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Department of Electronics and Communication Engineering
Program: B. Tech -ECE
Academic Year: 2023-24

COURSE CODE	COURSE TITLE	CO NO	DESCRIPTION OF COURSE OUTCOME
23EC2228F	Biomedical Electronics & IOT for Healthcare	1	Analyze the human bio-electric and Nonelectrical signal characteristics and understand the functionality of each body parts.
		2	Apply the Knowledge of Medical Instruments in clinical and ambulance to assist
		3	Apply the knowledge of various Bio-sensors for healthcare using Nextgen Internet of Things Technology.
		4	Analyze the various applications of IoMT in real world.
		5	Design the IoT based Health monitoring and Elderly Assist modules.
23EC2236F	Electronic Circuits for Medical Instrumentation	1	Identifying sources of bioelectric phenomena in nerves, muscles and examine the general properties of physiological systems, including nonlinearity and non-stationarity.
		2	Demonstrate amplifiers and find random noise related factors which is to be useful measures of a signal conditioning systems.
		3	Interpret aliasing and the sampling theorem, Analog-to-digital and digital-to-analog converters.
		4	Illustrate several circuits and systems applied in medical instrumentation.
		5	Experimental design, simulate and analyze bio signal characteristics using MATLAB/Multisim/COMSOL.
22BMI3101R	Biomedical Signal and Image Processing	1	Demonstrate the basic concepts related to Biomedical signals and images.
		2	Classify the Bio medical signal processing methods to eliminate the artefacts arise in biomedical signals.
		3	Explain the Biomedical imaging and enhancement techniques.
		4	Apply advanced signal processing approaches for biomedical signals and images.
		5	Analyze and implement appropriate signal/Image processing algorithms for practical problems involving biomedical signals and systems Using MATLAB.

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		6	Case Study of the Bio medical Audio signal Analysis and Biomedical Image Analysis.
22BMI3202	Advanced Biomedical Signal and Image Processing	1	Summarize the basic concepts of digital signal processing techniques and identify the nature of Biomedical signals.
		2	Apply the Filtering Techniques.
		3	Analyze the various Techniques for Detection of Events and Biosignals.
		4	Analyze several circuits and systems for the application in medical instrumentation.
22BMI3303 R	Materials for Bio-Medical Applications	1	Summarize the characteristics of biomaterials.
		2	Apply surface modification for biomedical applications.
		3	Apply Biocompatibility Testing and Response of Biomaterial to Human Body.
		4	Analyse Bio-implants & Surgical Aids for biomedical applications.
		5	Design and evaluate a solution based on nanomaterial technology for a given need in the field of healthcare and biomedical Engineering using COMSOL/OFDTD.
		6	Evaluating and identify suitable biomaterials for biosensors
22BMI3404	Nanotechnology and Nanosensors	1	Summarize the basic concepts of Nanosensors
		2	Interpret the fabrication, characterization of nanosensors
		3	Apply nanomaterials to manipulate nanosensors
		4	Apply quantum dots in Sensing and Imaging Application.
22BMI3505	Biosensing and Bioelectronics	1	Summarize the working principles of biosensors
		2	Interpret characterization of optical and electrochemical sensors
		3	Apply the response of biosensors
		4	Analyse selective biomedical devices for future applications
		5	Design and interfacing of Biological Systems with electronic systems, non-conventional bioelectronic devices using SPICE/OFDTD/COMSOL
23EC2210R	Network Protocols and Security	1	Apply the knowledge of communication to understand the concepts of physical layer and datalink layer.
		2	Analyse various MAC protocols and apply IP addressing concepts to subnet a network.
		3	Analyse static and dynamic routing algorithms and transport layer protocols.
		4	Analyse application layer protocols and various

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			cryptographic algorithms
		5	Analyse the functionality of the network using different protocols and working of various cryptographic algorithms.
23EC2210A	Network Protocols and Security	1	Apply the knowledge of communication to understand the concepts of physical layer and datalink layer.
		2	Analyze various MAC protocols and apply IP addressing concepts to subnet a network.
		3	Analyze static and dynamic routing algorithms and transport layer protocols.
		4	Analyze application layer protocols and various cryptographic algorithms.
		5	Analyze various link layer protocols and advanced security concepts.
		6	Analyze the functionality of the network using different protocols and working of various cryptographic algorithms.
23EC2210P	Network Protocols and Security	1	Apply the knowledge of communication to understand the concepts of physical layer and datalink layer.
		2	Analyze various MAC protocols and apply IP addressing concepts to subnet a network.
		3	Analyze static and dynamic routing algorithms and transport layer protocols.
		4	Analyze application layer protocols and various cryptographic algorithms.
		5	Analyze various link layer protocols and advanced security concepts.
		6	Analyze the functionality of the network using different protocols and working of various cryptographic algorithms.
23EC2235F	Resilient Networks	1	Interpret the basics of network threats and attacks
		2	Interpret network security Protocols and technologies such as SSL, TLS and IP Security Architecture
		3	Interpret Network defense using Access control, Password management, Incident response, security awareness
		4	Analyze different Secure network architectures and Hardening
		5	Analyze the network security functions by configuring networks with the given requirements
23EC2239F	Wireless LANS	1	Apply the knowledge of networks to WLANs and 802.11 WLANs and IP Networking
		2	Radio transmission capacity, Throughout, Interpret Bandwidth, efficiency, Forword error

