculty of science. The faculty is not ignoring the developments in the field of Electronics. The revision of existing syllabus of Electronics subject in science faculty is essential. This is a humble endeavour to initiate the process towards an era of knowledge. The students from science faculty should also be competent for this change in the technology.

In this year, a student will be able to understand handling of laboratory equipment, build Electronics circuits with confidence. In the subject, the student will also get a basic and proper knowledge in the field of Embedded System design.

4. **STRUCTURE OF COURSE:**

Level	**Sem**	**Major**			**RM**	**OJT**	**RP**	**Total**
		Discipline Specific Core Mandatory		**Discipline Specific Elective**				
		T	**P**	**T**				
6	**I**	12 (3 Courses)	2	4 (1 Course out of Two)	4	-	-	**22**
	II	12 (3 Courses)	2	4 (1 Course out of Two)	-	-	4	**22**
6.5	**III**	12 (3 Courses)	2	2 (1 Course out of Two)	-	-	6	**22**
	IV	12 (3 Courses)	2	4 (1 Course out of Two)	-	4	-	**22**
Total		48	6	16	4	4	10	**88**
		70			8		10	

M. Sc. II Semester III

Level	Course Code	Title of the Course	Course Category	No. of Lectures Per Week	Credits
6	**DSC (Discipline Specific Core)**				
	MET531	Antennas	Theory	4	4
	MET532	Control Systems	Theory	4	4
	MET533	Microcontroller System Design and ARM Architecture	Theory	4	4
	DSE (Discipline Specific Elective) (any one out of two)				
	MET534 E-I	Wireless Sensor Networks	Theory	2	2
	MET534 E-II	Analog Circuit Design			
	MEP535	Research Project	RP	12	6
	MEP536	Practical Course: Lab I (Based on MET531, 532, 533)	Practical	4	2
Total					**22**

M. Sc. II Semester IV

Level	Course Code	Title of the Course	Course Category	No. of Lectures Per Week	Credits
6	**DSC (Discipline Specific Core)**				
	MET541	Digital Image Processing	Theory	4	4
	MET542	Industrial Automation	Theory	4	4
	MET543	ARM Programming and Embedded Communication Protocols	Theory	4	4
	DSE (Discipline Specific Elective) (any one out of two)				
	MET544 E-I	Automotive Electronics	Theory	4	4
	MET544 E-II	Real Time Operating Systems			
	MEP545	On Job Training	OJT	8	4
	MEP546	Practical Course: Lab II (Based on MET 541, 542, 543)	Practical	4	2
Total					**22**

Notations (MET xyz):

M: M.Sc., **E:** Electronics, **T:** Theory, **P:** Practical, **x (1 to 4):** Semester number, **yz (1 to 5):** course number, **DSC:** Discipline Specific Core, **DSE:** Discipline Specific Elective

SEMESTER III

DSC: VII MET531: Antennas

- **Course Objectives:** Students will be able to...
  1. Provide an in-depth understanding of modern antenna concepts, and practical antenna design for various applications.
  2. Study theory of different types of antennas used in communication systems.
  3. Learn types of antennas including the planar printed antennas. An in-depth study will be made for the analysis and design of arrays.
  4. Understand a brief introduction of smart antenna concept will be given at the end further exploration ideas.

Total Credits=04	**SEMESTER - III** **MET531: Antennas**	**Total No. of Hours: 60**
UNIT I	**Basic Antenna Concepts**	**15**
	1.1 Types of Antennae, Radiation Mechanism, Current Distribution of Thin Wire Antenna, Radiation pattern, Radiation power density 1.2 Radiation intensity, beam width, Directivity, Antenna efficiency, Gain, Beam efficiency, Bandwidth, Polarization, Input impedance 1.3 Antenna radiation efficiency, Antenna vector effective length and effective areas 1.4 Maximum directivity and maximum effective area, Friss transmission formula 1.5 Duality of antennas, Antenna temperature.	
UNIT II	**Radiation Integrals and Auxiliary potential functions**	**15**
	2.1 Introduction 2.2 The Vector Potential for an Electric Current Source, The Vector Potential for a Magnetic Current Source 2.3 Electric and Magnetic Fields for Electric and Magnetic Current Sources 2.4 Solution of the Inhomogeneous Vector, Potential Wave Equation, 2.5 Far-Field Radiation 2.6 Duality Theorem, Reciprocity and Reaction Theorems	
UNIT III	**Linear wire, Loop antennas**	**15**
	3.1 Infinitesimal dipole, small dipole, Region Separation, Finite length	

	dipole, Half-wavelength dipole 3.2 Linear elements near or on infinite perfect conductors, Ground effects 3.3 Small circular loop, Circular loop of constant current, Circular loop with nonuniform current 3.4 Ground and Earth curvature effects. 3.5 Polygonal loop antennas 3.6 Mobile Communication Systems Applications	
UNIT IV	**Traveling wave, broadband, Microstrip and Reflector antennas**	**15**
	4.1 V antenna, Rhombic antenna, Helical antenna 4.2 electric-magnetic dipole 4.3 Yagi-Uda array of linear elements, Yagi-Uda array of loops 4.4 Basic Characteristics of microstrip antenna 4.5 Feeding Methods of microstrip antenna 4.6 Rectangular patch, Circular Patch 4.7 Plane reflector, Corner reflector	

