K.E. Society's
Rajarambapu Institute of Technology, Rajaramnagar
(An Empowered Autonomous Institute, affiliated to Shivaji University, Kolhapur)
M. Tech. Electronics Engineering
Curriculum Structure and Evaluation Scheme (NEP 2020)
To be implemented for 2025-27 & 2026-28 Batch

DEPARTMENT OF ELECTRONICS AND TELECOMMUNICATION ENGINEERING

F. Y. M. Tech						Semester: I					
Course Code	Course	Teaching Scheme				Evaluation Scheme					
							Theory Marks			Practical Marks	
		L	T	P	Credits	Scheme	Max	Min. % for passing		Max	Min. % for passing
EEE129	Embedded System Design	3	1	--	4	ISE	30	40	40	--	--
						ESE	70	40		--	--
EEE131	FPGA Based System Design	3	1	--	4	ISE	30	40	40	--	--
						ESE	70	40		--	--
EEE133	Microwave and Communication Engineering	3	--	--	3	ISE	30	40	40	--	--
						ESE	70	40		--	--
	Programme Elective-I	3	--	--	3	ISE	30	40	40	--	--
						ESE	70	40		--	--
	Programme Elective-II	3	--	--	3	ISE	30	40	40	--	--
						ESE	70	40		--	--
EEE143	Embedded System Design Lab	--	--	2	1	ISE	--	--		50	50
						ESE	--	--		50	50
EEE145	FPGA Based System Design Lab	--	--	2	1	ISE	--	--		50	50
						ESE	--	--		50	50
SHP5513	Technical Communication	02	--	--	01	ISE	--	--		100	50
	TOTAL	**17**	**2**	**4**	**20**						

Total Contact Hours/week: 23
Total Credits 20
ISE = In Semester Evaluation, ESE = End Semester Exam

DEPARTMENT OF ELECTRONICS AND TELECOMMUNICATION ENGINEERING

Program Elective-I

Sr. No.	Course Code	Course
1.	EEE135	Wireless Networks
2.	EEE137	Industrial IoT
3.	EEE139	Machine Learning and Generative AI

Program Elective-II

Sr. No.	Course Code	Course
1.	EEE1016	Soft Computing
2.	EEE141	Optical Communication System
3.	EEE1036	Optimization Techniques

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DEPARTMENT OF ELECTRONICS AND TELECOMMUNICATION ENGINEERING

F. Y. M. Tech						Semester: II					
Course Code	Course	Teaching Scheme				Evaluation Scheme					
		L	T	P	Credits	Scheme	Theory Marks			Practical Marks	
							Max	Min. % for passing		Max.	Min. % for passing
EEE1026	Industrial Automation	3	1	--	4	ISE	30	40	40	--	--
						ESE	70	40		--	--
EEE130	Advanced Signal Processing	3	1	--	4	ISE	30	40	40	--	--
						ESE	70	40		--	--
	Programme Elective-III	3	--	--	3	ISE	30	40	40	--	--
						ESE	70	40		--	--
	Programme Elective– IV	3	--	--	3	ISE	30	40	40	--	--
						ESE	70	40		--	--
EEE1046	Research Methodology	2	1	--	3	ISE	30	40	40	--	--
						ESE	70	40		--	--
EEE1066	Industrial Automation Lab	--	--	2	1	ISE	--	--		50	50
						ESE	--	--		50	50
EEE144	Advanced Signal Processing Lab	--	--	2	1	ISE	--	--		50	50
						ESE	--	--		50	50
EEE1086	Mini project	--	--	2	1	ISE	--	--		100	50
	TOTAL	**14**	**3**	**6**	**20**						

Total Contact Hours/week: 23
Total Credits 20

ISE = In Semester Evaluation, ESE = End Semester Exam

DEPARTMENT OF ELECTRONICS AND TELECOMMUNICATION ENGINEERING

Program Elective-III

Sr. No.	Course Code	Course
1.	EEE132	Advance Communication Network
2.	EEE134	Image Processing and Computer Vision
3.	EEE136	Biomedical Instrumentation

Program Elective-IV

Sr. No.	Course Code	Course
1.	EEE138	ASIC Design
2.	EEE140	Automotive Electronics
3.	EEE142	Renewable Energy

DEPARTMENT OF ELECTRONICS AND TELECOMMUNICATION ENGINEERING

S. Y. M. Tech						**Semester: III**				
Course Code	**Course**	**Teaching Scheme**				**Evaluation Scheme**				
							Theory Marks		**Practical Marks**	
		L	**T**	**P**	**Credits**	**Scheme**	Max	Min. % for passing	Max	Min. % for passing
EEE2016	Industry Internship	--	--	-	1	ISE	--	--	100	50
	Open Elective	3	--	--	3	ESE	100	40	--	--
EEE2036	Dissertation Phase I	--	--	12	6	ISE	--	--	100	50
EEE2056	Dissertation Phase II	--	--	20	10	ISE	--	--	100	50
						ESE	--	--	100	50
	TOTAL	**3**	**--**	**32**	**20**					

Total Contact Hours/week: 35
Total Credits 20

ISE = In Semester Evaluation, ESE = End Semester Exam

***Note-** Student has to complete industry internship of 02 weeks after second semester however its evaluation will be carried out in third semester.

Open Elective

Sr. No.	Course Code	Course
1.	MOE2012	Artificial Intelligence and Machine Learning
2.	MOE2022	Creative Thinking: Techniques and Tools
3.	MOE2032	MOOC Course
4.	MOE2041	Energy Audit and Management
5.	MOE2062	Augmented Reality and Virtual Reality
6.	MOE2072	Industrial Instrumentation
7.	MOE2082	Advanced Mechatronics systems
8.	MOE2091	Disaster Management

Note for Open Elective

An Open Elective course is included in the curriculum of S. Y. M. Tech (Semester-III), under which students need to learn either MOOC course or courses offered by department.

Guidelines for MOOC course under Open Elective

1. If students opt for MOOC course as an Open Elective, he/she should select this course from NPTEL platform only.
2. As three credits are allotted to open elective, selected MOOC course must be of minimum 8 weeks or 30 hours.
3. Students need to solve assignments given by platform and also, give the final certification exam at allotted NPTEL exam center.
4. Student must secure certification of NPTEL platform within program duration, otherwise he/she will not beeligible for final evaluation.
5. If student fails in NPTEL certification course, he or she should reregister for the course in the next semester.

Guidelines for other courses mentioned under Open Elective:

1. Student can opt for courses mentioned in the curriculum.
2. While selecting the course, students must take care that selected course from the list is not learned in UG or PG first year curriculum.
3. Lectures of these courses will be conducted by concerned department faculty by online mode.
4. Evaluation of these courses will be as mentioned in the curriculum.

DEPARTMENT OF ELECTRONICS AND TELECOMMUNICATION ENGINEERING

S. Y. M. Tech						**Semester: IV**				
Course Code	**Course**	**Teaching Scheme**				**Evaluation Scheme**				
							Theory Marks		**Practical Marks**	
		L	**T**	**P**	**Credits**	**Scheme**	Max	Min.% for passing	Max	Min.% for passing
EEE2026	Dissertation Phase III	--	--	16	08	ISE	--	--	100	50
EEE2046	Dissertation Phase IV	--	--	24	12	ISE	--	--	100	50
						ESE	--	--	100	50
	TOTAL		--	**40**	**20**					

Total Contact Hours/week: 40
Total Credits 20

ISE = In Semester Evaluation, ESE = End Semester Exam

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DEPARTMENT OF ELECTRONICS AND TELECOMMUNICATION ENGINEERING

SEMESTER I

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DEPARTMENT OF ELECTRONICS AND TELECOMMUNICATION ENGINEERING

Class:- **F.Y. M. Tech.**	**Semester-I**
Course Code: **EEE129**	Course Name: **Embedded System Design**

L	T	P	Credits
3	1	--	4

Course Description:

This course on embedded systems will expose the students to the fundamental requirements of embedded systems and the interaction between hardware and software in such systems. Next the course will discuss steps of hardware design and very important issue of designing for less power consumption. Since many of the embedded systems will have real time constraints, use EDA tools to design embedded systems will be discussed. The course will end with a brief overview of design verification methods that are adopted for embedded system design.

Course Learning Outcomes:

After successful completion of the course, students will be able to,

1. Illustrate Cortex M3 / M4 processor architecture and its features
2. Apply programming skills to develop algorithm for peripherals and interrupts
3. Develop embedded system software.
4. Design and develop embedded systems based applications

Prerequisite: Microprocessors / Microcontrollers, Computer Programming

Course Content

Unit No.	Description	Hrs.
1.	**ARM Cortex –M Architecture and Programming** ARM Cortex M3 / M4 Architecture, Registers, CPU status, Clock generation, Memory organization, Instruction Set, Programming model – Registers, Operation Modes, Embedded C Programming.	06
2.	**Cortex M CPU Interrupts** Nested Vectored Interrupt Controller (NVIC), Vector table, Interrupt priorities, Interrupt Inputs and Pending behavior, Fault Exceptions, Supervisor and Pendable Service Call, SYSTICK Timer, Interrupt Sequences, Exits, Tail Chaining, Interrupt Latency, Start-up files, initialization of peripherals interrupts, Interrupt routines programming.	06

3.	**ARM Peripherals and Programming** On chip peripherals, GPIO, RTC, Watchdog, ADC, DAC, Timer, PWM, Memory, DMA programming, External Peripheral Interfacings and their programming.	**06**
4.	**Communication and Programming** Communication Peripherals: UART, I2C, I2S, and SPI , CAN BUS programming, LIN bus programming, Drivers for serial port communication.	**06**
5.	**Algorithm Designing and Debugging** State Machine based Embedded Programming, Writing initialization programs, Debugging techniques, Debugging with JTAG, Debugging with UART port, open source tools for software development	**06**
6.	**Embedded System Implementation** Development Environment, Debugging Techniques, Designing, Manufacturing and Testing steps and issues.	**06**

References –

Text Books:

1. Joseph Yiu, "The Definitive Guide to ARM® Cortex®-M3 and Cortex®-M4 Processors", Newnes publication
2. Frank Vahid and Tony Givargis, "Embedded System Design", Wiley publication
3. Yifeng Zhu, "Embedded Systems with Arm Cortex-M Microcontrollers in Assembly Language and C", E-Man Press LLC

Reference Books:

1. Sloss Andrew N, Symes Dominic, Wright Chris, "ARM System Developer's Guide: Designing

Useful Links

1. https://nptel.ac.in/
2. https://in.coursera.org/
3. https://www.nxp.com/
4. https://www.arm.com/

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DEPARTMENT OF ELECTRONICS AND TELECOMMUNICATION ENGINEERING

Class:-**F.Y. M. Tech.**	**Semester-I**
Course Code: **EEE131**	Course Name: **FPGA Based System Design**

L	T	P	Credits
3	1	--	4

Course Description:

This course covers the systematic design of advanced digital systems using field-programmable gate arrays (FPGAs). The emphasis is on top-down design starting with a software application, and translating it to high-level models using a hardware description language (Verilog). The course will focus on design for high-performance computing applications using streaming architectures. Finally, the test bench development, simulation for bit-true design verification, and synthesis of complete digital systems is also covered.

Course Learning Outcomes:

After successful completion of the course, students will be able to,

1. Describe VLSI front end and back design of combinational and sequential systems.
2. Model VLSI circuits and system using Verilog HDL
3. Analyze digital Design in terms of various parameters
4. Design and synthesize various digital modules

Prerequisite: Basics of digital design, programming in C will be beneficial.

Course Content

Unit No.	Description	Hrs.
1.	**Overview of VLSI Design** Digital system design options and trade-offs, Design methodology and technology overview, High Level System Architecture and Specification	06
2.	**Hardware Description Language** Dataflow Modeling: Continuous assignments, delay specification, expressions, operators, operands, operator types. Behavioral Modeling: Structured procedures, initial and always, delay control, generate statement, event control, conditional statements, loops, sequential and parallel blocks. (Examples: Multiplexers, Encoder, Decoder, BCD decoder, Array multiplier)	06
3.	**Synchronous Sequential Circuits** Blocking and non-blocking assignments, Tasks and Functions: Differences between tasks and functions, declaration, invocation, automatic tasks and functions, Design of Finite State Machines Using CAD Tools, basics of	06

	Algorithmic State Machine (ASM) (Example: Flip flops, Registers, Counters, Serial Adder, ADD Shift Multiplier, Static Random Access Memory (SRAM))	
4.	**Logic block architecture** FPGA logic cells, timing models, power dissipation I/O block architecture: Input and Output cell characteristics, clock input, Timing, Power dissipation, Programmable interconnect - Partitioning and Placement, Routing resources, delays	**06**
5.	**Microprocessor Design** History of Microprocessors, Instruction Set Design, FPGA Microprocessor Cores, Hardcore Microprocessors Softcore Microprocessors, Case Studies- Micro blaze Nios-Processor Design.	**06**
6.	**Protocol implementation** Introduction to UART ,SPI, I2C, Verilog implementation of UART,I2C, SPI	**06**

References –

Text Books

1. Samir Palnitkar, Verilog HDL, a guide to digital design and synthesis, Prentice Hall
2. Kamran Eshringhan and Douglas Pucknell, Basics of VLSI Design, PHI publications
3. Wayne Wolf, FPGA Based Digital Design, Prentice Hall publication

References

1. Charles Roth, Lizy Kurian John and Byeong Kil Lee, Digital System Design using Verilog HDL, Cengage Learning publication
2. Stephen Brown, Fundamentals of Digital Logic with Verilog Design, Tata McGrawHill publication

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DEPARTMENT OF ELECTRONICS AND TELECOMMUNICATION ENGINEERING

Class: - **M. Tech.**	**Semester-I**
Course Code: **EEE133**	Course Name: **Microwave and Communication Engineering**

L	T	P	Credits
3	-	--	3

Course Description:

This course is offered as the core course at the second semester of Electronics Engineering post-graduate programme, consists of two modules. The first module constitutes the study of basic antenna parameters, radiation mechanism, RF link design. The second module covers the design and analysis of Antenna arrays, micro strip patch antennas, the design of various types of impedance matching circuits, and the design of various types of microwave filters.