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			correction
		3	Interpret WLAN switches and MAC Protocols
		4	Analyse IEEE8020.11 protocols and frame structure.
		5	Simulate and verify the connectivity of Access controller (AC) and Access points (AP) using eNSP simulator
23CC3101R	TCP/IP & Other Protocol Suites	1	Apply the knowledge of networks understand the Architectural Evolution of TCP/IP, standards, Comparisons between OSI/ISO & TCP/IP Protocol Suite, different Addressing systems, ATM ARP and their analysis
		2	Analyse DHCP Theory and Operation, DHCP Architecture, DHCP Auto-Configuration: Network Address Translation
		3	Analyse Domain Name system
		4	Analyse ICMPv4/v6, IGMP, MLD, UDP, IP Fragmentation, IP Sec, EAP
		5	Analyse and deployment different protocols suites using Cisco packet tracer
23CC3101A	TCP/IP & Other Protocol Suites	1	Apply the knowledge of networks understand the Architectural Evolution of TCP/IP, standards, Comparisons between OSI/ISO & TCP/IP Protocol Suite, different Addressing systems, ATM ARP and their analysis
		2	Analyze DHCP Theory and Operation, DHCP Architecture, DHCP Auto-Configuration: Network Address Translation
		3	Analyze Domain Name system
		4	Analyze ICMPv4/v6, IGMP, MLD, UDP, IP Fragmentation, IP Sec, EAP
		5	Analyze and deployment different protocols suites using Cisco packet tracer
		6	Simulate and analyze different protocols suites using Cisco packet tracer
		7	Simulate and analyze the advanced features of protocol suites
23CC3102	Cloud Computing and Networks Security	1	Apply the concepts of Cloud computing in Networking
		2	Able to analyse different Topologies and Architecture standards
		3	Apply security concepts in could computing
		4	Analysis of various Network Security issues
		5	Inspect the privacy and security, architecture, design in Edge computing

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23CC3203R	VoIP Systems & Broadband Networks – VoIP	1	Apply the basic concepts of Classical Telephony, IP Networking and SS7 signaling
		2	Analyze different VoIP Architectures and Protocols
		3	Analyze Broadband Wireless, Access Technologies, Passive Optical Networks and Fiber-to-the-Home in real time scenario
		4	Analyze Broadband Optical NWs and Multimedia Network-Connection
		5	Analysis of VoIP Protocols using Cisco packet tracer
23CC3203A	VoIP Systems & Broadband Networks – VoIP	1	Apply the basic concepts of Classical Telephony, IP Networking and SS7 signaling
		2	Analyze different VoIP Architectures and Protocols
		3	Analyze Broadband Wireless, Access Technologies, Passive Optical Networks and Fiber-to-the-Home in real time scenario
		4	Analyze Broadband Optical NWs and Multimedia Network-Connection
		5	Analyze the signaling and calling procedures for VoIP protocol and apply the advanced boradband access technologies in real time scenario
		6	Analysis of VoIP Protocols using cisco packet tracer
		7	Analysis of VoIP Protocols using Wireshark
23CC3404	5G Mobile and IEEE standards – 5GMS	1	Apply the concept of 5G & RF Front-End, advancement over LTE Beyond 4G, building Blocks of 5G, 5G Architecture, 5G for IoT Apps in modern communication issues.
		2	Apply the principles of advanced waveforms and air interfaces, 5G Waveforms, Channels, Milli-meter wave technology, 5G Radio Access Technologies.
		3	Apply 5G Evaluation & Applications: MTC, D2D Communication, Multi-hop D2D, multi-carrier D2D
		4	Appy IEEE802Std: 802.11 (WiFi), 802.15.1 (Bluetooth), 802.15.4 (Zigbee), 802.16 (WiMax), 4G/5G
		5	Implementation of call procedures used in 5G networks in 5G lab.
23CC3205	IP Multimedia Subsystems and Emerging Technologies -- IMS	1	Interpret Next-Gen NWs, IMS Standards, Models, IMS Architectures and IMS Core NW
		2	Interpret IMS Protocol Stacks & IMS Operation: H248, MEGACO, RTP, RTCP, IMS to IMS Call/Flow Operation