- **Course Outcomes:** students should 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. C. A. Balanis. Antenna Theory Analysis and Design. Wiley India P. Ltd, 2010. ISBN: 978-0471667827.
  2. J. D. Kraus. Antennas. Tata McGraw-Hill Publishing Company Ltd, 1999. ISBN: 978-0072321030.
  3. R. C. Hansen. Phased Array Antennas. John Wiley & Sons, 1998. ISBN: 978-0471010655.
  4. W. L. Stutzman and G. A. Thiele. Antenna Theory and Design. John Wiley & Sons, 2012. ISBN: 978-0470576649.
  5. S. Ramo, J. R. Whinnery, and T. Van Duzer. Fields and Waves in Communication Electronics. John Wiley & Sons, 1994. ISBN: 978-0471585510.

SEMESTER III

DSC: VIII MET532: Control System

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

Total Credits=04	**SEMESTER – III** **MET532: Control System**	**Total No. of Hours: 60**
UNIT I	**Introduction to Control Theory**	**15**
	1.1. Basic Concepts of Control System, Open loop and Closed loop systems, Classifications 1.2. Effect of feedback on Control System performance. 1.3. Transfer function modeling and representation of Control system, Pole & zero concept. 1.4. Mathematical modeling of linear mechanical and Electrical systems, Electrical analogy, 1.5. Block reduction techniques, Signal flow graph 1.6. Mason’s gain formula.	
UNIT II	**Time Domain Analysis and stability**	**15**
	2.1. Type and Order of Control system, Typical tests signal. 2.2. Time Response of first and second order systems to unit step input, Steady state errors. 2.3. Time Domain Specifications of Second Order System, Dominant Closed loop Poles of Higher Order Systems 2.4. Concept of Stability: absolute, relative, and marginal, nature of system response 2.5. Stability analysis using Hurwitz's criterion, Routh's criterion, 2.6. Basic properties of Root Loci, construction of Root loci 2.7. Angle and magnitude condition for stable systems.	

	2.8. Concept of inverse root locus and root contour.	
UNIT III	**Frequency Domain and State Variable Analysis**	**15**
	3.1. Steady state response of a system to sinusoidal input 3.2. Relation between time and frequency response for second order systems 3.3. Frequency response specifications 3.4. Stability Analysis with Bode Plots, Polar Plots, conformal mapping, Nyquist stability criterion. 3.5. Introduction to state space analysis, State space representation for i) Electrical Network ii) nth order differential equation iii) Transfer function. 3.6. State model from transfer function using: Direct, parallel, cascade, decomposition method.	
UNIT IV	**Control system components and controllers**	**15**
	4.1 Modeling and transfer function of control system components-Potentiometer 4.2 DC and AC Servomotors, gear trains, tacho-generators. 4.3 Design concepts of P, PI, PD, PID controllers, Compensator Networks-lag and lead	

- **Course Outcomes:** Student should be able to...
  1. Carry out modelling of discrete systems in state space.
  2. Evaluate programming strategies in the domain of control systems.
  3. Analyse systems in Time and frequency domain.
  4. Design modern control systems with computer simulation.

- **Reference Books:**

  1. U. A. Bakshi and V. U. Bakshi. Control System Engineering, 1st ed. Pune: Technical Publications, 2008. ISBN: 978-8184312001.
  2. I. J. Nagrath and M. Gopal. Control Systems Engineering, 5th ed. New Delhi: New Age International, 2002. ISBN: 978-8122411886.
  3. K. Ogata. Modern Control Engineering, 4th ed. New Delhi: PHI Learning, 2009. ISBN: 978-8120338663.

4. B. C. Kuo. Automatic Control System, 3rd ed. New Delhi: PHI Learning, 2010. ISBN: 978-8120339127.
5. Schaum's Series: Feedback Control Systems. Publisher: McGraw-Hill Education, Year of Publishing: 2017, Edition: 2nd, ISBN: 978-1259642588.
6. L. Fenical, Control Systems, 1st ed. Cengage Learning India, Year of Publishing: 2017, ISBN: 978-8131529351.
7. S. Ghosh, Control Systems Theory & Applications, 1st ed. Pearson Education, Year of Publishing: 2010, ISBN: 978-8120341182.
8. S. K. Bhattacharya, Control Systems Engineering, 1st ed. Pearson Education, Year of Publishing: 2017, ISBN: 978-9332575775.
9. N. S. Nise, Control System Engineering, 5th ed. Wiley, Year of Publishing: 2020, ISBN: 978-1119385995.