Course Learning Outcomes:

After successful completion of the course, students will be able to,

1. Describe different types of path loss models.
2. Design RF link, microwave networks and circuits.
3. Compute parameters of microwave networks and circuits.
4. Aanalyze different types of antennas and microwave circuits

Prerequisite: Basic knowledge of electromagnetics and communication engineering

Course Content

Unit No.	Description	Hrs.
1.	**Introduction to Microwave Systems and Antennas:** Microwave Frequency Bands, Physical Concept of radiation, Near and Far field regions, Power radiated by antenna, Antenna pattern characteristics, Antenna Gain, Antenna efficiency, Aperture efficiency and effective area, Antenna Noise temperature and G/T, Friis Transmission equation.	06
2.	**Radiation Mechanisms** Potential function, Radiation Mechanism of Linear wire antenna, RF link design	06
3.	**Wireless Propagation Mechanism:** Free space propagation model, ground reflection model, knife edge diffraction model, path loss prediction in hilly terrain, fading and diversity techniques.	06

4.	**Antenna Arrays:** Array of two isotropic point sources, pattern multiplication, Uniformly spaced arrays with uniform and non-uniform excitation, Broadside and End fire array.	**06**
5.	**Design Considerations and applications** Microstrip antennas, Broadband and frequency independent antennas, Parabolic Dish Antenna, Antennas for special applications, Smart antennas.	**06**
6.	**Microwave Design Principles** Impedance transformation, Impedance Matching, Microwave Filter Design.	**06**

References -

Text Books:

1. David M. Pozar, Microwave Engineering, Wiley Interscience publication
2. Constantine A. Balanis, Antenna Theory, John Wiely & Sons Inc Publisher
3. J. D. Kraus, Antennas and wave Propagation, McGraw Hill. Publisher

Reference Books:

1. Theodore S. Rappaport, Wireless Communication Principles and Practice, Pearson Publisher

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DEPARTMENT OF ELECTRONICS AND TELECOMMUNICATION ENGINEERING

Class:- **F.Y. M. Tech.**	**Semester-I**
Course Code: **EEE143**	Course Name: **Embedded System Design Lab**

L	T	P	Credits
-	-	2	1

Course Description:

The course will be helpful to provide overview of ARM embedded systems which enables the students to explore different aspects and develop different applications in real time embedded systems. It aims to develop students' ability of developing programs, analyzing the performance of the embedded systems, interpreting the results and writing the report on the conduction of experimentation.

Course Learning Outcomes:

After successful completion of the course, students will be able to,

1. Apply programming skills to integrate hardware peripherals of ARM microcontroller.
2. Test and debug programs for ARM microcontroller.
3. Develop and demonstrate small embedded systems using ARM C programming

Prerequisite: Microcontroller based subjects

Course Content

Unit No.	Description	Hrs.
1.	Introduction of the development tools and kit	02
2.	GPIO Programming and External Peripheral Interfaces	02
3.	Interrupt programming (IRQ and NV-IRQ)	02
4.	FIQ programming and comparison of FIQ with VIRQ and NVIRQ	02
5.	Programming Timer to develop applications	02
6.	Programming Timer to perform capture operation and match facility of timer	02
7.	Programming PWM and application of it	02
8.	Programming ADC	02
9.	Programming DAC	02
10.	Programming UART	02

References –

Text Books:

1. Joseph Yiu, "The Definitive Guide to ARM® Cortex®-M3 and Cortex®-M4 Processors", Newnes publication
2. Frank Vahid and Tony Givargis, "Embedded System Design", Wiley publication
3. Yifeng Zhu, "Embedded Systems with Arm Cortex-M Microcontrollers in Assembly Language and C", E-Man Press LLC

Reference Books:

1. Sloss Andrew N, Symes Dominic, Wright Chris, "ARM System Developer's Guide: Designing

Useful Links

1. https://nptel.ac.in/
2. https://in.coursera.org/
3. https://www.nxp.com/
4. https://www.arm.com/

Class:-**F.Y. M. Tech.**	**Semester-I**
Course Code: **EEE145**	Course Name: **FPGA based System Design Lab**

L	T	P	Credits
-	-	2	1

Course Description:
This course deals with the experimentation on FPGA boards. It provides hands on experience in to model, simulate, emulate and verify the results of various VLSI circuits and systems. It also gives exposure to industry grade front end tool like Xilinx VIVADO.

Course Learning Outcomes:
After completion of this course students will be able to
1. Design digital circuit as per operation
2. Model VLSI circuits and Systems using Verilog HDL
3. Use of Tools and techniques to perform experiment and verify the results
4. Demonstrate effectively though oral/lab report

Prerequisite:
Basics of digital design, programming in C will be beneficial.

Course Content

Unit No.	Description	Hrs.
1.	Introduction to VLSI front and Backend development tools	02
2.	Design and Verify Basic Adders and Subtractor using gate level primitives	02
3.	Design, synthesize and implement following combinational circuits a. 8:1 Mux/Demux, b. 8-bitMagnitude comparator	02
4.	Design, synthesize and implement following basic memory elements a. latches b. flip-flops	02
5.	Design and implementation of 4-bit shift registers a. SISO, SIPO, PISO, PIPO b. Universal Shift registers.	02
6.	Design and implementation of following counters a. 3-bit Synchronous UP Down counter b. Even/odd counter	02

	c. Ring counter/ Johnson counter	
7.	Model Sequence generator/detectors, Synchronous FSM – Mealy and Moore machines (Sequence detector, ADD/Shift multiplier).	**02**
8.	Model following Random Access Memories and verify their functionality a. Single port SRAM b. Dual port RAM	**02**
9.	Design Arithmetic Logic Unit for different operations	**02**
10	Design 4-bit adder	**02**
11	Design and implement processor	**02**
12	Design and implement DSP algorithm	**02**

References –

Text Books

1. Samir Palnitkar, Verilog HDL, a guide to digital design and synthesis, Prentice Hall,
2. Kamran Eshringhan and Douglas Pucknell, Basics of VLSI Design, PHI publications

References

1. Charles Roth, Lizy Kurian John and Byeong Kil Lee, Digital System Design using Verilog HDL, Cengage Learning
2. Stephen Brown, Fundamentals of Digital Logic with Verilog Design, Tata McGrawHill publication
3. Sung Mo Kang, Yousuf Leblebici, CMOS digital Integrated Circuit Design, Tata McGrawHill publication

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Class: **F. Y. M. Tech**	Semester: **I**
Course Code:**SHP5513**	Course Name: **Technical Communication**

L	T	P	Credits
02	--	--	**01**

Course Description:

This course is designed to help students in improving skills that will enable them to produce well designed technical documents and to deliver impressive oral presentations. The course focuses on principles of effective writing and on types of documents common in technical fields. While the emphasis will be on writing, oral communication of technical information will form an important component of the course, as well. The course assists students in preparing them for oral presentations in various professional contexts.

Course Learning Outcomes:

After successful completion of the course, students will be able to,

1. Construct grammatically correct sentences in different types of technical writing, such as reports and proposals.
2. Apply technical writing skills to improve readability of documents.
3. Demonstrate professional skills required in job interviews and at workplace.

Prerequisite: Students who enroll themselves to this course should have adequate LSRW abilities of English language.

Course Contents

Unit No.	Description	Hrs.
01	**Planning and Preparation:** Planning and Preparation, Word Order, breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness.	**04**
02	**Paraphrasing and Plagiarism:** Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticizing, Paraphrasing and Plagiarism.	**03**
03	**Sections of Research Paper:** Sections of a Paper, Abstracts, Introduction, Review of the Literature, Methods, Results, Discussion, Conclusions, and The Final Check.	**03**

04	**Sections of Research Paper:** Key skills needed when writing a Title, key skills needed when writing an Abstract, key skills needed when writing an Introduction, skills needed when writing a Review of the Literature.	**04**
05	**Sections of Research Paper:** Skills needed when writing the Methods, skills needed when writing the Results, skills needed when writing the Discussion, skills needed when writing the Conclusions, useful phrases, how to ensure good quality of the paper at the time of submission.	**04**
06	**Professional skills:** Resume Writing, e-Mails, Interview skills, Dos and Don'ts while Answering, FAQs, GROUP DISCUSSION: Structured and Unstructured GD, Opening and Closure, Showing Agreement and Disagreement.	**06**

Reference Books:

Text Books:

1. Adrian Wall work, English for Writing Research Papers, Springer New York Dordrecht Heidelberg London.

Reference Books:

1. Day R, How to Write and Publish a Scientific Paper, Cambridge University Press,
2. Goldbart R, Writing for Science, Yale University Press (available on Google Books).
3. Jeff Butterfield, Soft Skills for Everyone, Cengage Learning India Private Limited.
4. John Seely, Oxford Guide to Effective Writing and Speaking; Oxford University Press.
5. Thomas N. Huckin and Leslie A. Olsen, Technical Writing and Professional.
6. Communication for Nonnative Speakers of English; Tata McGraw Hills, International Edition.

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Class: - **First Year M. Tech**	Semester-**I**
Course Code: **EEE135**	Course Name: **Wireless Network (PE-I)**

L	T	P	Credits
3	-	-	3

Course Description:

Introduction to the concepts of wireless sensors and associated circuits and networking. To enable students to appreciate various applications of wireless sensor networks and to impart design principles of wireless networks

Course Learning Outcomes:

After completion of this course, students will be able to:

1. Understand core concepts of wireless sensors, circuits, and networking.
2. Identify and analyze real-world wireless sensor network applications.
3. Apply wireless network design principles to create efficient networks.
4. Address challenges like energy efficiency, scalability, and data communication.
5. Integrate wireless sensors with computing and IoT for improved performance.

Prerequisite: Basic knowledge of sensors and Communication

Course Content		
Unit no.	**Description**	**Hrs.**
1.	**Introduction Cellular and Ad Hoc Wireless Networks**-Application of Ad Hoc Wireless Networks, Issues in Ad Hoc Wireless Networks: Medium Access Scheme-Routing, Multicasting-Transport Layer Protocols-Pricing Scheme-Quality of Service Provisioning-Self Organization-Security-Addressing and Service Discovery-Energy Management-Scalability Deployment Considerations, Ad Hoc Wireless Internet	06
2.	**Sensor Networks Comparison with Adhoc wireless networks**-Challenges for WSNs - Difference between sensor networks and Traditional sensor networks Types of Applications, Enabling Technologies for Wireless Sensor Networks, Single Node Architectures, Hardware Components, Energy Consumption of Sensor Nodes, Issues in Designing a Multicast Routing Protocol	06
3.	**Sensor Network Architecture Data Dissemination**-Flooding and Gossiping-Data gathering Sensor Network Scenarios, Optimization Goals and Figures of Merit, Design Principles for WSNs	06
4.	**Gateway Concepts: -** Need for gate way, WSN to Internet Communication, Internet to WSN Communications Tunneling	06

5.	**MAC Protocols MAC Protocols for Sensor Networks** -Location Discovery, Quality of Sensor Networks, Evolving Standards, Other Issues, Low duty cycle and wake up concepts, The IEEE 802.15.4 MAC Protocols, Energy Efficiency, Geographic Routing Mobile nodes	**06**
6.	**Routing Gossiping and Agent based Unicast Forwarding**-Energy Efficient Unicast Broadcast and Multicast-Geographic Routing-Mobile Nodes-Security-Application Specific Support - Target detection and tracking-Contour edge detection-Field Sampling	**06**

Text Books:

1. Holger Karl and Andreas Willig, Protocols and Architectures for Wireless Sensor Networks John Wiley & Sons Limited
2. Wilson, Sensor Technology hand book, Elsevier publications

Reference book:

1. D.Tse, P. Viswanath, "Fundamentals of Wireless Communication", Cambridge University Press
2. S.G. Glisic, "Advanced Wireless Communications", 4G Technologies, Wiley.

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DEPARTMENT OF ELECTRONICS AND TELECOMMUNICATION ENGINEERING

Class:-**First Year M. Tech**	Semester-**I**
Course Code: **EEE137**	Course Name: **Industrial IoT (PE -I)**

L	T	P	Credits
3	-	-	3

Course Description:
This course provides a comprehensive understanding of Industrial Internet of Things (IIoT), focusing on its architecture, technologies, and applications in modern industries. Students will learn about IIoT protocols, sensors, data analytics, machine-to-machine communication, and edge computing, equipping them to address industrial challenges with innovative IIoT solutions.

Course Learning Outcomes:
After completion of this course, students will be able to:

1. Analyze the impact of IoT on productivity, efficiency, and decision-making in industrial automation.
2. Design IoT systems using edge computing, cloud platforms, and AI analytics.
3. Apply IoT to solve problems in industries like manufacturing, healthcare, and energy.
4. Assess IoT security challenges and propose solutions for system reliability and data integrity.

Prerequisite: Knowledge digital design, Probability & Statistics, Programming Fundamentals, Basic Automation Systems, etc.