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		3	Interpret IMS-PSTN, IMS Services: Comparison of GSM, IMS, PSTN, Web-Msg, Voice Video, VoLTE, RCS
		4	Inspect Emerging Tech. of IMS & Appn: Cloud, IoT Applications, NFV, SDN, PDAS, DSL, Cable-Set-Top Box
		5	Inspect the knowledge of IP Multimedia Subsystems and Emerging Technologies to solve real world problems
OEEC0001	Wireless Ad-hoc Networks	1	Apply the knowledge of Communication networks and wireless technologies to realize Wireless Adhoc Networks
		2	Apply the concepts of different routing protocols in real scenarios.
		3	Analyze the concepts of MAC, transport layer and security protocols.
		4	Analyze the concepts of wireless sensor network and implementation of hardware architecture.
22SDEC04	Design of Networks using NS-3	1	Analyze and simulate Simple Topology Creation, TCP/IP Performance Analysis, Routing Protocols Evaluation, Traffic Modelling, Quality of Service (QoS) Analysis, Using NS-3
		2	Analyze and simulate Congestion Control Algorithms, Network Security Analysis, Network Protocol Development, Wireless Network Simulation, Peer-to-Peer (P2P) Networks, MPLS, IoT, SDN Using NS-3
		3	Analyze and simulate Wireless Network Simulation, Peer-to-Peer (P2P) Networks, MPLS, IoT, SDN Using NS-3
22CCF3506	IT Security: Défense against digital dark arts	1	Interpret the basics of network threats and attacks in Security monitoring and incident response
		2	Analyse cryptography algorithms and HMAC & CMAC: SHA -1 Algorithm.
		3	Analyse different Network authentication Protocols
		4	Analyse Network security Protocols and technologies
		5	Analyse the network security protocols and cryptography algorithms
22EC2238	Peer-To-Peer Networks	1	Demonstrate the client - server networks and their dynamics
		2	Apply and practice the unstructured networks and their applications
		3	Apply the random walk techniques for peer-to-peer networks
		4	Analyze the structured networks and their

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			applications
		5	Analyze the different peer to peer networks
23EC2103	Signals & Communication Systems	1	Understand the basic Continuous Time Signals and Systems
		2	Solve the frequency domain challenges and applications to systems.
		3	Interpret the principles of linear and angle modulation and demodulation techniques.
		4	Analyze the analog transmitters and receivers in the presence of noise
22EC2103A	Signals & Communication Systems	1	Understand the basic Continuous Time Signals and Systems
		2	Solve the frequency domain challenges and applications to systems.
		3	Interpret the principles of linear and angle modulation and demodulation techniques.
		4	Analyze the analog transmitters and receivers in the presence of noise
		5	Analyze real time accepts of time and frequency domain systems
		6	Analyze the signal conditioning and communication systems
23EC2208	DIGITAL COMMUNICATIONS	1	Understand the pulse modulation techniques.
		2	Interpret the transmission through band limited signals.
		3	Analyze the Digital Transmission via Carrier Modulation
		4	Analyze the Spread Spectrum Modulation
		5	Analyze the nonlinear equilizers and modulation BER errors due to channel.
		6	Analyze digital modulation techniques using simulation tools
23EC2208A	DIGITAL COMMUNICATIONS	1	Understand the pulse modulation techniques.
		2	Interpret the transmission through band limited signals.
		3	Analyze the Digital Transmission via Carrier Modulation
		4	Analyze the Spread Spectrum Modulation
		5	Analyze the nonlinear equilizers and modulation BER errors due to channel.
		6	Analyze digital modulation techniques using simulation tools
		7	Analyze the advanced digital schemes using SDR hardware via GNU Radio.
23EC2208P	DIGITAL COMMUNICATIONS	1	Understand the pulse modulation techniques.
		2	Interpret the transmission through band limited