SEMESTER III

DSC: IX MET533: Microcontroller System Design and ARM Architecture

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

Total Credits=04	**SEMESTER – III** **MET533: Microcontroller System Design and ARM Architecture**	**Total No. of Hours: 60**
UNIT I	**Analog Interfacing**	**15**
	1.1 Review of microcontroller solutions for control/measurement systems 1.2 Minimum system with 89C51/PIC microcontrollers 1.3 Push Buttons, LEDs, Relays, Keyboard Interfacing, Key debouncing, ADC and DAC Interfacing. 1.4 Connecting External Memory: Latch Operation, External Program Memory, External program, and Data memory access.	
UNIT II	**System Design**	**15**
	2.1. Minimum system with 89C51/PIC microcontrollers to monitor frequency, voltage, displacement, liquid level, weight, speed, traffic light control system with software development for above. 2.2. Isolation Techniques: Relays, opto-couplers and their specifications, Interfacing of Relays and opto-couplers with microcontrollers, isolation methods for heavy and a. c. loads.	
UNIT III	**Interfacing**	**15**
	3.1. Transducers and digital sensors for temperature, pressure, and speed, 3.2. Signal Conditioning. 3.3. Instrumentation Amplifiers for RTD, thermocouple, bridge and LVDT 3.4. System design with 89C51 for measurement and control of temperature, pressure, speed using ON/OFF, Proportional and PID modes.	

	3.5. Stability aspects of the system, Software development.	
UNIT IV	**ARM Architecture**	**15**
	4.1.Introduction to ARM microprocessor and its features 4.2.ARM Architecture, 4.3.Programming model, Processor Operating States, Registers, Exceptions, 4.4.ARM organization – 3-stage/5-stage pipelined ARM organization.	

- **Course Outcomes:** Student should be able to...
  1. Present 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. Explore 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., 2018.
  3. A. V. Deshmukh. Microcontrollers: Theory and Applications. TMH, 2019.
  4. S. I. Ahson. Microprocessors Application in Process Control. TMH, 2017.
  5. D. H. Sheingold. Transducer Interfacing Handbook. Analog Devices Technical Handbook, Norwood, USA, 2016.
  6. S. Furber. ARM System-on-Chip Architecture. Addison Wesley, 2018.

SEMESTER III

DSE: V MET534 E-I: Wireless Sensor Networks

- **Course Objectives:** Students will be able to...
  1. Compare different wireless techniques such as mobile, radio, satellite etc.
  2. Understand modern wireless Sensor Networks
  3. Distinguish wireless systems based on performance features.
  4. Identify architecture, structure, and security as well as privacy aspects in IoT.
  5. Design and configure RFID and WSN networks considering security issues.

Credits=02	**SEMESTER – I** **MET534 E-I: Wireless Sensor Networks**	**Total No. of Hours: 30**
UNIT I	**Introduction to Wireless Communication System:**	**07**
	1.1.Evolution of mobile communications, 1.2.Mobile Radio System around the world 1.3.Types of Wireless communication System, Comparison of Common wireless system 1.4.Trend in Cellular radio and personal communication. 1.5.Second generation Cellular Networks, Third Generation (3G), Fourth Generation (4G), Fifth Generation (5G)	
UNIT II	**Recent wireless technologies**	**08**
	2.1.Multicarrier Modulation, OFDM, MIMO system, diversity multiplexing trade-off, MIMO-OFDM system, smart-antenna. 2.2.beam forming and MIMO, cognitive radio, software defined radio, communication relays, spectrum sharing. 2.3.Wireless Systems: GSM system architecture, Radio interface, Protocols, Localization and calling, Handover, Authentication and security in GSM, GSM speech coding. 2.4.Concept of spread spectrum, Architecture of IS-95 CDMA system, Air interface. 2.5.CDMA forward channels, CDMA reverse channels, soft handoff, CDMA features, Power control in CDMA, Performance of CDMA System.	
UNIT III	**Wireless Sensor Networks**	**07**
	3.1.History and context	

	3.2.WSN Architecture, the node, connecting nodes, Networking Nodes 3.3.Securing Communication WSN specific IoT applications, 3.4.challenges: Security, QoS, Configuration, Various integration approaches 3.5.Data link layer protocols, routing protocols and infrastructure establishment.	
UNIT IV	**Applications of WSN and IoT technologies**	**08**
	4.1.Applications of WSN, Identification of IoT Objects and Services 4.2.Structural Aspects of the IoT, Environment Characteristics, Traffic Characteristics, Scalability, Interoperability, Security and Privacy, Open Architecture 4.3.Key IoT Technologies, Device Intelligence, Communication Capabilities 4.4.Mobility Support, Device Power, Sensor Technology, RFID Technology, Satellite Technology, 4.5.RFID: Introduction, Principle of RFID, Components of an RFID system, Technological challenges, Security challenges, IP for IoT, Web of Things.	