Course Content		
Unit no.	**Description**	**Hrs.**
1.	**Introduction to IIoT** Overview of Industrial IoT, architecture, key components, industrial protocols (e.g., Modbus, Profinet), and applications in manufacturing, energy, and transportation.	**06**
2.	**Sensors and Actuators** Types (temperature, pressure, motion, etc.), working principles, calibration, integration with IIoT systems, and techniques for data acquisition and transmission.	**06**
3.	**Communication Technologies** Detailed study of IIoT protocols (e.g., MQTT, CoAP, OPC-UA), and wireless communication technologies such as LoRaWAN, Zigbee, and 5G for IIoT connectivity.	**06**

4.	**Edge and Cloud Computing** Concepts of edge computing, edge devices, data processing at the edge, cloud computing platforms, and integration between edge and cloud in IIoT systems.	**06**
5.	**Data Analytics in IIoT** Big data frameworks, machine learning algorithms for predictive maintenance, real-time data monitoring, anomaly detection, and decision-making for IIoT.	**06**
6.	**Security and Privacy in IIoT** Overview of threats and vulnerabilities, encryption techniques, authentication mechanisms, secure communication protocols, and privacy-preserving strategies.	**06**

Text Books:

1. Alasdair Gilchrist, Industry 4.0: The Industrial Internet of Things, A press.
2. Sudip Misra, Chandana Roy, and Anandarup Mukherjee, Introduction to Industrial Internet of Things and Industry 4.0, CRC Press.

Reference Books:

1. Arsheep Bahga, Vijay Madisetti, Internet of Things: A Hands-on Approach, Universities Press.
2. Sudip Misra, Chandana Roy, Anandarup Mukherjee, Introduction to Industrial Internet of Things and Industry 4.0, CRC Press.
3. Vijay Madisetti and Arshdeep Bahga, Internet of Things: A Hands-On Approach, Universities Press.
4. Rajkumar Buyya and Amir Vahid Dastjerdi, Internet of Things: Principles and Paradigms, Elsevier.
5. Sabina Jeschke, Christian Brecher, Houbing Song, and Danda B. Rawat, Industrial Internet of Things, Springer.

Class: **FY M.Tech ETC Engg.**	Semester-I
Course Code: **EEE139**	Course Name: **Machine Learning and Generative AI (PE-I)**

L	T	P	Credits
3	-	--	3

Course Description:
This course provides an in-depth exploration of Machine Learning (ML) and Generative AI techniques, with a focus on their applications in Electronics Engineering. Students will gain foundational knowledge in ML algorithms and deep learning frameworks, as well as advanced skills in generative models like GANs and VAEs. The course bridges theoretical concepts with practical implementations, emphasizing their use in Image Processing, hardware acceleration, and real-world applications. Students will have a robust understanding of the principles and tools required to design and deploy ML and AI-based solutions, preparing them for research and innovation in the field of Electronics Engineering.

Course Learning Outcomes:
After successful completion of the course, students will be able to,
1. Describe continuous time and discrete time signals & systems.
2. Determine the response of LTI systems using convolution.
3. Design different types of digital filters for various applications.
4. Apply the knowledge of DSP processor for real time applications.

Prerequisite: Basic knowledge of linear algebra, probability, Image Processing and Python Programming

Course Content

Unit No.	Description	Hrs.
1.	**Introduction to AI and ML** Overview and history of Machine Learning, steps of ML, Types of learning: Supervised, unsupervised, reinforcement learning, Linear Algebra : Modelling Matrices, Row and Column Space, Rank, Determinant, Vector Space, Eigen Values and Eigen Vectors, Determined, Underdetermined and Overdetermined Systems, Homogeneous and Heterogeneous Equations	06
2.	**Machine Learning and Algorithms**	06

	Linear and Logistic Regression, Loss and Cost Function, Gradient Descent, Multiclass and Multilable Classification, Support Vector Machine, K-Nearest Neighbor, Bayes Theorem, Bagging and Boosting algorithm	
3.	**Deep Learning** Introduction to Neural Networks, Perceptron, activation functions, feedforward networks, Backpropagation Network, Optimization of Neural Network, Convolutional Neural Networks (CNNs), Recurrent Neural Networks (RNNs) for sequence data, Applications	06
4.	**Generative AI and Generative Models** Generative AI Overview, Difference between discriminative and generative models, Introduction to Data augmentation, Generative Adversarial Networks (GANs): Architecture & training, Variational Autoencoders (VAEs): Concepts and examples, Diffusion models and their applications	06
5.	**Hardware Accelerators for AI and ML** Introduction to AI Hardwares, GPUs vs TPUs: Architecture and use cases, Edge AI : Running ML models on Embedded Processor Boards along with Power and performance optimization, Case studies and applications of AI-ML and GenAI	06
6.	**Research Trends in ML and Generative AI** Ethics and challenges in AI, Future of Generative AI, ML for advanced circuit design and optimization, Generative AI in electronic system design, Autonomous Cars, Generative BOTs, Text-to-image generation	06

References -

Text Books:

1. Kevin P. Murphy, Machine Learning: A Probabilistic Perspective, MIT Press.
2. Ian Goodfellow, Yoshua Bengio & Aaron Courville, Deep Learning, MIT Press.
3. David Foster, Generative Deep Learning: Teaching Machines to Paint, Write, Compose, and Play, O'Reilly Media.
4. Stuart Russell, Peter Norvig, Artificial Intelligence: A Modern Approach, Prentice Hall
5. Elaine Rich, Kevin Knight, Shivashankar B Nair, Artificial Intelligence, Tata McGraw Hill

Reference Books:

1. Nilsson N. J., Artificial Intelligence: A New Synthesis, Morgan Kaufmann Publication.
2. Patrick Henry Winston, Artificial Intelligence, Addison Wesley

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DEPARTMENT OF ELECTRONICS AND TELECOMMUNICATION ENGINEERING

Class:-**First Year M. Tech**	Semester-**I**
Course Code: **EEE1016**	Course Name: **Soft Computing (PE- II)**

L	T	P	Credits
3	-	-	3

Course Description:

This course offers a comprehensive introduction to Soft Computing methodologies, focusing on Fuzzy Logic and Neural Networks. It emphasizes a strong foundation in theoretical concepts, enabling students to understand and apply computational approaches to address complex engineering challenges. Students will explore fuzzy systems, neural network architectures, and their diverse real-world applications across various domains.

Course Learning Outcomes:

After completion of this course, students will be able to:

1. Analyze soft computing principles to evaluate their effectiveness and limitations in engineering.
2. Compare fuzzy logic and traditional logic in managing uncertainty and complexity.
3. Design and implement neural network models for classification, prediction, and control, assessing scalability and adaptability.
4. Integrate fuzzy logic and neural networks to create hybrid systems and assess their impact on intelligent engineering solutions.

Prerequisite: Knowledge digital design, Probability & Statistics. etc.

Course Content		
Unit no.	**Description**	**Hrs.**
1.	**Fuzzy Sets, Relations and Fuzzy Control** Classical Sets, Classical Set Operations, Properties of Classical Sets, Fuzzy Sets, Fuzzy Membership Functions, Fuzzy Set Operations, Properties of Fuzzy Sets, Real world Problems based on Fuzzy sets.	**06**
2.	**Fundamentals of Neural Networks** Introduction, Basic Structure of a Neuron, Model of Biological Neurons, Elements of Neural Networks, Weighting Factors, Threshold Activation Function, Linear Separable Patterns, Single Layer Perceptron, Multi-Layer Perceptron.	**06**
3.	**Fuzzy Relations** Fuzzy Relations, Alpha-Cut Fuzzy Sets, Classical Relations vs. Fuzzy Relations , Extension Principle, Real world Problems based on Fuzzy Relations.	**06**

4.	**Neural Network Architecture** NN Classifications, Feedforward and feedback networks, Supervised and Unsupervised Learning Networks, Back Propagation Algorithm, Delta Training Rule, Radial Basis Function Network (RBFN), Kohonen Self Organization Network, Hopfield Network.	**06**
5.	**Fuzzy Control System** Fuzzy Knowledge base control system, Neuro Fuzzy system, Adaptive Neuro Fuzzy System, Fuzzy control Design, Analysis of Fuzzy Control Systems.	**06**
6.	**Applications of Soft Computing** Adaptive Neuro-Fuzzy Inference Systems, Applications of Adaptive Neuro-Fuzzy Inference Systems, Applications of Neural Networks in Medicine and Biological Sciences, Application of Neural Network in Design of Digital Filters, Application of Computer Networking Using Neural Network, Autonomous Underwater Vehicle Control Using Fuzzy Logic, Application of Fuzzy Logic for Control of Heating, Chilling and Air Conditioning Systems.	**06**

Text Books:

1. Ali Zilouchian, Mo Jamshidi, Intelligent control systems using soft computing methodologies, CRC Press LLC, 2001.
2. Timothy J. Ross, Fuzzy Logic with Engineering Applications, 3rd Edition, Wiley, 2011.
3. Dimiter Driankov, An Introduction to Fuzzy Control, Springer-Verlag Berlin Heidelberg, 3rd Edition, Wiley, 2013.

Reference Books:

1. S.N. Shivanandam, Principle of soft computing, Wiley.
2. Jyh-Shing Roger Jang, Chuen-Tsai Sun, Eiji Mizutani, Euro-Fuzzy and Soft Computing, Prentice-Hall of India.
3. George J. Klir and Bo Yuan, Fuzzy Sets and Fuzzy Logic-Theory and Applications,
4. Prentice Hall.
5. James A. Freeman and David M. Skapura, Neural Networks Algorithms, Applications, and Programming Techniques, Pearson publication.

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DEPARTMENT OF ELECTRONICS AND TELECOMMUNICATION ENGINEERING

Class: - **First Year M. Tech**	Semester-**I**
Course Code: **EEE141**	Course Name: **Optical Communication System (PE-II)**

L	T	P	Credits
3	-	-	3

Course Description:
This course deals with the principles and techniques involved in optical fiber communication. It emphasizes the use of optical fibers for transmitting information over long distances. It explores the key components, design considerations, and challenges involved in building an efficient optical communication system.

Course Learning Outcomes:
After completion of this course, students will be able to:
1. Describe the principles and properties of fiber optic communication.
2. Analyze the performance of optical sources and detectors.
3. Estimate the power and rise time budget for an optical link.
4. Illustrate the concepts and components used in WDM.
5. Design an optical network and analyze its performance

Prerequisite: Basic knowledge of Engineering Physics and Digital Communication

Course Content		
Unit no.	**Description**	**Hrs.**
1.	**Overview of Optical Fiber Communications** Motivations for Light wave communications, optical spectral bands, decibel, nits, network information rates, key elements of optical fiber systems, Standards for optical fiber communications.	**06**
2.	**Optical Fibers: Structures Wave guiding and Fabrication** Introduction to vector nature of light, basic optical laws and definitions, optical fiber modes and configurations, Mode theory of circular waveguide, Single mode fibers, Graded index fibers, Fiber materials, Photonic crystal fibers, Fiber fabrication, Mechanical properties of fiber	**06**
3.	**Transmission Characteristics of Optical Fiber** Attenuation, Material absorption loss, scattering loss, Bending Loss, Dispersion, Chromatic dispersion, Intermodal dispersion, Polarization mode dispersion, Dispersion modified single mode fibers. International fiber standards	**06**
4.	**Optical Sources, Detectors and Link Design**	**06**

	LEDs and Laser Diodes, Photo detectors pin-diodes, APDs, detector responsivity, noise, Optical receivers. Optical link design, Power budget and Rise Time Budget.	
5.	**WDM Concepts and Components** Overview of Wavelength Division Multiplexing, Passive Optical Couplers, Isolator and Circulators, Fiber grating filters, Active optical components, Tunable light sources, Erbium Doped Fiber Amplifier, Raman Amplifier	**06**
6.	**Optical Networks** Network Concepts, Network topologies, SONET/SDH, High speed light wave links, Optical Add/Drop Multiplexing, Optical Switching, Passive Optical Networks, Optical Ethernet, Optical Fiber System performance monitoring and Measurement	**06**

Text Books:

1. Gerd Keiser, Fibre Optic communication, Mc-Graw Hill
2. John M Senior, Optical Fiber Communications Principles and Practice, Pearson

Reference Books:

1. A Ghatak and K Tyagrajan, An Introduction to fiber Optics, Cambridge University Press
2. Siva Ram Murth, Mohan Guruswamy, WDM Optical Networks Concepts Design and Algorithms, PHI Eastern Economy

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DEPARTMENT OF ELECTRONICS AND TELECOMMUNICATION ENGINEERING

Class:-**First Year M. Tech**	Semester-**I**
Course Code:**EEE1036**	Course Name: **Optimization Techniques (PE- II)**

L	T	P	Credits
3	-	-	3

Course Description:
This course provides a thorough introduction to various optimization techniques, including classical methods and modern soft computing approaches such as genetic algorithms, particle swarm optimization, and simulated annealing. Emphasis is placed on understanding the theory behind these techniques and applying them to solve real-world engineering problems. Students will learn to formulate optimization problems and select appropriate techniques based on problem characteristics and constraints.

Course Learning Outcomes:
After completion of this course, students will be able to:

1. Analyze and evaluate optimization techniques, including classical, heuristic, and soft computing methods.
2. Formulate optimization problems and choose the best techniques for real-world engineering solutions.
3. Implement classical optimization methods like linear programming and dynamic programming.
4. Apply heuristic methods like genetic algorithms and particle swarm optimization to complex problems.
5. Compare the advantages and limitations of different optimization techniques in engineering.

Prerequisite: Knowledge of calculus, linear algebra, and probability.