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			signals.
		3	Analyze the Digital Transmission via Carrier Modulation
		4	Analyze the Spread Spectrum Modulation
		5	Analyze the nonlinear equilizers and modulation BER errors due to channel.
		6	Analyze digital modulation techniques using simulation tools
		7	Analyze the advanced digital schemes using SDR hardware via GNU Radio.
23EC2020	Wireless Communication	1	Understand working of cellular mobile communication and methods to imrove channel capacity and reduce interference
		2	Explore and study different fading mechanisms in mobile communication
		3	Apply the concepts of equalization and diversity techniques to mitigate fading in wireless channels
		4	Interpret the concepts of Wireless Architecture and Standards
		6	Analyze Spectrum bands of wireless technologies, verification of different types of fading and study various communication protocols
23EC3021	Radio Wave Propagation	1	Explore different frequency bands used in wireless communication and study Propagation Mechanisms.
		2	Analyze Mobile Radio channel characterization with focus on signal variations.
		3	Interpret tropospheric effects and ionospheric effects on radio wave propogations
		4	Analyze wave Propagations in Underwater by analyzing acoustic waves.
		6	Analyze various Spectrum bands of wireless communication and study different types of fading with various communication protocols
23EC4051	4G Wireless Technologies and Cellular Communication	1	Interpret the Spreading Sequences and Multiuser systems and systems for packet evolution
		2	Demonstrate the Multi carrier modulations using OFDM
		3	Extrapolate the MIMO systems and its eigenmode channels
		4	Analyse the Ultra-Wide Band technologies and challenges
		5	Determine the multicarrier systems and multi antenna systems

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		6	Analyse LTE and OFDM transmission in deep radio
		7	Determine the LTE frames using in spectrum and learning deep ratio techniques
23EC4051A	4G Wireless Technologies and Cellular Communication	1	Interpret the Spreading Sequences and Multiuser systems and systems for packet evolution
		2	Demonstrate the Multi carrier modulations using OFDM
		3	Extrapolate the MIMO systems and its eigenmode channels
		4	Analyse the Ultra-Wide Band technologies and challenges
		5	Determine the multicarrier systems and multi antenna systems
		6	Analyse LTE and OFDM transmission in deep radio
		7	Determine the LTE frames using inspectrum and learning deep ratio techniques
23EC4052	Modern Satellite Communication Systems	1	Interpret the concepts of satellite orbits, orbital mechanics and frequency allocations to enable Earth space communications.
		2	Interpret the subsystems that enable control of orbit and attitude in satellites.
		3	Analyze the atmospheric impairments and mitigation techniques to enable earth-space communication.
		4	Analyze satellites application in enabling the 5G ecosystem.
		5	
		6	Analyze the mission requirements and simulate complex ground, sea, air, and space platform analyses in an integrated environment.
		7	
23EC4053	5G Wireless Technologies	1	Interpreting the 5G's architectural framework, quality of service, security, and call flow process as per 3GPP standards, and unlock the potential of its use cases, deployment, and operational scenarios.
		2	Interpret the Multi-RAT Dual Connectivity (MR-DC) architecture from the UE and RAN perspectives, MR-DC bearers and strategies for managing secondary RAN node mobility and key 5G protocols for effective communication and security in mobile networks.
		3	Apply channel sounding, transport channel processing, and physical layer control signalling to design a radio-interface architecture that enables

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			wireless connectivity.
		4	Analyze Multi-Antenna Transmission and Beam Management scenarios for enabling channel capacity for high throughput communications.
		5	Analyze the QoS requirements for enabling real time communications and private networks.
		6	Analyze the 5G architecture and call process with 3GPP standards using 5G mobile network.
		7	Design and Analyze the QoS requirements with respective use-case scenario to enable information exchange between devices with hardware reealization.
23EC4053A	5G Wireless Technologies	1	Interpreting the 5G's architectural framework, quality of service, security, and call flow process as per 3GPP standards, and unlock the potential of its use cases, deployment, and operational scenarios.
		2	Interpret the Multi-RAT Dual Connectivity (MR-DC) architecture from the UE and RAN perspectives, MR-DC bearers and strategies for managing secondary RAN node mobility and key 5G protocols for effective communication and security in mobile networks.
		3	Apply channel sounding, transport channel processing, and physical layer control signalling to design a radio-interface architecture that enables wireless connectivity.
		4	Analyze Multi-Antenna Transmission and Beam Management scenarios for enabling channel capacity for high throughput communications.
		5	Analyze the QoS requirements for enabling real time communications and private networks.
		6	Analyze the 5G architecture and call process with 3GPP standards using 5G mobile network.
		7	Design and Analyze the QoS requirements with respective use-case scenario to enable information exchange between devices with hardware reealization.
23EC4054	Optical Wireless communications	1	Interpret the behavior of wireless optical channel and its scattering parameters.
		2	Apply various channel models for estimation of losses in optical wireless communication.
		3	Analyze and interception of modulation techniques utilized in VLC.
		4	Analyze the application of optical source detectors