- **Course Outcomes:** Student should be able to...
  1. Explore wireless communication systems.
  2. Present cutting edge wireless technologies
  3. Design wireless sensor network.
  4. Develop applications of WSN and IoT
- **Reference Books:**

  1. T. S. Rappaport, Wireless Communication. Prentice Hall, 2017. ISBN: 978-0133594173.
  2. V. Garg, Wireless Communications and Networking. Elsevier, 2020. ISBN: 978-0123860030.
  3. K. Feher, Wireless Digital Communication. PHI, 2017. ISBN: 978-8120348255.
  4. W. C. Y. Lee, Mobile Communications Engineering. McGraw Hill Publications, 2018. ISBN: 978-0071633658.
  5. Rajpandya. Mobile and Personal Communication System and Services. IEEE Press, PHI, 2015. ISBN: 978-8120348255.

6. T. L. Singh, Wireless Communications. TMH, 2019. ISBN: 978-9385676573.
7. C. K. Toh, Adhoc Mobile Wireless Network. Pearson, 2017. ISBN: 978-0321305697.
8. D. Minoli, Building the Internet of Things with IPv6 and MIPv6: The Evolving World of M2M Communications. Willy Publications, 2019. ISBN: 978-1118473474.
9. B. Scholz-Reiter, and F. Michahelles, Architecting the Internet of Things. Springer, 2016. ISBN: 978-3642191565 (print), 978-3642191572 (eBook).
10. P. N. Mahalle, and P. N. Railkar, Identity Management for Internet of Things. River Publishers, 2018. ISBN: 978-8793102903 (Hard Copy), 978-8793102910 (eBook).
11. H. Chaouchi, The Internet of Things: Connecting Objects to the Web. Willy Publications, 2010. ISBN: 978-1848211407.
12. O. Hersent, D. Boswarthick, and O. Elloumi, The Internet of Things: Key Applications and Protocols. Willy Publications, 2016. ISBN: 978-1118995350.

SEMESTER III

DSE: VI MET534 E-II: Analog Circuit Design

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

Total Credits=04	**SEMESTER – III** **MET534 E-II: Analog Circuit Design**	**Total No. of Hours: 30**
UNIT I	**Power Supply Designing**	**07**
	1.1.Typical specifications, Concept of ideal power supply & Voltage regulation, Rectifier and filter design, Heat-sink selection, three terminal IC regulator & Variable Regulator 1.2.Zener series and shunt regulators, transistors as series and shunt regulators, Regulator design with discrete components and IC 741/78xx 1.3.Current sources and their design with discrete components and ICs and SMPS design. 1.4.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. 1.5.Concept of PCB Designing.	
UNIT II	**Frequency Response of Amplifiers**	**08**
	2.1.BJT models and modeling parameters, equivalent circuits for CE, CB and CC configurations, Single stage amplifier, small signal analysis, distortion. 2.2.Design of single stage RC-coupled amplifier with frequency response (f1 and f2) 2.3.Frequency Response: Low and High frequency equivalent circuit, bode plots, Miller effect, square wave testing, and frequency response of multistage amplifiers.	

	2.4.Different coupling schemes and gain of multistage amplifiers	
UNIT III	**Tuned Amplifier and Oscillators**	**08**
	3.1.Tuned amplifier design, multistage tuned amplifiers: synchronous and stagger tuning cascade configuration, large signal tuned amplifier. 3.2.Oscillators: design and analysis of LC and RC oscillators, Hartley, Colpitt's, Miller oscillators, phase shift and Wien-bridge oscillators, crystal oscillators and applications 3.3.Circuit Design and Analysis using PSPICE – Schematics, attributes, and types of analysis in PSPICE.	
UNIT IV	**Operational Amplifiers and their Applications**	**07**
	4.1.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. 4.2.Inverting and non-inverting amplifiers with design aspects input and output impedance, common mode errors and limitations, bandwidth. 4.3.Bridge and instrumentation amplifier, Practical design aspect of integrator and differentiators, Active Filters: transfer functions poles and zeros 4.4.V to I and I to V Conversion, V to F and F to V Conversion, Electrostatic Shielding and Grounding.	

- **Course Outcomes:** Student should be able to...
  1. Design Power Supply System
  2. Analyse the frequency responses of various amplifiers.
  3. Acquire knowledge of various oscillator circuits.
  4. Evaluate applications of operational Amplifiers.
- **Reference Books:**

  1. G. K. Mittal, Electronic Devices and Circuits. Khanna Publishers, 2009. ISBN: 9788174091954.
  2. R. Lenk, Practical Design of Power Supplies. John Wiley & Sons, 2005. ISBN: 978-0-08-097138-4.