Course Content		
Unit no.	**Description**	**Hrs.**
1.	**Introduction to Optimization** Overview of optimization techniques, Classification of optimization problems, Optimization criteria, constraints, and methods. Formulation of optimization problems. Linear and nonlinear optimization problems.	**06**
2.	**Classical Optimization Techniques** Unconstrained optimization methods: Gradient descent, Newton's method. Constrained optimization: Lagrange multipliers, Kuhn-Tucker conditions. Quadratic programming.	**06**

3.	**Linear Programming** Formulation of linear programming problems, Simplex method, Duality theory, Sensitivity analysis, Applications of linear programming.	**06**
4.	**Evolutionary Algorithms** Genetic algorithms: Selection, Crossover, Mutation. Applications in function optimization and Travelling Salesman Problem. Parameter tuning and improvements.	**06**
5.	**Swarm Intelligence Algorithms** Particle Swarm Optimization (PSO): Basic concepts, Algorithm design, Applications in engineering problems. Comparison with Genetic Algorithms, Hybridization of PSO and GA for optimization.	**06**
6.	**Simulated Annealing and Hybrid Methods** Introduction to Simulated Annealing, Algorithm design, Cooling schedule. Applications in optimization problems. Hybrid methods combining classical optimization and soft computing techniques.	**06**

Text Books:

1. S. S. Rao, Engineering Optimization: Theory and Practice, 4th Edition, Wiley, 2009.
2. Kalyanmoy Deb, Optimization for Engineering Design: Algorithms and Examples, 2nd Edition, Prentice-Hall, 2019.
3. J. L. Horst, P. M. Pardalos, Handbook of Global Optimization, Springer, 2003.

Reference Books:

1. M. S. Bazaraa, J. J. Jarvis, H. D. Sherali, Linear Programming and Network Flows, 4th Edition, Wiley, 2010.
2. R. C. Eberhart, Y. Shi, Particle Swarm Optimization, Morgan Kaufmann, 2001.
3. D. B. Fogel, Evolutionary Computation: Toward a New Philosophy of Machine Intelligence, IEEE Press, 2000.
4. D. P. Bertsekas, Nonlinear Programming, 2nd Edition, Athena Scientific, 1999.

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DEPARTMENT OF ELECTRONICS AND TELECOMMUNICATION ENGINEERING

SEMESTER II

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DEPARTMENT OF ELECTRONICS AND TELECOMMUNICATION ENGINEERING

Class: - **F.Y. M. Tech.**	Semester- **II**
Course Code:**EEE1026**	Course Name: **Industrial Automation**

L	T	P	Credits
3	1	--	4

Course Description:

This advanced course focuses on the principles and applications of industrial automation, including PLCs, SCADA, DCS, and industrial communication protocols. It highlights cutting-edge topics such as Industrial IoT (IIoT), artificial intelligence in automation, energy-efficient solutions, and cybersecurity in industrial systems. Designed for postgraduate students, the course emphasizes innovation and problem-solving to prepare for leadership roles in automation and smart manufacturing.

Course Learning Outcomes:

After successful completion of the course, students will be able to,

1. Explain advanced concepts and technologies in industrial automation systems, including their principles and applications.
2. Apply appropriate tools and techniques to address specific industrial automation problems.
3. Analyze complex automation challenges and propose systematic, technology-driven solutions.
4. Design and implement innovative automation systems by integrating multiple emerging technologies.

Prerequisite: Basic knowledge of transducers, measurements, instrumentation and power electronics

Course Content

Unit No.	Description	Hrs.
1.	**Automation components:** Definition, need, and scope of industrial automation, contactors, control relays, sensors, actuators, power electronics devices SCR, DIAC, TRIAC, power MOSFET and IGBT, types of power electronic circuits, protection circuits, control circuits, Review of process controllers, Motion control systems: Servo motors; stepper motors, and drives.	06

2.	**Programmable Logic Controllers:** PLC hardware components- I/O modules and specifications, memory design and types, program scan, seal-in circuits, interlocking circuits, PLC programming- developing PLC wiring diagrams and ladder logic programs.	**06**
3.	**Programming Timers and Counters:** Timer instructions, on-delay and off-delay timers, retentive timers, cascading timers, counter instructions, up and down counters, combining counter and timer, timer/counter applications. Program control instructions, function block programming.	**06**
4.	**Industrial Communication Systems:** Data communication, Device Net, Control Net, Ethernet, Modbus, Field Bus, Profibus, Industrial IoT (IIoT): Concepts and applications, Wireless communication in automation: Zigbee, Bluetooth, and Wi-Fi	**06**
5.	**SCADA and DCS Systems** Overview of SCADA: Architecture and components, Functions and applications of SCADA in monitoring and control, Introduction to Distributed Control Systems (DCS): Architecture and advantages, Comparison of PLC, SCADA, and DCS systems in industrial automation.	**06**
6.	**Emerging Trends in Industrial Automation** Applications of robotics in manufacturing and process industries, Artificial Intelligence (AI) and Machine Learning (ML) in automation, Cybersecurity in industrial automation systems, Role of digital twins in predictive maintenance. Green automation: Energy-efficient automation solutions.	**06**

References -

Text Books:

1. Frank Petruzella, Programmable Logic Controllers, McGraw Hill Publication
2. A. K. Gupta, S. K. Arora, Industrial Automation and Robotics, Laxmi Publications
3. John W. Webb, Ronald A. Reis, Programmable Logic Controllers: Principles and Applications, Pearson Education.
4. Jon Stenerson, Industrial Automation and Process Control, Pearson.

Reference Books:

1. S.K. Singh, "Industrial Instrumentation and Control", McGraw Hill Publication
2. C.D. Johnson," Process Control Instrumentation Technology", Prentice Hall India Publication

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DEPARTMENT OF ELECTRONICS AND TELECOMMUNICATION ENGINEERING

Class: - **F.Y. M. Tech.**	Semester-**II**
Course Code: **EEE130**	Course Name: **Advanced Signal Processing**

L	T	P	Credits
3	1	--	4

Course Description:
Advances in integrated circuit technology have had a major impact on the technical areas to which digital signal processing techniques and hardware are being applied. The efficient use of such hardware devices requires thorough understanding of various digital signal processing techniques. These techniques encompass filter design methods, power spectrum estimation and sampling rate conversion. The subject is essential for anyone whose work is concerned with signal processing applications.

Course Learning Outcomes:
After successful completion of the course, students will be able to,
1. Explain techniques available for implementation of digital signal processing system
2. Design and simulate the working of given digital signal processing system
3. Evaluate performance of digital signal processing system
4. Interpret the performance of digital signal processing system

Prerequisite: Basic knowledge of Signals and Systems and Digital Signal Processing.

Course Content

Unit No.	Description	Hrs.
1.	**Overview of DSP** Characterization in time and frequency, Digital filter design and structures: Basic FIR/IIR filter design &structures, design techniques of linear phase FIR filters, IIR filters by impulse invariance, bilinear transformation, FIR/IIR Cascaded lattice structures, and Parallel all pass realization of IIR..	06
2.	**Linear Prediction and optimal filter** Stationary random process, forward-backward linear prediction filters, solution of normal equations, AR Lattice and ARMA Lattice-Ladder Filters, Wiener Filters for Filtering and Prediction	06

3.	**Multirate DSP** Decimators and Interpolators, Sampling rate conversion, multistage decimator & interpolator, poly phase filters, QMF, digital filter banks, Applications in subband coding.	**06**
4.	**Adaptive filters** Applications, Gradient Adaptive Lattice, Minimum mean square criterion, LMS algorithm, Recursive Least Square algorithm	**06**
5.	**Wavelet Transform for Signal Processing** Introduction to Wavelet transform, Time frequency Resolution, Heisenberg's Uncertainty Principle, The CT Wavelet Transform-scaling-shifting, DT Wavelet Transform, One stage filtering, Approximation and details, Filter bank analysis, Wavelet Reconstruction, Application in compression and demonising.	**06**
6.	**Applications of DSP** Application to Radar, application to image processing, DSP in speech processing, MFCC, LPC and other feature extraction methods.	**06**

References -

Text Books:

1. J.G. Proakis and D.G. Manolakis, Digital signal processing: Principles, Algorithm and Applications, Prentice Hall publication.
2. N. J. Fliege, Multirate Digital Signal Processing: Multirate Systems -Filter Banks Wavelets, John Wiley and Sons Ltd. publication

Reference Books:

1. Bruce W. Suter, Multirate and Wavelet Signal Processing, Academic Press publication.
2. M. H. Hayes, Statistical Digital Signal Processing and Modeling, John Wiley & Sons Inc publication.
3. S. Haykin, Adaptive Filter Theory, Prentice Hall publication.
4. D.G.Manolakis, V.K. Ingle and S.M.Kogon, Statistical and Adaptive Signal Processing, McGraw Hill publication.

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DEPARTMENT OF ELECTRONICS AND TELECOMMUNICATION ENGINEERING

Class: - **FY M. Tech**	Semester-**II**
Course Code: **EEE1046**	Course Name: **Research Methodology**

L	T	P	Credits
2	1	-	3

Course Description:

The course has been developed with orientation towards research related activities and recognizing the ensuring knowledge. The knowledge, skills and competency of engineers required by industry for enhancing their competitiveness in the market need to be developed from research in engineering and technology. The students are to learn research methodology course to understand importance and present papers in conferences and journals. Learners will be able to perform documentation and administrative procedures relating to proposals and report writing.

Course Learning Outcomes:

After completion of this course, students will be able to:

1. Appreciate the need for research.
2. Describe the various types of researches and their applications.
3. Explain the basic methods of data collection.
4. Apply the appropriate analysis in research studies.

Prerequisite: Basic knowledge of research related activities

Course Content		
Unit no.	**Description**	**Hrs.**
1.	**Introduction to research methodology** Research Methodology-Introduction, Meaning of Research, Research Methodology, Research Method, Types of Research, Steps for Research Process – Research process, Define research problems, Research Problem as Hypothesis Testing, Extensive literature review in research, Development of working hypothesis, Preparing the research design, Collecting the data, Analysis of data, Research Designs – Characteristics of a Good Design, Different Types of Research Designs, Descriptive Research Design, Experimental Research Design, Lab-Experiment, The Field Experiment.	04
2.	**Data Collection** Methods and Techniques of Data Collection - Primary and Secondary Data, Methods of Collecting Primary Data, Collection of Secondary Data, Attitude Measurement and Scales - Attitudes, Attributes and Beliefs, Deterministic Attitude Measurement Models: The Guttman Scale, Summative Models: The Likert Scale, The Q-Sort Technique.	04

3.	**Data Measurement** Questionnaire Designing- Contents of the questionnaire, Format of the questionnaire, Steps involved in the questionnaire, Structure and Design of Questionnaire, Sampling and Sampling Designs - Advantage of Sampling over Census, Simple Random Sampling, Other Methods of Sampling, Sampling Design, Non-Probability Sampling Methods.	**04**
4.	**Data Presentation and Analysis** Data Processing - Editing of Data, Coding of Data, Classification of Data, Statistical Series, Tables as Data Presentation Devices, Graphical Presentation of Data, Statistical Analysis and Interpretation of Data- One Sample Tests, Two Sample Tests, Sample Tests, Multivariate Analysis of Data - Regression Analysis, Discriminant Analysis, Factor Analysis.	**04**
5.	**Report Writing** Ethics in Research- Principles of research ethics, Advantages of research ethics, Limitations of the research ethics, Steps involved in ethics, Substance of Reports Proposal, Categories of Report, Reviewing the Draft.	**04**
6.	**Formats of Reports** Parts of a Report, Cover and Title Page, Introductory Pages, Text, Reference Section, Typing Instructions, Copy Reading, Proof Reading. Each of these heads and subheads are explained with the help of examples.	**04**

References-

Text Books:

1. Research Methodology, Indira Gandhi National Open University, School of Management Studies.
2. C. R. Kothari, Research methodology methods and Techniques, New Age International Publishers.

Reference Books:

1. Stuart Melville, Wayne Goddard, Research Methodology: An Introduction for Science and Engineering Students

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DEPARTMENT OF ELECTRONICS AND TELECOMMUNICATION ENGINEERING

Class:- **F.Y. M. Tech.**	Semester-**II**
Course Code: **EEE1066**	Course Name: **Industrial Automation Lab**

L	T	P	Credits
-	-	2	1

Course Description:

The course provides an experiential learning on sensor, actuator, power devices, power converters, control circuits, drives and PLC ladder programming by conducting experiments. It aims to develop students' ability of developing program, analyzing the performance of the converters, interpreting the results and writing the report on the conduction of experimentation.

Course Learning Outcomes:

After successful completion of the course, students will be able to,

1. Develop a ladder program for the given application.
2. Use PLC to control the output devices.
3. Measure the performance parameters of the system.
4. Interpret the results of the experimentation.
5. Write report on conduction of the experiments.

Prerequisite: Basic knowledge of transducers, measurements, instrumentation and power electronics.

Course Content

Experiment No	Description	Hrs.
01	Develop and test ladder program for sequential control application of lamps/motors.	02
02	Develop and test ladder program for the given application using timer.	02
03	Develop and test ladder program for the given application using counter	02
04	Develop and test ladder program to count the number of objects	02

05	Develop and test ladder program for a Flashing Light Control	**02**
06	Develop and test ladder program for a Traffic Light control.	**02**
07	Develop and test ladder program to control speed of steeper motor.	**02**
08	Develop and test ladder program to control speed of BLDC motor.	**02**
09	Implement three phase semi / full converter/chopper for speed control of DC motor.	**02**
10	Implement V/f control method for speed control of three-phase induction motor.	**02**

References -

Text Books:

1. Frank Petruzella, "Programmable Logic Controllers", McGraw Hill.
2. S.K. Singh, "Industrial Instrumentation and Control", McGraw Hill
3. C.D. Johnson, "Process Control Instrumentation Technology", Prentice Hall India
4. Webb and Reis, "Programmable Logic Controllers: Principles and Applications", Prentice Hall India.
5. M. H. Rashid, "Power Electronics Circuits Devices and Applications", Prentice Hall India

Reference Books:

1. Bimal K Bose, "Modern Power Electronics and AC Drives", Pearson Education Asia.
2. Vedam Subramanyam, "Electric Drives – Concepts and Applications", McGraw Hill.
3. Krishna Kant, "Computer Based Process Control", Prentice Hall India

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DEPARTMENT OF ELECTRONICS AND TELECOMMUNICATION ENGINEERING

Class:- **F.Y. M. Tech.**	Semester-**II**
Course Code: **EEE144**	Course Name: **Advanced Signal Processing Lab**

L	T	P	Credits
-	-	2	1

Course Description:

Advances in integrated circuit technology have had a major impact on the technical areas to which digital signal processing techniques and hardware are being applied. The efficient use of such hardware devices requires thorough understanding of various digital signal processing techniques. These techniques encompass frequency analysis of signals, filter design methods, sampling rate conversion, and power spectrum estimation. The subject is essential for anyone whose work is concerned with signal processing applications

Course Learning Outcomes:

After successful completion of the course, students will be able to,

1. Design digital signal processing system based on given specifications.
2. Develop MATLAB program to simulate the working of designed DSP system.
3. Analyze performance of digital signal processing system.
4. Demonstrate effectively though oral/lab report.