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		5	Analyze the free space optical communications techniques.
23EC4054A	Optical Wireless communications	1	Interpret the behavior of wireless optical channel and its scattering parameters.
		2	Apply various channel models for estimation of losses in optical wireless communication.
		3	Analyze and interception of modulation techniques utilized in VLC.
		4	Analyze the application of optical source detectors
		5	Analyze the free space optical communications techniques.
23EC4055	Machine Learning for Wireless Communications	1	Assess mobile network coverage and optimize capacity using machine and deep learning algorithms.
		2	Analyze techniques to optimize energy efficiency in mobile networks and automate them using Machine Learning.
		3	Analyze the Adaptive Modulation and Coding techniques in a mobile network using Machine Learning to optimize capacity and coverage.
		4	Analyze channel equalizers for enhancing efficiency in a mobile network using deep learning algorithms.
		6	Analyze mobile network optimization techniques using Machine Learning and Deep Learning algorithms.
		7	Evaluate the Machine Learning and Deep Learning algorithms for 5G and 6G mobile networks optimization
23EC3051	Advanced Embedded Systems	1	Understand the concept of embedded systems and multicore System on chip.
		2	Identify the various communication interfaces and protocols for efficient embedded system and the interconnection networks.
		3	Development of Software Tools and Debugging Techniques
		4	Apply the concept of multicore SoC in building real time applications
		5	Analyse the programming of microcontroller and interface various peripheral devices to the microcontroller
		6	Analyse the simulation of microcontroller using simulation tools like Keil and Proteus
23EC3052	Embedded Systems for IoT	1	Able to Understand the requirements of functional blocks and the functioning of IoT devices

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		2	Able to understand and apply the Communication models that are used for the development of the IoT based Systems
		3	Able to understand and apply different networking topologies and protocols used for the development of IoT based Networks
		4	Able to Understand and apply IoT Application in different Case studies
		5	Analyze the programming & interfacing of NODE MCU using the hardware/software tool
23EC3053	Real-time Embedded systems	1	Apply the different task-scheduling algorithms for real-time systems application
		2	Apply Multiprocessor scheduling and real-time communication, databases, and synchronization in Real-time System
		3	Able to analyse an RTOS and be able to interpret the feasibility of a task set to accomplish and Timers.
		4	Analyze to develop model-driven development approaches to construct an execution environment with case studies.
		5	Analyze a performance of real-time application and different task scheduling algorithms in real-time systems
		6	Analyze to develop a real-time application and different task-scheduling algorithms in real-time systems
23EC3054	Cloud and Edge Computing	1	Able to understand the need for new computing paradigms and apply the major components of Cloud architectures.
		2	Able to Identify potential technical challenges of the transition process and suggest solutions.
		3	Able to Build data collection, analytics, and decision-making capabilities into these Cloud and Edge compute systems, Analyze data and application requirements and pertaining issues.
		4	Able to Design and model infrastructures and analytics into Cloud and Edge Computing to perform decision-making.
		5	Design Cloud and Edge compute systems to provide multi-level intelligence for IoT, transducers and other devices, using the Open Fog Reference Architecture.
FC-1	Embedded System Design	1	Able to apply the principal concept of embedded systems and the architecture of embedded system design.

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		2	Able to apply the role of controller, timer, and interfaces for embedded system design
		3	Able to design and analyse the various communication interface and protocols for efficient embedded systems.
		4	Able to analyse an embedded system considering the trade-off between designing functionality in hardware versus software.
		5	Able to apply and analyse the Embedded system design knowledge using the architecture and programming and Performance analysis for modular implementation for a complete system.
22CPS3506	Wireless sensor Networks	1	Able to Understand the various theoretical concepts related to wireless sensors and networking of the sensors
		2	Apply WSNs Architectures, Energy consumption of Sensor nodes for the development of the IoT based Systems
		3	Apply different MAC protocols, Routing mechanism used for the development of WSNs Application
		4	Apply node and network management related concepts for real time application of WSNs
		5	Analyse the programming & interfacing of WSNs using the hardware/software tool
23MT2007	Random Variables and Stochastic Process	1	Apply Mathematical models of random phenomena and solve probabilistic problems.
		2	Analyze different types of random variables and compute statistical parameters of the random variables.
		3	Apply random processes in the time domain and model time varying linear systems.
		4	Analyze random processes in frequency domains and model spectral characteristics of LTI systems.
23EC2224F	Deep Network Architectures	1	Apply CNN and asses various metrics for realistic applications
		2	Apply various deep learning techniques for training and testing of data sets
		3	Apply various network architectures for the analysis of data
		4	Apply deep and recurrent neural networks with various case studies.
22IMP3101 R	Natural Language Processing and Applications	1	Apply the fundamental concepts in NLP and review different NLP applications.
		2	Apply the basic structure of NLP Pipelines for text-based applications.