3. H. Zumbahlen, Linear Circuit Design Handbook. Elsevier Inc, 2008. ISBN: 978-0-7506-8703-4.
4. A. Williams, and F. Taylor, Electronic Filter Design Handbook. 4th ed., McGraw-Hill, 2006. ISBN: 978-0071471727.
5. S. Salivahanan, and N. S. Kumar, Electronic Devices and Circuits. 3rd ed., McGraw Hill, 2008. ISBN: 9780070617773.
6. S. Franco, Design with Operational Amplifiers and Linear IC. 3rd ed., TMH, 2002. ISBN: 9780072320848.
7. A. P. Malvino, and D. J. Bates, Electronic Principles. McGraw Hill, 2006. ISBN: 9780072963054.
8. M. H. Rashid, Microelectronic Circuits: Analysis and Design. PWS Publishing Company, 1999. ISBN: 9780534551629.
9. A. Motorshead, Electronic Devices. PHI, 2000. ISBN: 9788120319677.

SEMESTER III

RP: MEP535: Research Project

Students will undertake research in specific area of his Major/Core with an advisory supported by a teacher/Faculty member. Students are required to take 6 credit Research Project for semester III under the guidance of faculty members.

Credits 6	**SEMESTER III** **MEP535: Research Project**	**No. of Hours: 180**
Credits 4	**Project Work:** Topic Applicability Practical work and Result Presentation of Dissertation Publication	
Credits 2	**Laboratory Work:** Performance and Punctuality Laboratory Attendance / Extension Practical Skills Intellectual Property Rights	

SEMESTER – III

MEP536:

Lab III: General Electronics Lab (Hardware and Simulation)

(Based on MEP531, 532, 533 courses)

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

Credits = 02	**SEMESTER – III** **MEP536** **Lab III: General Electronics Lab (Hardware and Simulation)** **Based on MEP531, 532, 533 courses)**	**Total No. of Hours: 60**
	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. To study the OP-AMP as V to I converter and I to V converter 6. Study of operation of LM 331 as V to F converter and f to v converter 7. Design an Instrumentation amplifier. 8. Design and analysis of first order control system (Simulink) 9. To obtain step response of the given system and evaluate the effect P, PD, PI and PID controllers. 10. Bode & Nyquist plot using MATLAB. 11. To study and analysis of fast Fourier transform (FFT) and discrete Fourier transform (DFT) 12. Deign a FIR filter (MATLAB) 13. Study and analysis of LTI systems in Z domain. 14. Simulation of transfer function using Poles and Zeros 15. Interfacing using EDSIM-51 (LED, Sven Segment, LCD) 16. Interfacing using EDSIM- 51(Stepper Motor, ADC, DAC)	3 Hours for each Practical

	17. Interfacing using EDSIM-51 (Traffic light control/Liquid level /Weight) 18. Design a 89c51 system to control temperature/pressure using ON/OFF mode 19. Design an 89c51 system to control temperature/pressure using P/PID mode. 20. Study and generate waveforms using ARM Microprocessor	

- **Course Outcomes:** Students should be able to...
  1. Design and develop the Automation systems.
  2. Demonstrate the programming skill using PLC.
  3. Design and develop embedded systems.
  4. Use automation in electronic systems.

- **Reference Books:**

  1. D. Seal, ARM Architecture Reference Manual. 2nd ed. Addison-Wesley Professional, 2001. ISBN-10: 0201737191.
  2. S. Furber, ARM System-on-Chip Architecture. 2nd ed. Addison Wesley, 2000. ISBN-10: 0201675196.
  3. Philips Semiconductor. The I2C-bus Specification. 2000. [Online] Available: http://www.semiconductors.philips.com/i2c.
  4. PIC/AVR datasheets for I2C, SPI functions.
  5. Microchip Inc. Overview and Use of the SPI PIC Micro–Serial Peripheral Interface. [Online] Available: http://www.microchip.com.
  6. Robert Bosch GmbH. CAN Specification. 1997.
  7. J. W. Webb, and R. A. Reiss, Programmable Logic Controllers – Principle and Applications. 5th ed. PHI.
  8. J. R. 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 IV

DSC: X MET541: Digital Image Processing

- **Course Objectives:** Students will be able to...
  1. Learn digital image fundamentals and simple image enhancement techniques.
  2. Study the image segmentation and representation techniques.
  3. Become familiar with image compression methods.
  4. Understand the Object Recognition.

Total Credits=04	**SEMESTER – IV** **MET541: Digital Image Processing**	**Total No. of Hours: 60**
UNIT I	**DIP Fundamentals and Image Enhancement Techniques**	**15**
	1.1. Fundamental steps of Image Processing, components of IP, Image formation, image sampling and quantization, image types, Image histogram Color Fundamentals, Color Models, pixel connectivity, Pseudo color image processing. 1.2. Image enhancement in spatial domain, Basic gray level transformation, histogram processing, enhancement using arithmetic and logic operations. 1.3. Basic spatial filtering, smoothing, and sharpening spatial filters, Intensity transformation, contrast stretching, histogram equalization.	
UNIT II	**Segmentation and Compression in Image Processing**	**15**
	2.1. Point, line and edge detection, Thresholding, Regions Based segmentation, Edge linking and boundary detection, Hough transform. 2.2. Fundamentals of redundancies, Basic Compression Methods: Huffman coding, Concept of Discrete Cosine Transform, JPEG 2.3. Compression standard, Y CB CR transformation 2.4. Introduction to MPEG standard, Motion estimation, compensation, Introduction to video compression.	
UNIT III	**Image Restoration**	**15**
	3.1. A model of the image degradation/restoration process, noise models 3.2. Restoration in the presence of noise–only spatial filtering, Weiner filtering, constrained least squares filtering, geometric transforms. 3.3. Introduction to the Fourier transform and the frequency domain,	