Prerequisite: Basic knowledge of Signals and Systems and Digital Signal Processing and MATLAB

Course Content

Unit No.	Description	Hrs.
1.	Implementation of basic Signals in MATLAB.	02
2.	Implement Auto and Cross Correlation MATLAB.	02
3.	Design a MATLAB program to demonstrate DFT.	02
4.	Design IIR filter using BLT and IIV method.	02
5.	Design FIR filter in MATLAB. Consider appropriate specification.	02
6.	Sampling FFT of Input Sequence.	02
7.	Design Butterworth Low pass And High pass Filter Design.	02

8.	Design IIR Chebychev Type I, II Filter.	**02**
9.	Demonstrate filtering operation using any digital filter on this signal.	**02**
10.	Demonstrate wavelate Transform using MATLAB.	**02**
11.	Demonstrate up sampling and down sampling using MATLAB.	**02**
12.	Maximally Decimated Analysis DFT Filter.	**02**
13.	Cascade Digital IIR Filter Realization.	**02**
14.	Inverse Z-Transform and Parallel Realization of IIR filter.	**02**

References -

Text Books:

1. J.G. Proakis and D.G. Manolakis, Digital signal processing: Principles, Algorithm and Applications, Prentice Hall publication.
2. N. J. Fliege, Multirate Digital Signal Processing: Multirate Systems -Filter Banks Wavelets, John Wiley and Sons Ltd. publication.

Reference Books:

1. Bruce W. Suter, Multirate and Wavelet Signal Processing, Academic Press publication.
2. M. H. Hayes, Statistical Digital Signal Processing and Modeling, John Wiley & Sons Inc.
3. S. Haykin, Adaptive Filter Theory, Prentice Hall publication.
4. D.G.Manolakis, V.K. Ingle and S.M.Kogon, Statistical and Adaptive Signal Processing, McGraw Hill publication..

Class:- **F Y M. Tech**	Semester- **II**	**L**	**T**	**P**	**Credits**
Course Code : **EEE1086**	Course Name : **Mini Project**	-	-	2	1

Course Description:
There will be one mini project implemented during the course of the semester. Mini project is composed of the following four parts:

- Problem Analysis
- Solution Design
- Build and Test (software /hardware)
- Demonstrate and Report

Students are expected to present a functional design that fulfills the specifications of the assigned project.

Course Learning Outcomes:
After successful completion of the course, students will be able to,

1. Select title of mini-project and formulate its objectives correctly
2. Develop, simulate and implement the system by complying with desired technical specifications
3. Analyze and synthesize obtained results in theoretical and practical context
4. Present findings in logical order
5. Write a report to document his/her findings

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DEPARTMENT OF ELECTRONICS AND TELECOMMUNICATION ENGINEERING

Class: - **First Year M. Tech**	Semester-**II**
Course Code: **EEE132**	Course Name: **Advanced Communication Network (PE-III)**

L	T	P	Credits
3	-	-	3

Course Description:
This course is designed to provide students with a comprehensive understanding of networking concepts, covering the detailed functioning of each networking layer from the OSI and TCP/IP models. Students will explore a wide range of networking protocols associated with each layer, such as Ethernet, IP, TCP, UDP, HTTP, and others, gaining both theoretical insights and practical skills. The course also includes hands-on experience with network configuration, troubleshooting, and performance monitoring.

Course Learning Outcomes:
After completion of this course, students will be able to:
1. Understand advanced concepts in communication networking.
2. Design and develop protocols for communication networks.
3. Implement and analyse Quality of Service (QoS) mechanisms.
4. Optimize network design for efficiency and scalability.

Prerequisite: Basic knowledge of Communication network

Course Content		
Unit no.	**Description**	**Hrs.**
1.	**Overview of Internet Concepts: -** challenges and history. Overview of -ATM. TCP/IP Congestion and Flow Control in Internet-Throughput analysis of TCP congestion control. TCP for high bandwidth delay networks. Fairness issues in TCP.	06
2.	**Real Time Communications over Internet: -** Adaptive applications. Latency and throughput issues. Integrated Services Model (int Serv). Resource reservation in Internet. RSVP.; Characterization of Traffic by Linearly Bounded Arrival Processes (LBAP). Leaky bucket algorithm and its properties.	06
3.	**Packet Scheduling Algorithms: --** requirements and choices. Scheduling guaranteed service connections. GPS, WFQ and Rate proportional algorithms. High speed scheduler design. Theory of Latency Rate servers and delay bounds in packet switched networks for LBAP traffic.; Active Queue Management - RED, WRED and Virtual clock. Control theoretic analysis of active queue	06

	management.	
4.	**IP address lookup-challenges :-** Packet classification algorithms and Flow Identification Grid of Tries, Cross predicting and controlled prefix expansion algorithms	06
5.	**Admission control in Internet: -** Concept of Effective bandwidth. Measurement based admission control. Differentiated Services in Internet (Diff Serv). DiffServ architecture and frame work.	06
6.	**IPV4, IPV6, IP tunnelling; -,** IP switching and MPLS, Overview of IP over ATM and its evolution to IP switching. MPLS architecture and framework. MPLS Protocols. Traffic Engineering issues in MPLS.	06

Text Books:

1. Jean Le Boudec and Patrick Thiran, "Network Calculus a Theory of Deterministic Queueing Systems for the Internet", Springer Veriag
2. Zhang Wang, "Internet QoS", Morgan Kaufman

Reference Books:

1. Anurag Kumar, D. Manjunath and Joy Kuri, "Communication Networking: An Analytical Approach", Morgan Kaufman Publishers
2. George Kesidis, "ATM Network Performance", Kluwer Academic, Research Papers,

Class: - **FY M. Tech**	Semester-**II**
Course Code: **EEE134**	Course Name: **Image Processing and Computer Vision (PE-III)**

L	T	P	Credits
3	-	-	3

Course Description:
Image Processing and Computer Vision has fundamental importance to fields where images are enhanced, manipulated, and analyzed. They play a key role in remote sensing, medical imaging, inspection, surveillance, autonomous vehicle guidance, and more. Students will benefit from the direct visual realization of image processing concepts, and learn how to implement efficient algorithms to perform or design applications for various tasks.

Course Learning Outcomes:
After completion of this course, students will be able to:
1. Explain different concepts and processes in digital image processing
2. Apply different image processing operations on an image
3. Analyze various operations on image using different tools
4. Compare various filtering, enhancement, segmentation and classification techniques used in image processing
5. Design various applications in Image Processing

Prerequisite: Basic knowledge of MATLAB, Linear Algebra and Digital Signal Processing

Course Content		
Unit no.	**Description**	**Hrs.**
1.	**Digital Image Fundamentals** Components of image processing system, human and computer vision, hierarchy of image processing system, applications, image formation and digitization, binary, gray scale and color images.	05
2.	**Image Enhancement & Image Filtering** Gray level transformation function: Image Negatives, Log Transformations, Power Law Transformation, Piecewise Linear Transformation Functions, Histogram equalization, Basics of spatial filtering, smoothening linear filter, Sharpening spatial filter	07
3.	**Morphological Image Processing**	06

	Dilation and erosion, opening and closing operation, Hit or miss transformation. Basic morphological algorithms: Boundary extraction, region filling, thinning and thickening, skeletons.	
4.	**IMAGE SEGMENTATION** Thresholding, Role of illumination, global and adaptive thresholding, pixel based segmentation, region based segmentation and edge based segmentation	**06**
5.	**IMAGE SHAPE AND CLASSIFICATION** Shape representation, Feature space, Clusters and classification techniques, Supervised and Unsupervised classification	**06**
6.	**Real Life Applications and Case Studies** Face recognition, Object detection, Object Classification, various case studies	**06**

References –

Text Books:

1. R.C. Gonzalez & R.E. Woods, "Digital Image Processing", Pearson
2. Pratt W.K, "Digital Image Processing," John Wiley & Sons

Reference Books:

1. R.C. Gonzalez & R.E. Woods, "Digital Image Processing using MATLAB", Pearson
2. Georgy Gimel'farb, Patrice Delmas, "Image Processing and Analysis: A Primer," World Scientific

Class:-**First Year M. Tech**	Semester-I	L	T	P	Credits
Course Code: **EEE136**	Course Name: **Biomedical Instrumentation (PE-III)**	**3**	**-**	**-**	**3**

Course Description:
This course offers an in-depth understanding of biomedical instrumentation principles, focusing on the design, operation, and applications of instruments used in healthcare. Students will explore the functionality of medical devices, biosensors, signal acquisition, and processing techniques, emphasizing safety standards and advancements in healthcare technologies.

Course Learning Outcomes:
After completion of this course, students will be able to:
1. Analyze the working principles and applications of various biomedical instruments used in clinical diagnosis and research.
2. Design and evaluate medical devices and biosensors for healthcare applications.
3. Apply signal acquisition and processing techniques to interpret physiological data.
4. Assess the safety, ethical, and regulatory aspects of biomedical instrumentation systems.

Prerequisite: Knowledge of basic electronics, Fundamentals of human anatomy and physiology, Understanding of signal processing techniques, Exposure to digital and analog circuit design, etc.

Course Content		
Unit no.	Description	Hrs.
1.	**Introduction to Biomedical Instrumentation** Overview, classification of medical devices, measurement systems, and applications in healthcare and diagnostics.	06
2.	**Physiological Signal Acquisition** Bio-potential signals (ECG, EMG, EEG), electrodes, amplifiers, and noise reduction techniques.	06
3.	**Biosensors and Transducers** Types of biosensors, working principles, signal transduction, and integration with medical systems.	06
4.	**Medical Imaging Systems** Principles of X-rays, CT, MRI, and ultrasound; image acquisition and processing techniques.	06
5.	**Patient Monitoring and Therapeutic Devices** Devices for monitoring vital signs, infusion pumps, defibrillators, and ventilators; emerging wearable technologies.	06

6.	**Safety and Standards in Biomedical Instrumentation** Electrical safety in medical equipment, ISO standards, regulatory compliance, and ethical considerations.	06

Text Books:

1. John G. Webster, Medical Instrumentation: Application and Design, Wiley.
2. R. S. Khandpur, Handbook of Biomedical Instrumentation, McGraw-Hill.

Reference Books:

1. Joseph J. Carr and John M. Brown, Introduction to Biomedical Equipment Technology, Pearson.
2. Leslie Cromwell, Fred J. Weibell, and Erich A. Pfeiffer, Biomedical Instrumentation and Measurements, Prentice Hall.
3. Myer Kutz, Biomedical Engineering and Design Handbook, Volume 1: Biomedical Engineering Fundamentals, McGraw-Hill.
4. Shakti Chatterjee, Biomedical Instrumentation Systems, Cengage Learning.
5. Barbara Christe, Introduction to Biomedical Engineering Technology, CRC Press.

Class:-**F.Y. M. Tech.**	Semester-**II**
Course Code: **EEE138**	Course Name: **ASIC Design (PE-IV)**

L	T	P	Credits
3	-	--	3

Course Description:
This course covers the basics of ASIC with types of ASICS and SOC. It also coves the tradeoffs while designing ASIC. This course covers the principles and techniques used in the design of Application-Specific Integrated Circuits (ASICs), which are custom chips designed for specific applications. Students will learn about the entire ASIC design flow, including specification, architectural design, logic synthesis, verification, physical design, and algorithms .

Course Learning Outcomes:
After successful completion of the course, students will be able to,
1. Describe VLSI design flow and types of ASICs, SOC.
2. Analyze the tradeoff issues in ASIC design
3. Apply the algorithms for ASIC floor planning and placement
4. Design ASIC using high performance algorithms

Prerequisite: Basics of digital design, Verilog HDL and VLSI design,

Course Content

Unit No.	Description	Hrs.
1.	**Introduction to ASIC** VLSI Design flow, CMOS transistors, CMOS Design rules, Combinational logic Cell Sequential logic cell, Transistor as Resistors, Transistor parasitic capacitance Logical effort, Library cell design, and Library architecture.	06
2.	**Types of ASICs** Programmable ASICs - Antifuse, SRAM, EPROM, and EEPROM based ASICs. Programmable ASIC logic cells and I/O cells. Programmable interconnects. Latest Version - FPGAs and CPLDs and Soft-core processors.	06
3.	**Trade off issues at System Level** Optimization with regard to speed, area and power, asynchronous and low power system design. ASIC physical design issues, System Partitioning, Power Dissipation, and Partitioning Methods.	06
4.	**ASIC Physical placement** ASIC floor planning, Placement and Routing	06

5.	**System-On-Chip Design** SoC Design Flow, Platform-based and IP based SoC Designs, Basic Concepts of Bus-Based Communication Architectures, On-Chip Communication Architecture Standards, Low-Power SoC Design	**06**
6.	**ASIC case study** High performance algorithms for ASICS/ SoCs , case studies – Canonic Signed Digit Arithmetic, KCM, Distributed Arithmetic, High performance digital filters for sigma-delta ADC, USB controllers, OMAP.	**06**

References –

Text Books

1. M.J.S. Smith, "Application Specific Integrated Circuits", Pearson.

References

1. H. Gerez, "Algorithms for VLSI Design Automation", John Wiley
2. J. M. Rabaey, A. Chandrakasan, and B. Nikolic," Digital Integrated Circuit Design Perspective (2/e)", PHI

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Class:- **F.Y. M. Tech**	Semester-**II**
Course Code : **EEE140**	Course Name : **Automotive Electronics (PE-IV)**

L	T	P	Credits
3	-	-	3

Course Description:
Course will be helpful to provide overview of Automotive Electronics used in vehicles. This will be helpful in future generation Automobiles such as hybrid vehicles and electric vehicles which is emerging demand of the world.