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		3	Analyze the performance of algorithms for semantics in NLP and prioritize them for the existing applications.
		4	Apply machine learning models for finding solutions for problems in NLP and judge their performance.
		5	Evaluate and Analyze the operations applied in NLP pipelines through Python code development using NLTK, SpaCY, and Tensorflow Frameworks.
22IMP3506	Quantum computing	1	Understand the Foundation
		2	Interpret Qubits and Quantum Model of Computation
		3	Presenting Quantum Algorithms – I
		4	Explain Quantum Algorithms – II
		5	Analyse quantum computing lab using matlab/Python
22IMP3404	Data visualization	1	Understand Data science, data collection, and data pre-processing
		2	Applying descriptive statistical sampling techniques to explore various real world data sets
		3	Build data wrangling models with data science libraries like NumPy and Pandas
		4	Applying various data visualization tools to explore the data
		5	Analyse data streams using visualisation techniques
22IMP3202	Data Engineering	1	Describe the fundamental concepts of DE and review different DE tools and applications.
		2	Illustrate and summarize the basic structure of data Pipelines.
		3	Analyze the performance of algorithms for building a 311 data pipeline and prioritize them for the existing applications.
		4	Apply Data pipelines for deployment in production using Apache Sparak and PySpark and judge their performance.
		5	Implement Data processing algorithms and Information retrieval techniques on standard database systems concepts using python.
22IMP3303 R	Bio Medical Signal and Image Analysis	1	Understand the Basic concepts related to Biomedical signals and images
		2	Understand the Bio medical signal processing methods to eliminate the artefacts arise in biomedical signals
		3	Understand the Biomedical imaging and enhancement techniques

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Code	Course	No.	Outcome
		4	Apply signal processing approaches for biomedical signals and images
		5	Apply biomedical signal and image processing techniques
		6	Analyse advanced signal processing approaches through matalb
		7	Analyze biomedical signals using recurrent deep learning networks and time-frequency analysis.
OEEC0011	Image Processing	1	Understand the fundamental concepts of a digital image processing system and transformation techniques
		2	Understand image enhancement techniques in spatial and frequency domains.
		3	Apply image restoration and compression techniques
		4	Apply image segmentation, representations, and description
OEEC0017	Machine Learning for Engineering and Scientific applications	1	Understand machine learning concepts
		2	Apply machine learning techniques to engineering problems
		3	Explore real-world engineering and scientific applications
		4	Evaluate and interpret machine learning results
23EC2223R	Fundamentals of Robotics	1	Apply the functional elements to build simple robot
		2	Apply Denavit -Hattenberg parameters to position the manipulators
		3	Apply the differential motion through Jacobian to control the manipulator
		4	Analyze the force control techniques using Lagrange dynamic model
		5	Analyze the movement of manipulator with the required kinematics.
23EC2231F	Electronics Instruments & Automation	1	To understand the characteristics of Electronics instruments and their Measurements and use them to compute measurements.
		2	Explore the fundamental design concepts of Electronic Measuring Instruments and discover their usage in real time environment.
		3	Applying the importance of Control Systems in Automation to construct a robotic system with desired response.
		4	To analyze the industrial automation-based applications and summarize their advantages in sustainable development.
		5	Synthesize various electronic instruments and control systems for automation.

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23RAN3304R	Advanced Robotics	1	Apply the control techniques for path planning.
		2	Apply the basics of DH parameters for developing the models of Advanced Robotic Manipulator.
		3	Apply the functional and critical operational Robotics methods for preparing advanced level of Robotics.
		4	Analyze the concepts of Advanced Robotics Systems and Real-time environment for various applications.
		5	Analyze the fetch and frieght robots with various coordinate frames and joint angles
		6	Analyze the kinematics and dynamics requirements using VREP robotic simulation tool
23RAN3304A	Advanced Robotics	1	Apply the control techniques for path planning.
		2	Apply the basics of DH parameters for developing the models of Advanced Robotic Manipulator.
		3	Apply the functional and critical operational Robotics methods for preparing advanced level of Robotics.
		4	Analyze the concepts of Advanced Robotics Systems and Real-time environment for various applications.
		5	Analyze the fetch and frieght robots with various coordinate frames and joint angles
		6	Analyze the kinematics and dynamics requirements using VREP robotic simulation tool
		7	Analyze the construction and various parameters of a robot using the Studica Robotic System kit
23RAN3304P	Advanced Robotics	1	Apply the control techniques for path planning.
		2	Apply the basics of DH parameters for developing the models of Advanced Robotic Manipulator.
		3	Apply the functional and critical operational Robotics methods for preparing advanced level of Robotics.
		4	Analyze the concepts of Advanced Robotics Systems and Real-time environment for various applications.
		5	Analyze the fetch and frieght robots with various coordinate frames and joint angles
		6	Analyze the kinematics and dynamics requirements using VREP robotic simulation tool
		7	Analyze the construction and various parameters of a robot using the Studica Robotic System kit
23RAN3202	Autonomous Vehicles & Automotive Electronics	1	Apply the functional elements of robotics to build simple robot.
		2	Apply Denavit -Hattenberg parameters to position