	estimating the degradation function.	
UNIT IV	**Object Recognition**	**15**
	4.1.Object Recognition- patterns and pattern classes, recognition based on decision theoretic methods, structural methods. 4.2.Case studies: Character recognition, Content based image retrieval, image classification. 4.3.Introduction to Deep learning using CNN.	

- **Course Outcomes:** Student should be able to...
  1. Apply knowledge of mathematics for image understanding and analysis.
  2. Design and realize various algorithms for image segmentation and Compression.
  3. Apply restoration to remove noise in the image.
  4. Describe the object recognition system.

- **Reference Books:**

  1. R. C. Gonzalez and R. E. Woods, Digital Image Processing, 3rd ed. Pearson Education, 2008. ISBN: 978-0131687288.
  2. S. Sridhar, Digital Image Processing, 2nd ed. Oxford University Press.
  3. A. K. Jain, Fundamentals of Digital Image Processing, 4th ed. Prentice Hall India.
  4. M. Sonka, V. Hlavav, and R. Boyle, Image Processing, Analysis and Machine Vision, 2nd ed. Thomson Learning, 2001. ISBN: 978-0534953930.
  5. W. K. Pratt, Digital Image Processing, 3rd ed. John Wiley & Sons, 2007. ISBN: 978-0471767770.
  6. S. Jayaraman and T. Veerakumar, Digital Image Processing, 2nd ed. McGraw Hill Education.
  7. NPTEL Course “Digital Image Processing”
     a. https://nptel.ac.in/courses/117/105/117105079/
     b. https://nptel.ac.in/courses/106/105/106105032/

SEMESTER IV

DSC: XI MET542: Industrial Automation

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

Total Credits=04	**SEMESTER – IV** **MET542: Industrial Automation**	**Total No. of Hours: 60**
UNIT I	**Controller Principles**	**15**
	1.1. Process Characteristics - process equation, process load, process lag, self-regulation. 1.2. Control system parameters- Error, variable range, control parameter range, control lag, dead time, cycling, 1.3. Controller Modes: Discontinuous- two position, multi position, floating control. 1.4. Continues – proportional, integral, derivative & composite modes Control	
UNIT II	**Analog Controllers**	**15**
	2.1. Introduction, General Features 2.2. Electronic Controllers: Error Detector, Single Mode, Composite Controller Modes 2.3. Pneumatic Controllers: General Features, Mode Implementation 2.4. Design Considerations.	
UNIT III	**Digital Controller Design**	**15**
	3.1. Controller Design techniques, bode diagram method, PID controller. 3.2. Root Locus Method – Root locus Plot, Controller design 3.3. State Space Method – Controllability Observability, Full-state feedback, Regulators Tracker 3.4. Regulator design by pole placement, Controlling Voltage, Controlling Current 3.5. Control of Induction Motor	
UNIT IV	**Programmable Controllers and SCADA**	**15**

	4.1. PLC Basics: Programmable Controllers – functional diagram, operation, programming. 4.2. PLC system, I/O modules and interfacing 4.3. CPU processor, programming equipment, programming formats, 4.4. Construction of PLC ladder diagrams, devices connected to I/O modules. 4.5. PLC Programming. Ladder diagrams for process control: Ladder diagrams and sequence listings, ladder diagram construction and flow chart for spray process system. 4.6. PLC Registers Introduction to SCADA	

- **Course Outcomes:** Student 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 Books:**

  1. C. D. Johnson, Process Control Instrumentation Technology, 8th ed. (Publisher: Pearson Education, Year: 2020, ISBN: 978-0134832062)
  2. L. Umanand, Power Electronics Essentials and Applications (Publisher: Wiley, Year: 2013, ISBN: 978-1118362322)
  3. John W. Webb and Ronald A. Reiss, Programmable Logic Controllers – Principle and Applications, 5th ed. (Publisher: Pearson, Year: 2009, ISBN: 978-8120329905)
  4. JR. Hackworth and F.D Hackworth Jr., Programmable Logic Controllers – Programming Method and Applications (Publisher: Pearson, Year: 2004, ISBN: 978-8129704984)