Course Learning Outcomes:
After successful completion of the course, students will be able to,

1. Describe components of automotive electronics, its evolution, trends, safety standards and advances towards autonomous vehicles
2. Develop automotive grade microcontroller based system
3. Design and model various automotive control systems

Prerequisite: Knowledge of control systems, embedded systems etc.

Course Contents

Unit No	Description	Hrs
1.	**Automotive System** System approach, tools and processes, modern automotive system, need of electronics, Application of electronics ,Hybrid vehicles	06
2.	**Sensors & Actuators** System approach, Basic measurement systems, Sensors characteristics, various Sensors, various actuators, Eg. Solenoid motor based system	06
3.	**Microcontrollers & Microprocessors** Basics of microcontrollers, basics of microprocessors, Selection criteria, Automotive grade controllers, communication protocols, CAN, LIN, MOST	06
4.	**Automotive Control System** Controlling approach, State variable approach, Analog controls, Digital Controls, PID modelling PID tuning	06
5.	**Model Based Development** Model based design 1 ,Model based design 2 ,various control methods ,Study of automotive system of any one of the automotive system	06
6.	**Safety and Diagnostic Systems in Automobiles**	06

	Demonstration of safety systems of a vehicle ,Demonstration ABS ,Driver assistance system, Functional safety ,on board diagnostics	

References –

Text Books:

1. Tom Denton, Advance Automotive Diagnosis, Elseveir Science publication.
2. Allan Bonnick, Automotive Computer Controll System: Diagnostic Tools & Techniques, Elsevier Science publication.

Reference Books:

1. William B. Ribbens, Understanding Automotive Electronics, an imprint of Elseveir Science publication.
2. Ronald K Jurgen, Automotive Electronics Handbook, McGraw Hill publication.
3. K. Ogata, Moders Controll Engineering, Prentice Hall publication.

Class:- **F.Y. M. Tech**	Semester-II
Course Code: **EEE142**	Course Name: **Renewable Energy (PE-IV)**

L	T	P	Credits
3	-	-	3

Course Description:
To provide knowledge of solar energy concept and applications. To impart knowledge of geothermal, ocean and tidal energy and their applications. To understand the design of wind mills and applications. To understand the turbines and generators for small scale hydroelectric generation. To understand the important parts of a biogas plant, design and principle of bio-diesel.

Course Learning Outcomes:
After completion of this course, students will be able to:
1. To explain the basic principles of various renewable energy conversion processes and devices used therein
2. To identify various parameters that influences the performance of renewable energy devices/processes.
3. To undertake the field projects in the area of solar thermal, solar PV, wind, biomass, ocean energy, geothermal etc.
4. To identify suitable renewable source and technology for a given requirement. To develop the integrated renewable energy technology for decentralized power sector.

Prerequisite: Basic knowledge of engineering

Course Content		
Unit no.	**Description**	**Hrs.**
1.	**Need of sources of renewable energy** Introduction to different sources of renewable energy, e.g., Solar Energy, Wind Energy, Bio-mass, Geothermal Energy, Ocean energy, Solar Energy and Application.	06
2.	**Solar Energy** Basic concepts of radiations: Solar radiation, Direct and Indirect radiation, Radiation measuring instrument, applications, Basics of solar thermal applications both low and high temperature ranges such as water heating, air heating, steam generation, desalination of water, crop drying and power generation, Principle of photovoltaics including introduction to various components of a photovoltaic systems for standalone/hybrid/grid connected systems.	06
3.	**Wind Energy**	06

	Wind Resource assessment including instrumentation used in resource assessment, basic theory of wind, wind power generators both for decentralized applications and grid connected systems, performance characteristics, Augmentation of wind power, Betz criteria Data Measurement.	
4.	**Bioenergy** Types and availability of biomass resources, various methods of biomass utilization for energy generation: gasification, briquette, palletization, syn-gas, Anaerobic/Aerobic digestion, ethanol and biodiesel production, types of Bio-gas digesters, Combustion characteristics of biogas and its different utilization Data Presentation and Analysis	**06**
5.	**Hydro Energy** Basic principle of hydroelectric power generation, classification of hydropower projects (pico, micro, mini, small hydro sand large hydro projects), types of hydro turbine, various components of hydropower projects. Ocean Energy Principles utilization, thermodynamic cycles, tidal and wave energy, potential and conversion technique, Principle of ocean thermal energy conversion system.	**06**
6.	**Fuel Cells and Hydrogen Energy** Introduction, principle of fuel cells, thermodynamic analysis of fuel cells, types of fuel cells, fuel cell batteries, applications of fuel cells. Hydrogen as a renewable energy source, sources of hydrogen, fuel for vehicles, hydrogen production- direct electrolysis of water, thermal decomposition of water, biological and biochemical methods of hydrogen production	**06**

References-

Text Books:

1. Duffie, J. A., & Beckman, W. A. Solar engineering of thermal processes, fourth edition, Wiley.
2. Tiwari, G. N., & Ghosal, M. K. Fundamentals of renewable energy sources. Alpha Science International Limited.
3. Mukherjee, D., & Chakrabarti, S. Fundamentals of renewable energy systems. New Age International.

Reference Books:

1. Sukhatme, S. P. Solar Energy Principles of Thermal Collection and storage Tata McGraw Hill Publishing Company Ltd. New Delhi
2. Kothari, D. P., Singal, K. C., & Ranjan, R. Renewable energy sources and emerging technologies. PHI Learning Pvt. Ltd

SEMESTER III

Class: - **S. Y. M. Tech**	Semester-**III**
Course Code: **EEE2016**	Course Name: **Industry Internship**

L	T	P	Credits
-	-	-	1

Course Description:
In the field training work, student is expected to get training in the industry, related to subject specialization for duration of 15 days (minimum) for at least 6 hours per day.
The students who are doing course on MOOC/NPTEL/Coursera/Courses suggested by BOS should

- Select the course in consultation with supervisor and submit the details to Head of Program
- The course should be minimum 25 hours duration and should have certification facility.
- Student should complete course and get certificate the certificate copy should be submitted to head of program with supervisor signature.

In case student opted for industrial training he/she should write a report and submit the same for evaluation to head of program.

Course Learning Outcomes:
After successful completion of the course, students will be able to,

1. Apply engineering knowledge learned during the program
2. Propose creative and innovative solution to the given problem
3. Work in multi-disciplinary setting
4. Show concern for society, environment and other social concerns
5. Demonstrate given tasks according to the industrial needs with full integrity and responsibility

OPEN ELECTIVE

Note for Open Elective

An Open Elective course is included in the curriculum of S. Y. M. Tech (Semester-III), under which students need to learn either MOOC course or courses offered by department.

Guidelines for MOOC course under Open Elective

1. If students opt for MOOC course as an Open Elective, he/she should select this course from NPTEL platform only.
2. As three credits are allotted to open elective, selected MOOC course must be of minimum 6 weeks or 30 hours.
3. Students need to solve assignments given by platform and also, give the final certification exam at allotted NPTEL exam center.
4. Student must secure certification of NPTEL platform, otherwise he/she will not be eligible for final evaluation.
5. Final evaluation of the MOOC course will be based on oral examination conducted by department and marks secured in the exam conducted by NPTEL.
6. If student fails in NPTEL certification course, he or she should reregister for the course in the next semester.

Guidelines for other courses mentioned under Open Elective:

1. Student can opt for courses mentioned in the curriculum.
2. While selecting the course, students must take care that selected course from the list is not learned in UG or PG first year curriculum.
3. Lectures of these courses will be conducted by concerned department faculty by online mode.
4. Evaluation of these courses will be as mentioned in the curriculum.

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DEPARTMENT OF ELECTRONICS AND TELECOMMUNICATION ENGINEERING

Open Elective

Class: - **S. Y. M. Tech**	Semester- **III**
Course Code: **MOE2012**	Course Name: **Artificial Intelligence - Machine Learning**

L	T	P	Credits
3	--	--	3

Course Description:

Machine learning is a part of Artificial Intelligence. It uses interdisciplinary techniques such as statistics, linear algebra, optimization, and computer science to create automated systems that can sift through large volumes of data at high speed to make predictions or decisions without human intervention. Machine learning as a field is now incredibly pervasive, with applications spanning from business intelligence to homeland security, from analyzing biochemical interactions to structural monitoring of aging bridges, and from emissions to astrophysics, etc. This class will familiarize students with a broad cross-section of models and algorithms for machine learning, and prepare students for research or industry application of machine learning techniques.

Course Learning Outcomes:

After successful completion of the course, students will be able to,

1. Describe central machine learning methods and techniques and how they relate to artificial intelligence
2. Differentiate between supervised and unsupervised learning techniques
3. Apply the ML algorithms to a real-world problem,
4. Optimize the models learned and report on the expected accuracy that can be achieved by applying the models.
5. Evaluate a given problem and apply appropriate machine learning technique

Prerequisite: Statistics, linear algebra, optimization techniques, programming language

Course Content

Unit No	Description	Hrs.
01	**Introduction to Artificial Intelligence and Machine learning:** Introduction: What Is AI and ML? Examples of AI and ML, Applications, Supervised Learning, Un-Supervised Learning and Reinforcement Learning, Important Elements of Machine Learning- Data formats, Learnability, Statistical learning approaches, Elements of information theory	06
02	**Feature Selection:** Scikit- Learn Dataset, creating training and test sets, managing categorical data, Managing missing features, Data scaling and	06

	normalization, Feature selection and Filtering, Principle Component Analysis(PCA)- non-negative matrix factorization, Sparse PCA, Kernel PCA. Atom Extraction and Dictionary Learning.	
03	**Regression:** Linear regression- Linear models, A bi-dimensional example, Linear Regression and higher dimensionality, Polynomial regression, Logistic regression-Linear classification, Logistic regression, Implementation and Optimizations, Stochastic gradient descendent algorithms	**06**
04	**Naïve Bayes and Support Vector Machine:** Bayes Theorem, Naïve Bayes Classifiers, Naïve Bayes in Scikit- learn- Bernoulli Naïve Bayes, Multinomial Naïve Bayes, and Gaussian Naïve Bayes. **Support Vector Machine(SVM)-** Linear Support Vector Machines, Scikit-learn implementation, Linear Classification, Kernel based classification, Non-linear Examples. Controlled Support Vector Machines, Support Vector Regression.	**06**
05	**Decision Trees and Ensemble Learning:** Decision Trees- Impurity measures, Feature Importance. Decision Tree Classification with Scikit learn, Ensemble Learning-Random Forest, AdaBoost, Gradient Tree Boosting, Voting Classifier. Clustering Fundamentals- Basics, K-means: Finding optimal number of clusters, DBSCAN, Spectral Clustering. Evaluation methods based on Ground Truth- Homogeneity, Completeness, Adjusted Rand Index.	**04**
06	**Clustering Techniques:** Hierarchical Clustering, Expectation maximization clustering, Agglomerative Clustering Dendrograms, Agglomerative clustering in Scikit- learn, Connectivity Constraints. Introduction to Recommendation Systems- Naïve User based systems, Content based Systems, Model free collaborative filtering-singular value decomposition, alternating least squares.	**08**

References –

Text Books:

1. Giuseppe Bonaccorso, "Machine Learning Algorithms", Packt Publishing Limited.
2. Josh Patterson, Adam Gibson, "Deep Learning: A Practitioners Approach", O"REILLY

Reference Books:

1. Ethem Alpaydin, "Introduction to Machine Learning", PRENTICE HALL INDIA Publication.
2. Peter Flach, "Machine Learning: The Art and Science of Algorithms that Make Sense of Data", Cambridge University Press.

Open Elective

Class: - S. Y. M. Tech	Semester-III
Course Code: MOE2022	Course Name: **Creative Thinking: Tools & Techniques**

L	T	P	Credits
3	-	--	3

Course Description:

In today's ever-growing and changing world, being able to think creatively and innovatively are essential skills. It can sometimes be challenging to step back and reflect in an environment which is fast paced or when students required to assimilate large amounts of information. Making sense of or communicating new ideas in an innovative and engaging way, approaching problems from fresh angles, and producing novel solutions are all traits which are highly sought after by employers. This course will equip with a 'tool-box', introducing to a selection of behaviors and techniques that will augment innate creativity. Some of the tools are suited to use on own and others work well for a group, enabling you to leverage the power of several minds.

Course Learning Outcomes:

After successful completion of the course, students will be able to,

1. Comprehend importance in tackling global challenges as well as in everyday problem-solving scenarios
2. Apply different brainstorming techniques in group activities
3. Be proficient in the application of the 6 thinking hats tool in different life scenarios
4. Develop a systematic approach to idea generation through the use of morphological analysis
5. Innovate on an existing product, service or situation applying the SCAMPER method
6. Get confident with the theory of inventive problem solving, called TRIZ

Prerequisite:

There are no prerequisites to this online Creative Thinking course.