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			the manipulators
		3	Apply the differential motion through Jacobian to control the manipulator
		4	Analyse the force control techniques using Lagrange dynamic model
23RAN3102R	AUTONOMOUS MOBILE ROBOT SYSTEMS	1	Apply the basic mechanical and electrical systems concerning robots' locomotion and manipulation.
		2	Apply the mathematical models and computational and motion control methods to mobile robotic systems.
		3	Apply the sensor systems related to state measurements, navigation and localization.
		4	Analyse the A-star, Dijkstra algorithm for planning the required path.
		5	Analyse the path planning for the multiple robots
		6	Analyze different aspects of stability for a given robot model and apply the mathematical model for the desired movements
23RAN3102A	AUTONOMOUS MOBILE ROBOT SYSTEMS	1	Apply the basic mechanical and electrical systems concerning robots' locomotion and manipulation.
		2	Apply the mathematical models and computational and motion control methods to mobile robotic systems.
		3	Apply the sensor systems related to state measurements, navigation, and localization.
		4	Analyse the A-star, Dijkstra algorithm for planning the required path.
		5	Analyse the path planning for the multiple robots
		6	Analyze different aspects of stability for a given robot model and apply the mathematical model for the desired movements
		7	Develop a proper mapping and path planning algorithm for the locomotion of a given robot.
23RAN3102P	AUTONOMOUS MOBILE ROBOT SYSTEMS	1	Apply the basic mechanical and electrical systems concerning robots' locomotion and manipulation.
		2	Apply the mathematical models and computational and motion control methods to mobile robotic systems.
		3	Apply the sensor systems related to state measurements, navigation, and localization.
		4	Analyse the A-star, Dijkstra algorithm for planning the required path.
		5	Analyse the path planning for the multiple robots
		6	Analyze different aspects of stability for a given robot model and apply the mathematical model for the desired movements

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		7	Develop a proper mapping and path planning algorithm for the locomotion of a given robot.
23RAN3406	Human Machine Interface & Brain Machine Interface	1	Apply Norman's model to HMI
		2	Apply different GOMS models, Fitts Laws for improving the Human Machine Interaction
		3	Apply the concepts of Brainwaves for Bain Machine Interface
		4	Analyze different methodologies for HMI/BMI Applications
23RAN3507	Computer Vision &Robotics Applications	1	Apply the fundamental concepts of signal processing to computer vision
		2	Apply different methodologies of feature extraction, pattern analysis and visual geometric modelling to stochastic optimization problems
		3	Apply various Boundary and Edge Detection techniques in 3D signal (Video).
		4	Analyze the classifiers in different applications such as Biometrics, Medical diagnosis, document processing, mining of visual content, surveillance, and advanced rendering.
		5	Analyse the histogram and texture of image and Classification Model LDA in Python / MATLAB for Computer Vision applications
23RAN3101R	Robot Motion Planning, Dynamics& Control	1	Understand the basic principles of robot trajectory planning
		2	Apply motion of robot in the presence of obstacles
		3	Analyze motion planning and robot control
		4	Perform basic motion, force, and hybrid motion-force control to mobile robotics.
		5	Perform lab experiments using Robo studio and Move it studio for motion planning.
		6	Perform skill experiments using Move it studio for motion planning.
23RAN3101A	Robot Motion Planning, Dynamics& Control	1	Understand the basic principles of robot trajectory planning
		2	Apply motion of robot in the presence of obstacles
		3	Analyze motion planning and robot control
		4	Perform basic motion, force, and hybrid motion-force control to mobile robotics.
		5	Perform lab experiments using Robo studio and Movelt studio for motion planning.
		6	Perform skill experiments using Moveit studiofor motion planning.
		7	Develop algorithms for a predefined motion curve to be achieved by a robot.
23RAN310	Robot Motion Planning,	1	Understand the basic principles of robot trajectory