SEMESTER IV

DSC: X MET543: ARM Programming and Embedded Communication Protocols

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

Total Credits=04	**SEMESTER – IV** **MET543: ARM Programming and Embedded Communication Protocols**	**Total No. of Hours: 60**
UNIT I	**The ARM instruction set**	**15**
	1.1.Introduction, exceptions, conditional execution 1.2.Branch and branch with link, software interrupt 1.3.Data processing instructions, multiply instructions, data transfer instructions. 1.4.Architectural support for HLLs: Data types, Expressions, Conditional statements, loops.	
UNIT II	**Inter-Integrated Circuit (I2C) BUS**	**15**
	2.1.I2C bus specification, general characteristics, bus signals, Address mechanism. 2.2.Applications – microcontroller interfacing examples for I2C EEPROM, RTC, ADC, and digital temperature sensors.	
UNIT III	**Serial peripheral interface (SPI)**	**15**
	3.1.Introduction, Specifications, master slave configuration. 3.2.Applications - microcontroller interfacing examples for SPI EEPROM, RTC, ADC and digital temperature sensors.	
UNIT IV	**Recent embedded protocols**	**15**
	4.1.Controller Area Network (CAN): Specifications, basic concepts, Frame types, bus signals, Error handling, Addressing. 4.2.Introduction to Button devices, 1-wire protocol.	

- **Course Outcomes:** Student 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. Present and implement embedded communication protocols.

- **Reference Books:**

1. David Seal, ARM Architecture Reference Manual, 2nd ed. (Addison-Wesley Professional, 2001), ISBN-10: 0201737191.
2. Steve Furber, ARM System-on-Chip Architecture, 2nd ed. (Addison Wesley, 2000), ISBN-10: 0201675196.
3. "The I2C-bus Specification," Philips Semiconductor, 2000, http://www.semiconductors.philips.com/i2c.
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.

SEMESTER IV

DSE: VII MEP544 E-I: Automotive Electronics

- **Course Objectives:** Students will be able to...
  1. Introduce the students to basics of Automotive Systems.
  2. Understand the role of electrical and electronics in automotive systems.
  3. Acquainted with interfacing of sensors and actuators in automotive systems.
  4. Evaluate the impact of different transportation technologies on environment & energy supply.

Total Credits=04	**SEMESTER – IV** **MEP544 E-I: Automotive Electronics**	**Total No. of Hours: 60**
UNIT I	**Automotive Systems Overview**	**15**
	1.1. Overview of Automotive Industry, Global challenges 1.2. Role of technology in Automotive Electronics and interdisciplinary design. 1.3. Introduction to Modern Automotive Systems, need for electronics in automobiles and application areas of electronic systems in modern automobiles. 1.4. Introduction to Electronic systems in Automotive.	
UNIT II	**Sensors and Actuators in Automotive Systems**	**15**
	2.1. Sensors in powertrain: Throttle position sensor, Manifold absolute pressure sensor, Mass air flow sensor, EGO sensor, engine RPM sensor, Crankshaft position sensor, Coolant temperature sensor 2.2. Sensors in body electronics and chassis systems: Accelerometers, Hall effect sensor, RADAR, LiDAR, Ultrasonic sensor, Infrared sensor 2.3. Fuel Injection system, EGR, Electronic Fuel Ignition 2.4. Actuators in automotive systems like Automotive relays, DC motors, Stepper motors, Servo motors, Piezoelectric actuators, Solenoid valves, Hydraulic actuators	
UNIT III	**Automotive Control and Electronic Systems**	**15**
	3.1. Powertrain and transmission domain: Electronic Engine management, Transmission control, Adaptive Cruise Control, etc., 3.2. Chassis control domain: Antilock braking system, electronic	

	stability program, Traction Control, Active Suspension, Passive safety 3.3. Electrical circuits and wiring in vehicles, Power supply: types, characteristics, selection criteria. 3.4. Battery types, Battery Parameters, Technical characteristics. 3.5. Alternators in vehicles, Starter motors, Automotive alarms, Lighting	
UNIT IV	**Electric and Hybrid Vehicles**	**15**
	4.1. Difference between Hybrid Electric Vehicles and Conventional Vehicles. 4.2. An Overview Hybrid Electric Drivetrains and Electric Drivetrains. 4.3. Introduction to various electric drive-train topologies, power flow control in electric drive-train topologies, and fuel efficiency analysis. 4.4. Social and environmental importance of hybrid and electric vehicles	

- **Course Outcomes:** Student should be able to...
  1. Evaluate the sensors and their interfacing in automotive systems.
  2. Present the role of actuators in automotive systems.
  3. Demonstrate theory of operation of electronic control systems
  4. Evaluate the impact of different transportation technologies on environment & energy supply.
- **Reference Books:**

  1. Bosch, Automotive Electrics and Automotive Electronics: System and Components, Networking and Hybrid Drive, 5th ed. (Springer, 2014). ISBN: 978-3658039446.
  2. W. B. Ribbens, Understanding Automotive Electronics, 6th ed. (Elsevier Newnes). ISBN: 978-0750675994.
  3. N. Zaman, Automotive Electronics Design Fundamentals, 1st ed. (Springer). ISBN: 978-9811325133.
  4. Hillier's, Fundamentals of Motor Vehicle Technology on Chassis and Body Electronics, 5th ed. (Nelson Thrones).