Course Content

Unit No	Description	Hrs.
01	Introduction to the Principles of Creativity: Basic principles of creativity and highlight its importance in tackling global Challenges. Creativity is explored and applied at two different levels, lower and higher-level creativity	06

02	Creativity Tools: Augment our creativity using different methods Brainstorming, a creativity approach that aids the generation of ideas in solving a stated problem. Particularly focus on the application of brainstorming tools in group activities, with the aim of enabling to understand, evaluate and apply different types of brainstorming techniques in own context.	**06**
03	**Six Thinking Hats:** Principles as well as application of the 6 Hats thinking tool both at an individual level and in a group, under various professional and personal situations, allowing students to develop competency and accelerate proficiency on the use of technique.	**06**
04	**Clarifying the Problem:** Organizing a process, turning problems into opportunities, facts, feelings & hunches, problem as question.	**06**
05	**Generating Ideas:** Brainstorming, scamper, forced connections, portable think tank, case studies on generating ideas.	**06**
06	**Developing Ideas & Planning for action:** Organizing ideas, ideas to solutions, implementing solutions, case studies of development of ideas and plan of action.	**06**

References -

Text Books:

1. Michael Michalko," A Handbook of Creative-Thinking Techniques", Ten Speed Press.
2. Michael Michalko," Cracking Creativity: The Secrets of Creative Genius", Ten Speed Press.
3. Edward de Bono, "Lateral Thinking: A Textbook of Creativity", Penguin.
4. Edward de Bono, "Six Thinking Hats", Penguin.

Reference Books:

1. Creative Thinkering: Putting Your Imagination to Work, New World Library; Original edition,
2. The Creative Thinking Handbook: Your Step by Step Guide to Problem Solving in Business, Chris Griffiths, Kogan.

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Open Elective

Class: - **S. Y. M. Tech.**	Semester-**III**
Course Code: **MOE2032**	Course Name: **MOOC Course**

L	T	P	Credits
3	-	-	3

Course Description:

Student can opt for online certification course and produce certificate.

- The students who are doing course on MOOC/NPTEL Course /Courses suggested by DPGC should select the course in consultation with supervisor and submit the details to Head of Program.
- The course should be minimum 8 week or 30 hours' duration and should have certification facility.
- Student should complete course and get certificate. The certificate copy should be submitted to head of program with supervisor signature.

Course Learning Outcomes:

After successful completion of the course, students will be able to,

1. Identify the real applications and practices of courses studied, at industry level
2. Recognize various modelling, analysis and validation techniques adopted at industries.
3. Demonstrate the issues at design, manufacturing and assembly levels.
4. Summarize and present technical data in report format.

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DEPARTMENT OF ELECTRONICS AND TELECOMMUNICATION ENGINEERING

Open Elective

Class: **S. Y. M. Tech**	Semester: **III**
Course Code: **MOE2041**	Course Name: **Energy Audit and Management**

L	T	P	Credits
03	--	--	**03**

Course Description:
This course provides basic understanding of energy audit and management. Essential theoretical and practical knowledge about the concept of energy conservation, energy management, and different approaches of energy conservation in industries, economic aspects of energy conservation project and energy audit and measuring instruments in commercial and industrial sector will be achieved through this course.

Course Learning Outcomes:
After successful completion of the course, students will be able to,
1. Identify the important of Energy Scenario.
2. Use energy audit knowledge to carry out energy audit of a given firm.
3. Examine different rolls in energy action planning
4. Apply project finance and management skills to carry out energy audit
5. Plan for energy monitoring and targeting.

Prerequisite: Electric Machines, Thermal Systems and Finance system

Course Content		
Unit No	**Description**	**Hrs.**
01	**Energy Scenario:** Energy Needs of Growing Economy, Long Term Energy Scenario, Energy Pricing, Energy Sector Reforms, Energy and Environment, Air Pollution, Climate Change, Energy Security, Energy Conservation and its Importance, Energy Strategy for the Future, Energy Conservation Act-2001 and its Features.	**06**
02	**Energy Management and Audit:** Energy audit- need, Types of energy audit, Energy management (audit) approach-understanding energy costs, Bench marking, Energy performance, Matching	**06**

	energy use to requirement, maximizing system efficiencies, Optimizing the input energy requirements, Fuel and energy substitution, Energy audit instruments	
03	**Energy Action Planning:** Key elements, Force field analysis, Energy policy purpose, perspective, Contents, Formulation, Ratification, Organizing –location of energy management, Top management support, Managerial function, Roles and responsibilities of energy manager, Accountability. Motivating-motivation of employees: Information system-designing barriers, Strategies; Marketing and communicating-training and planning.	**06**
04	**Financial Management:** Investment-need, Appraisal and criteria, financial analysis techniques-Simple payback period, Return on investment, Net present value, Internal rate of return, Cash flows, Risk and sensitivity analysis; Financing options, Energy performance contracts and role of ESCOs	**06**
05	**Project Management:** Definition and scope of project, technical design, Financing, Contracting, Implementation and performance monitoring. Implementation plan for top management, Planning Budget, Procurement Procedures, Construction, Measurement & Verification	**06**
06	**Energy Monitoring and Targeting:** Defining monitoring & targeting, Elements of monitoring & targeting, Data and information-analysis, Techniques -energy consumption, Production, Cumulative sum of differences (CUSUM).	**06**

References:

Text Books:

1. Amit Kumar Tyagi, Handbook on Energy Audits and Management, TERI Publication
2. Wayne C. Turner, Energy Management Handbook, Wiley Inter Science Publication

Reference Books:

1. P. O'Callaghan, Energy Management, McGraw - Hill Book Company
2. Bureau of Energy Efficiency Study material for Energy Managers and Auditors Examination: Paper I

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Open Elective

Class: **S. Y. M. Tech.**	Semester: **III**
Course Code: **MOE2062**	Course Name: **Augmented Reality and Virtual Reality**

L	T	P	Credits
03	--	--	**03**

Course Description:
This course presents an introduction to virtual and augmented reality technologies, with an emphasis on designing and developing interactive virtual and augmented reality experiences. The course will cover the history of the area, fundamental theory, and interaction techniques. Students are provided with hands-on experience developing applications for modern virtual and augmented reality systems. In the course, students will also explore libraries and tools for creating AR/VR experiences such as Vuforia and UNITY.

Course Learning Outcomes:
After successful completion of the course, students will be able to:
1. Define the basic concepts of Virtual and Augmented Reality
2. Identify the differences in AR/VR concepts and technologies
3. Describe the fundamental concepts relating to Virtual Reality such as presence, immersion, and engagement
4. Evaluate usability of AR/VR applications and critique their use of AR/VR capabilities
5. Design and prototype effective AR/VR applications using UNITY platform for various application.

Prerequisites: Programming and Data Structures

Course Content		
Unit No	**Description**	**Hrs.**
01	**Introduction to Augmented Reality:** Definition and Scope, Brief History of Augmented Reality, Displays (Multimodal Displays, Spatial Display Model, and Visual Displays), Strong vs Weak, AR Applications AR Challenges in AR.	**06**
02	**Introduction to Virtual Reality:**	**06**

	Definition and Scope, Types of VR Characteristics, Basic VR environments, Limitations of VR environments, Immersion Vs Presence.	
03	**Interaction design for AR/VR environments:** Interaction design process Identifying user needs, AR/VR design considerations Typical AR/VR Interface Metaphors, User experience (UX) guidelines for AR/VR, UX challenges for AR/VR, Prototyping for AR/VR, Evaluation of the developed AR/VR prototype.	**06**
04	**Introduction to UNITY:** Unity Overview: Windows, Interface, Navigation, Terminology, Game Objects, Hierarchy, Parenting Objects, Asset Store, Importing Plug-ins, Creating a Terrain, Materials, Colors, Transparency, Introduction to Mono behaviours: Awake, Start, Update.	**06**
05	**Introduction to Vuforia and Physics in UNITY:** Vuforia Overview: Interface, Navigation, Terminology, Image Targeting, Custom Images, Overview of Physics in Unity, Introduction to Scripting: Terminology, Creating Objects, Accessing Components, Debugging, Lists, Loops.	**06**
06	**Expanding on Scripting and Interaction:** Creating Trigger Events, Manipulating Components in Scripts, Programming Interactions between Objects and Tracked Images in AR, designing a simple User Interface in AR, Introduction to colliders and their use: On Collision Enter, On Collision Exit. On Collision Stay, On Trigger vs On Collision, Rigid bodies and how Colliders report to them.	**06**

References:

Text Books:

1. Vince, "Virtual Reality Systems", Pearson Education.
2. Grigore Burdea, Philippe Coiffet,"Virtual Reality Technology", Wiley.
3. Schmalstieg, D., & Hollerer, T. Augmented reality: principles and practice.Addison-Wesley Professional.

Reference Books:

1. Azuma, R.T. A survey of augmented reality. Presence: Teleoperators & Virtual Environments.
2. Azuma, R., Baillot, Y., Behringer, R., Feiner, S., Julier, S., & MacIntyre, B. Recent advances in augmented reality. IEEE computer graphics and applications.

3. Bhagat, K. K., Liou, W.-K., & Chang, C.-Y.A cost-effective interactive 3D virtual reality system applied to military live firing training. Virtual Reality,.
4. Carmigniani, J., Furht, B., Anisetti, M., Ceravolo, P., Damiani, E., & Ivkovic, M. Augmented reality technologies, systems and applications. Multimedia tools and applications.
5. Raisamo, R., Rakkolainen, I., Majaranta, P., Salminen, K., Rantala, J., & Farooq, A. Human augmentation: Past, present and future. International journal of human-computer studies.
6. Schuemie, M. J., Van Der Straaten, P., Krijn, M., & Van Der Mast, C. A. Research on presence in virtual reality: A survey. Cyber Psychology & Behavior.

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Open Elective

Class: **S. Y. M. Tech**	Semester: **III**
Course Code: **MOE2072**	Course Name: **Industrial Instrumentation**

L	T	P	Credits
03	--	--	**03**

Course Description:
This course is an overview of the principles, concepts, and applications of process transmitters found in an industrial plant. Continuous measurement and control of all the parameters will be emphasized. Also, practical installation and calibration procedures of various types of sensors and transducers will be covered. Open and closed loop control systems will also be discussed, including such concepts as on/off control, set point, overshoot, undershoot, gain, feedback, PID loops, and reverse/direct acting systems.

Course Learning Outcomes:
After successful completion of the course, students will be able to,
1. Elaborate working principal of different transducers.
2. Select suitable transducer/sensor for specific application.
3. Justify the use of specific measurement technique for specific task.
4. Evaluate the Calibration and Interfacing of the transducers.

Prerequisite: Basic knowledge of sensor and measurement

Course Content

Unit No	Description	Hrs
01	**Metrology:** Measurement of length, Gauge blocks, Plainness, Area using Simpson's rule, Plain meter, Diameter, Roughness, Angle using Bevel protractor, sine bars and Clinometer, Mechanical, Electrical, Optical and Pneumatic Comparators. Optical Methods for length and distance measurements using Optical flats and Michelson Interferometer.	06
02	**Velocity and Acceleration Measurement:** Relative velocity, Translational and Rotational velocity measurements, Revolution counters and Timers ,Magnetic and Photoelectric pulse counting	06

	stroboscopic methods. Accelerometers-different types, Gyroscopes-applications.	
03	**Force and Pressure Measurement:** Force measurement, Different methods, Gyroscopic Force Measurement, Vibrating wire Force transducer. Basics of Pressure measurement, Manometer types, Force-Balance and Vibrating Cylinder Transducers, High and Low-Pressure measurement, McLeod Gauge, Knudsen Gauge, Momentum Transfer Gauge, Thermal Conductivity Gauge, Ionization Gauge, Dual Gauge Techniques, Deadweight Gauges, Hydrostatic Pressure Measurement.	06
04	**Flow Measurement and Level Measurement:** Flow Meters- Head type, Area type (Rota meter), electromagnetic type, Positive displacement type, mass flow meter, ultrasonic type, vertex shedding type, Hotwire anemometer type, Laser Doppler Velocity-meter. Basic Level measurements, Direct, Indirect, Pressure, Buoyancy, Weight, Capacitive Probe methods.	06
05	**Density, Viscosity and Other Measurements:** Density measurements, Strain Gauge load cell method, Buoyancy method, Air pressure balance method, Gamma ray method, Vibrating probe method. Units of Viscosity, specific gravity scales used in Petroleum Industries, Different Methods of measuring consistency and Viscosity, two float Vis's orator, Industrial consistency meter. Sound Level Meters, Microphones, Humidity Measurement.	06
06	**Calibration and Interfacing:** Calibration using Master Sensors, Interfacing of Force, Pressure, Velocity, Acceleration, Flow, Density and Viscosity Sensors, Variable Frequency Drive. Open and closed loop control system with on/off control, setpoint, overshoot, undershoot, gain, feedback, PID loops, and reverse/direct acting systems.	06

References:

Text Books:

1. Doeblin E.O., "Measurement Systems – Applications and Design", McGraw Hill International.
2. Patranabis D, "Principles of Industrial Instrumentation", Tata McGraw Hill.

Reference Books:

1. Considine D. M., "Process Instruments and Control Handbook", McGraw Hill International.
2. Jain R.K., "Mechanical and Industrial Measurements", Khanna Publications.

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Open Elective

Class: **S. Y. M. Tech**	Semester: **III**
Course Code: **MOE2082**	Course Name: **Advanced Mechatronics Systems**

L	T	P	Credits
03	**--**	**--**	**03**

Course Description:
The course will be helpful to provide overview of mechanical and electronic systems used in industrial atmosphere. This will be helpful for upcoming automation in industry. Mechatronics is a multidisciplinary field of science that includes a combination of Mechanical Engineering, Electronics, Computer Engineering, Telecommunications Engineering and Control Engineering. Mechatronics is a multi-disciplinary study dealing with the integration of mechanical devices, actuators, sensors, electronics, intelligent controllers and computers. Mechatronics generally involves

(i) implementing electronics control in a mechanical system
(ii) enhancing existing mechanical design with intelligent control and
(iii) replacing mechanical component with an electronic solution.

This course will cover all aspects related with mechatronics such as sensors and transducers, actuators and mechanisms, signal conditioning, microprocessors and microcontrollers, modeling & system response and design of mechatronics systems.