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1P	Dynamics& Control		planning
		2	Apply motion of robot in the presence of obstacles
		3	Analyze motion planning and robot control
		4	Perform basic motion, force, and hybrid motion-force control to mobile robotics.
		5	Perform lab experiments using Robo studio and Movelt studio for motion planning.
		6	Perform skill experiments using Moveit studiofor motion planning.
		7	Develop algorithms for a predefined motion curve to be achieved by a robot.
23RAN3203	Robot Manipulation & Wheeled Mobile Robots	1	Understand the various contacts elements required for robot's manipulator
		2	Apply the concept of forces/ friction to find out the performance of the manipulator
		3	Apply the basic concepts used to check the performance of mobile robots
		4	Apply the concept of feedback control and odometry for Mobile robots
22RAN3405	Artificial Intelligence for Robotics	1	Understand the concepts of AI
		2	Apply basic principles of AI in solutions that require problem- solving
		3	Apply basic principles of AI in solutions that require planning
		4	Analyze AI in Robotics
23RA51A4	Swarm Robotics Control Systems	1	ApplytheprinciplesandvariousSwamRoboticsControlSystemsfordirection study
		2	Apply multi-agent systems, parallel, scalable, stable for different types of tasks
		3	Apply concepts of Swam Robotics Control Systems and Creating Advanced behavior module.
		4	Apply the Cooperative algorithms, earlier progress of swarm robotics algorithms, Features of swarm robotics algorithm for navigate and control swarm movements efficiently
23EC1202	Digital Design & Computer Architecture	1	Build the combinational and programmable digital logic circuits using logic gates and optimization methods
		2	Construct the sequential and memory circuits using flip-flops
		3	Organize computer architecture and instructions sequence
		4	Model the Memory Architecture and I/O Organization modules
		5	Develop and analyze of computer architecture modules using basic combinational, sequential and

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			memory logics
23EC1203	Basic Electrical & Electronic Circuits	1	Understand the basic concepts of circuits and its fundamentals
		2	Grasp the principles of AC circuits, including sinusoidal waveforms, impedance, and power factor.
		3	Comprehend the behavior of basic electronic components, such as diodes, and transistors.
		4	Understand the basic functional Principles of analog and digital ICs.
23EC2104R	Analog Electronic Circuit Design	1	Apply the knowledge of Semiconductor physics and discuss BJT configurations and their applications
		2	Apply the limitations of BJT and discuss the characteristics and applications of Field Effect Transistors
		3	Apply the linear and nonlinear circuits approaches and realize the characteristics of operational Amplifiers
		4	Apply the concept of a feedback system and realize the working principles of Oscillators and multivibrators
		5	Design and analyze analog circuits for real-time applications using Passive and Active Components.
		6	Simulate and analyze electronic circuits using Multisim and myDAQ.
23EC2104A /P	Analog Electronic Circuit Design	1	Apply the knowledge of Semiconductor physics and discuss BJT configurations and their applications
		2	Apply the limitations of BJT and discuss the characteristics and applications of Field Effect Transistors
		3	Apply the linear and nonlinear circuits approaches and realize the characteristics of operational Amplifiers
		4	Apply the concept of a feedback system and realize the working principles of Oscillators and multivibrators
		5	Design and analyze analog circuits for real-time applications using Passive and Active Components.
		6	Simulate and analyze electronic circuits using Multisim and myDAQ.
23EC2211R	VLSI Design	1	Realize MOS device with transient and DC characteristics

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		2	Understand the characteristics of CMOS inverter
		3	Analyze the static and dynamic characteristics of CMOS circuits
		4	Evaluate the performance of CMOS circuits
		5	Design and implement the combinational and sequential circuits using Cadence VLSI Design Full Suite
		6	Design and analysis of VLSI circuits for real time applications.
23EC2211A /P	VLSI Design	1	Realize MOS device with transient and DC characteristics
		2	Understand the characteristics of CMOS inverter
		3	Analyze the static and dynamic characteristics of CMOS circuits
		4	Evaluate the performance of CMOS circuits
		5	Design and implement the combinational and sequential circuits using Cadence VLSI Design Full Suite
		6	Design and analysis of VLSI circuits for real time applications.
23EL3001R	Digital VLSI Design	1	Realize Digital CMOS device with different methodologies
		2	Understand the various CAD Tool design synthesis and functional simulation processes
		3	Design various combinational and sequential digital circuits using Verilog HDL.
		4	Design and modeling of various CMOS digital circuits.
		5	Design, implement, and analyze the combinational and sequential circuits using Xilinx Vivado Full Suite

Academic Professor I/C   **HOD-ECE**