SEMESTER IV

DSE: VIII MET544 E-II: Real Time Operating Systems

- **Course Objectives:** Students will be able to...
  1. Learn the principles of Linux operating Systems.
  2. Study computer networking topologies.
  3. Learn OSI reference model.
  4. Study internet address.

Total Credits=04	**SEMESTER – IV** **MET544 E-II: Real Time Operating Systems**	**Total No. of Hours: 60**
UNIT I	**Introduction**	**15**
	1.1.Introduction to Operating System: Computer Hardware Organization. 1.2.BIOS and Boot Process. 1.3.Multi-threading concepts. 1.4.Processes, Threads, Scheduling.	
UNIT II	**Basics Of Real-Time Concepts**	**15**
	2.1.Terminology: RTOS concepts and definitions, real-time design issues, examples. 2.2.Hardware Considerations: logic states, CPU, memory, I/O, Architectures. 2.3.RTOS building blocks. 2.4.Real-Time Kernel.	
UNIT III	**Process Management and Inter-Process Communication**	**15**
	3.1.Concepts, scheduling, IPC, RPC, CPU Scheduling. 3.2.Scheduling criteria, scheduling algorithms 3.3.Threads: Multi-threading models, threading issues, thread libraries, 3.4.synchronization Mutex: creating, deleting, prioritizing mutex, mutex internals	
UNIT IV	**Pipes, Memory Management**	**15**
	4.1.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	

	4.2.CASE STUDIES: 4.3.Case study Linux POSIX system, RTLinux / RTAI, Windows system, Vxworks, uItron 4.4.Kernel Design Issues: structure, process states, data structures, inter-task communication mechanism 4.5.Linux Scheduling	

- **Course Outcomes:** Student should be able to...
  1. Explore the concepts of operating systems.
  2. Analyse 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 Books:**

  1. J. J. Labrosse, MicroC/OS-II: The Real-Time Kernel (Newnes, 2002). ISBN: 978-1578201037.
  2. Jane W. S. Liu, Real-time Systems (Prentice Hall, 2000). ISBN: 978-0130996510.
  3. W. Richard Stevens, Advanced Programming in the UNIX® Environment, 2nd ed. (Pearson Education India, 2011). ISBN: 978-8131719999.
  4. Philips A. Laplante, Real-Time System Design and Analysis, 3rd ed. (John Wiley & Sons, 2004). ISBN: 978-0470871058.
  5. Doug Abbott, Linux for Embedded and Real-Time Applications, 2nd ed. (Newnes, 2011). ISBN: 978-1856177504.

SEMESTER IV

OJT: MET545 On-Job Training

OJT will provide the opportunities for internship with local/regional industries, business organization, health and allied areas, local government, etc. so that students may actively engaged with the employability opportunities. Students will undergo 4 credit work-based learning/OJT/internship.

Credits=04	**MET545: On-Job Training**	**Total No. of Hours: 120**
Credits 2	On Job Training Appreciation by Trainer	
Credits 2	On Job Training Reporting On Job Training Presentation	

SEMESTER – IV

MEP 546:

Lab IV: Electronics Design Lab (Hardware and Software Lab)

(Based on MEP541, 542, 543 courses)

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

Credits=02	**SEMESTER – IV** **MEP546** **Lab IV: General Electronics Lab (Hardware and Simulation)** **Based on MEP541, 542, 543 courses)**	**Total No. of Hours: 60**
	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. 9. Study and programming of pelletizer system using PLC. 10. Study and programming of Automatic warehouse using PLC. 11. Bit LED and Switch Interface 12. Buzzer Relay and Stepper Motor Interface 13. Time delay program using built in Timer / Counter feature. 14. 4x4 Matrix Keypad Interface 15. Displaying a message in a 2-line x 16 Characters LCD display 16. ADC and Temperature sensor LM 35 Interface 17. I2C Interface – 7 Segment display 18. I2C Interface – Serial EEPROM 19. Transmission from Kit and reception from PC using Serial Port 20. Generation of PWM Signal	3 Hours for each Practical

- **Course Outcomes:** Students should be able to...
  1. Design and develop the Automation systems.
  2. Demonstrate programming skill using PLC.
  3. Design and develop embedded product.
  4. Demonstrate automation in electronic systems.
- **Reference Books:**

  1. D. Seal, ARM Architecture Reference Manual, 2nd ed. (Addison-Wesley Professional, 2001). ISBN: 0201737191.
  2. S. Furber, ARM System-on-Chip Architecture, 2nd ed. (Addison Wesley, 2000). ISBN: 0201675196.
  3. "The I2C-bus Specification," Philips Semiconductor, 2000, http://www.semiconductors.philips.com/i2c.
  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. J. W. Webb and R. A. Reiss, Programmable Logic Controllers – Principle and Applications, 5th ed. (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).