Course Learning Outcomes:
After successful completion of the course, students will be able to,

1. Explain Mechatronics System.
2. Analyze the Mechatronics Based System.
3. Model, simulate, and verify the mechatronics systems.
4. Identify Electrical, Hydraulic and Pneumatic Components.

Prerequisite: Basic knowledge of research related activities.

Course Content		
Unit No.	**Description**	**Hrs.**
01	**Introduction:**	**06**

	What is Mechatronics, Integrated Design Issues in mechatronics, Mechatronics Design Process, Mechatronics Key elements, applications in mechatronics.	
02	**Modelling and Analysis of Mechatronics Systems:** Block Diagram Modelling, Analogy approach, Impedance Diagrams, Electrical Systems, Mechanical systems and electromechanical systems. Mass-Spring-Oscillation and Damping system, Dynamic response of systems, Transfer function and frequency response. Labview, MATLAB, Scilab.	**06**
03	**Sensors and Actuators:** Performance terminology of sensors, Displacement, Position & Proximity Sensors, Displacement, Position sensors, Force, Fluid pressure, Liquid flow sensors, temperature, light sensor, Acceleration and Vibration measurement, Electrical and Mechanical Actuation Systems.	**06**
04	**Signal Conditioning:** Introduction to signal processing, Op-Amp as signal conditioner, Analogue to Digital Converter, Digital to Analogue Converter, Signal processing devices, relays, contactors and timers. Microcontrollers, PID controllers and PLCs.	**06**
05	**Hydraulic system and Pneumatic system:** Flow, pressure and direction control valves, actuators, and supporting elements, hydraulic power packs, and pumps, Pneumatic system components and graphic representations, Advantages and limitations of pneumatic systems.	**06**
06	**Case Study:** List of various mechatronics systems, Case study of pick and place mechanism of robotic arm using pneumatic power, Hydraulic circuit for CNC Lathe machine, 3D Printer, Auto-control system for Green House Temperature and Auto-focusing in Digital Cameras.	**06**

References –

Text Books:

1. Bradley, D. Dawson, N. C. Burd and A.J. Loader, "Mechatronics: Electronics in product and process", Chapman and Hall, London.
2. Devadas Shetty, Richard A. Kolkm, "Mechatronics system design, PWS publishing company.
3. David G. Alciatore, Michael B. Histand, "Introduction to mechatronics and measurement systems" Mc Graw Hill Education.

References Books:

1. Intelligent Mechatronic Systems: Modeling, Control and Diagnosis, R. Merzouki, A. K. Samantaray, P. M. Pathak, B. Ould Bouamama, Springer, London.
2. Technical website: https://onlinecourses.nptel.ac.in/noc21_me27/course

Open Elective

Class: **S. Y. M. Tech**	Semester: **III**
Course Code: **MOE2091**	Course Name: **Disaster Management**

L	T	P	Credits
03	--	--	03

Course Description:
This course provides a holistic understanding of disaster management, covering both natural and manmade disasters. Students will delve into the meaning, nature, and various types of disasters, exploring their effects on individuals, communities, and the environment. The course encompasses a global perspective while focusing on the disaster profile of India, considering regional and seasonal variations

Course Learning Outcomes:
After successful completion of the course, students will be able to,

1. Outline disaster and disaster management cycle.
2. Summarize disaster preparedness and response activities for various types of disaster.
3. Apply various advanced techniques for disaster management.
4. Examine role of various agencies in disaster management.
5. Dissect the disaster management scenario in India.

Prerequisite: Environmental Science

Course Content

Unit No.	Description	Hrs.
01	**Natural Disaster:** Meaning and nature of natural disasters, their types and effects. Floods, Drought, Cyclone, Earthquakes, Landslides, Avalanches, Volcanic, eruptions, Heat and cold Waves, Climatic Change: Global warming, Sea Level rise, Ozone Depletion.	06
02	**Manmade Disasters:** Nuclear disasters, chemical disasters, biological disasters, building fire, coal fire, forest fire. Oil fire, air pollution, water pollution, deforestation, Industrial wastewater pollution, road accidents, rail accidents, air accidents, sea accidents. Disasters -A Global View, Disaster Profile of India- Regional, and Seasonal.	06

03	**Disaster management cycle:** Introduction to Disaster Management Cycle: Mitigation, Preparedness, Response and Recovery. Disaster Mitigation, Hazard identification and vulnerability analysis, Mitigation strategies or measures	**06**
04	**Disaster Preparedness, Response and Recovery:** Introduction to Disaster Preparedness, Disaster Risk Reduction (DRR), The Emergency Operation Plan (EOP). Introduction to Disaster Response, Aims of disaster response, Disaster Response Activities, Modern and traditional responses to disasters, Modern methods of disaster response, Disaster Recovery, The Recovery Plan, Disasters as opportunities for development initiatives.	**06**
05	**Role of technology in Disaster management:** Geographic Information System (GIS) and Disaster Management. GIS applications. Global Positioning System (GPS) and Disaster Management, Applications of GPS to Disaster management. Remote Sensing and its significance in Disaster Management.	**06**
06	**Role of Multiple Stakeholders in Disaster management:** Role of NGO's, Community based organizations, media, Central, State, District and Local Administration, armed forces, Police and other organizations.	**06**

References:

Codes of Practice:

1. National Disaster Management Authority (NDMA). National Disaster Management Plan 2019.
2. National Disaster Management Authority (NDMA). National Disaster Management Act 2005.

Text Books:

1. Coppola, D. P. "Introduction to International Disaster Management", Elsevier USA.
2. Singh R. B., "Disaster Management", Rawat Publication.

Reference Books:

1. Reiter L., "Earthquake Hazard Analysis: Issues and Insight", Colombia University Press.
2. Mileti D. S. "Disaster by Design: A Reassessment of National Hazards in United States", The National Academic Press.

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Class:- **S. Y. M. Tech**	Semester- **III**
Course Code: **EEE2036**	Course Name: **Dissertation Phase-I**

L	T	P	Credits
-	-	12	6

Course Learning Outcomes:
After completion of this course students will be able to:
1. Identify research opportunities in his/her domain or multidisciplinary domains
2. Formulate the problem statement and its objectives correctly
3. Apply the principles of project management during development of the project
4. Present synopsis in logical order
5. Write synopsis of the proposed system

Course Description:

DISSERTATION PHASE-I
It consists of Synopsis Preparation and Synopsis approval by DPGC committee
SYNOPSIS PREPARATION
Postgraduate student should decide on the dissertation topic in consultation with its supervisor and come out with a synopsis of dissertation work, in July/August of an academic year. The Synopsis shall consist of three chapters - Introduction, Literature Review and Methodology with expected deliverables.
It is expected that student should have in-depth understanding of the selected problem, knowledge of probable solutions to the same problem and expected outcomes from the dissertation work. The synopsis shall consist of following points

- Title
- Introduction
- Literature Survey
- Objectives
- Methodology
- Activity chart
- References

The title should be brief, accurate, descriptive, and comprehensive and clearly indicate the subject for the investigation. The introduction part should include

- Area of the work
- Importance of the work

- Literature review should examine the most current studies on the topic and presenting the significant aspects of these studies.
- Compare different authors' views about the issue
- Summarize the literature in terms of a knowledge gap identification e.g. performance improvement of the existing system, functionality improvement of the existing, proposing an entirely new approach, etc.

It should be followed by the Problem statement formulated based on identified gap and objectives of the study. Methodology shall include information such as techniques, sample size, target populations, equipment's, data analysis, etc. and explain why proposed methodology is most suitable to solve the undertaken problem. It should be followed by activity chart mentioning probable duration for completion of various activities to be undertaken during dissertation work and appropriate list of references. The references should be from reputed journals such IEEE, Science direct, Elsevier etc.

SYNOPSIS APPROVAL AND EVALUATION BY DPGC COMMITTEE

The student should submit the synopsis duly signed by supervisor in the prescribed format to the department office. The DPGC committee is advised to conduct the Synopsis Presentation for the students of the program within the stipulated period and give approval to the synopsis with the evaluation score. The committee is advised to find the enough complexity in the dissertation work, and all committee members should remain present at the time of the presentation.

The objective of the presentation is to find quality of work undertaken by the student, student's understanding about basic concepts required to carry out the work, scope of the work, correctness of the methodology, consistency of proposed work with dissertations works of other students and student's ability to communicate his or her ideas and work. The committee can suggest modifications in the synopsis if it does not fulfill above-mentioned requirements. The student should prepare a modified synopsis by incorporating suggestions given by members and give presentation again. The supervisor must ensure that student have incorporated all suggestions.

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Class:- **S. Y. M. Tech.**	Semester- **III**
Course Code: **EEE2056**	Course Name: **Dissertation Phase-II**

L	T	P	Credits
-	-	20	10

Course Learning Outcomes:

After completion of this course students will be able to:

1. Identify research opportunities in his/her domain or multidisciplinary domains.
2. Formulate the problem statement and its objectives correctly
3. Develop, simulate and implement the system by complying with desired technical specifications
4. Analyze and synthesize obtained results in theoretical and practical context
5. Present report in logical order
6. Write report of the system implementation
7. Apply the principles of project management during development of the project

Course Description:

DISSERTATION PHASE-II

After synopsis approval, it is expected that student should start working on the selected problem as per activity chart given in the synopsis. It is expected that at least 40% dissertation work should be completed by a student in this phase.

EVALUATION OF DISSERTATION PHASE-II

Evaluation (ISE) of Dissertation Phase-II shall be carried before the end of the semester-III and shall be jointly evaluated by Supervisor and Internal-examiner appointed by DPGC committee. The student should give presentation / demonstration of the work done. The examiners shall look at student's progress and quality of the work done. The suggestions shall be given to the student, if required. The student should keep a record of these suggestions and incorporate them in his or her work. The supervisor should ensure that suggestions given are incorporated by the student.

The End –semester examination (ESE) of Dissertation Phase-II shall be carried out by Controller-of-Examinations after the end of Semester-III. The student should give presentation and/or demonstration of completed work in front of supervisor and external examiner appointed by COE.

SEMESTER IV

Class: - **S. Y. M. Tech**	Semester- **IV**
Course Code: **EEE2026**	Course Name: **Dissertation Phase-III**

L	T	P	Credits
-	-	16	8

Course Learning Outcomes:

After completion of this course students will be able to:

1. Identify research opportunities in his/her domain or multidisciplinary domains.
2. Formulate the problem statement and its objectives correctly
3. Develop, simulate and implement the system by complying with desired technical specifications
4. Analyze and synthesize obtained results in theoretical and practical context
5. Present report in logical order
6. Write report of the system implementation
7. Apply the principles of project management during development of the project

Course Description:

DISSERTATION PHASE-III

In Dissertation Phase-III, it is expected that student should complete at least 70% of the dissertation work and prepare a draft of the paper for publication.

EVALUATION OF DISSERTATION PHASE-III

The evaluation (ISE) of Dissertation Phase-III shall be carried out in March of the academic year by Supervisor and Internal examiner appointed by DPGC. The appointed members shall look at student's progress and quality of the work done. The suggestions shall be given to the student, if required. The student should keep a record of these suggestions and incorporate them. The supervisor should ensure that suggestions given are incorporated by the student. If student's progress is not as per expectation, the committee member shall issue a written notice to the student about probable extension.

Class: - **S. Y. M. Tech**	Semester- **IV**
Course Code: **EEE2046**	Course Name: **Dissertation Phase-IV**

L	T	P	Credits
-	-	24	12

Course learning outcomes:

After completion of this course students will be able to:

1. Identify research opportunities in his/her domain or multidisciplinary domains.
2. Formulate the problem statement and its objectives correctly
3. Develop, simulate and implement the system by complying with desired technical specifications
4. Analyze and synthesize obtained results in theoretical and practical context
5. Present report in logical order
6. Write report of the system implementation
7. Apply the principles of project management during development of the project

Course Description:

DISSERTATION PHASE-IV

In Dissertation Phase-IV, it is expected that student should complete

- 100% implementation of the proposed system
- Simulation/ experimentation work on the proposed system
- Performance evaluation of the proposed system
- Comparison of the proposed system with existing systems
- Writing of the conclusion
- Preparation of a draft-copy of the dissertation report with Plagiarism report

EVALUATION OF DISSERTATION PHASE-IV

The DPGC committee is advised to evaluate the dissertation pre-submission presentation and/or system demonstration given by the students at the end of semester –IV within the stipulated period and give approval/modifications to the work done by the student along with the evaluation score.

The committee is advised to verify work completion as per the synopsis, and all committee members should remain present for the presentation. The objective of the presentation/ demonstration is to understand techniques implemented by the student, student's own contribution in the development process, obtained results, comparison of results with existing systems, and deliverables of the dissertation work.

The committee can suggest modifications if it does not fulfill above-mentioned requirements in the system/ draft copy of the report. In this case, the student should modify the system in a given time span based on suggestions given by the members and give presentation again in front of committee members.

The members should ensure that student has incorporated all suggestions and gives him/her approval to submit the dissertation work for final evaluation.

FINAL EVALUATION OF DISSERTATION WORK:

The final evaluation of the dissertation work shall be carried out by a three-member committee, comprising of Chairman, External Examiner and concerned supervisor. This committee should be appointed by Controller of Examinations.

The student should give presentation and demonstration of work carried out in front of committee members. The external examiner and supervisor should evaluate student's performance based on following points

1. Justification and clarity of the problem statement and project objectives
2. Use of appropriate, applicable and justifiable methodology to solve problem undertaken
3. Reliability and validity of data collection instruments /resources used, critical data analysis and interpretation
4. Overall system design
5. Experimental Results and their comparison with existing systems
6. Critical analysis of obtained results and their interpretation and correlation with project deliverables
7. Scientific justification of conclusions
8. self-contribution of the candidate in project development irrespective of use of readymade hardware/software
9. Presentation skills

The chairman shall ensure smooth conduct of the examination.