KKR & KSR
INSTITUTE OF TECHNOLOGY AND SCIENCES
(AUTONOMOUS)

Accredited by NBA & NAAC with Grade "A" and Affiliated to JNTUK-Kakinada
Vinjanampadu, Vatticherukuru Mandal, Guntur, Andhra Pradesh 522017

MASTER OF TECHNOLOGY (M. Tech)

INTERNET OF THINGS (IoT)

COURSE STRUCTURE

R-20 REGULATION
(CHOICE BASED CREDIT SYSTEM)

(Applicable from the batches admitted in AY: 2020-2021)

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

COURSE STRUCTURE AND SYLLABUS

SEMESTER-I

S. No.	Course Code	Course Title	L	T	P	C	IM	EM	TM
THEORY									
1	20IO1T01	Principles of Sensors and Signal Conditioning	3	0	-	3	25	75	100
2	20IO1T02	Internet of things (IoT) Reference Architecture	3	0	-	3	25	75	100
3	20IO1EYY	**Elective – I**	3	0	-	3	25	75	100
4	20IO1EYY	**Elective-II**	3	0	-	3	25	75	100
5	20GR1M01	Research Methodology & IPR	2	0	-	2	25	75	100
6	20GS1A02	**Audit Course -1** Disaster Management	2	0	-	-	---	---	---
PRACTICAL									
7	20IO1L01	IoT Laboratory I	0	0	4	2	25	75	100
8	20IO1L02	Sensors and Devices Lab	0	0	4	2	25	75	100
						Total Credits	**18**	**175**	**525**	**700**

SEMESTER-II

S. No.	Course Code	Course Title	L	T	P	C	IM	EM	TM
THEORY									
1	20IO2T01	Wireless Sensor Networks and IoT	3	0	3	3	25	75	100
2	20IO2T02	Microcontrollers for IoT Prototyping	3	0	3	3	25	75	100
3	20IO2EYY	**Elective-III**	3	0	3	3	25	75	100
4	20IO2EYY	**Elective-IV**	3	0	3	3	25	75	100
5	20IO2P01	Mini Project with Seminar	2	0	2	2	100	--	100
6	20GS2A01	**Audit Course -2** English for Research Paper Writing	2	0	-	-	---	---	---
PRACTICAL									
6	20IO2L01	IoT Laboratory II	0	0	4	2	25	75	100
7	20IO2L02	Advanced Networking Lab using NS3	0	0	4	2	25	75	100
						Total Credits	**18**	**250**	**450**	**700**

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

COURSE STRUCTURE AND SYLLABUS

SEMESTER-III

S. No.	Course Code	Course Title	L	T	P	C	IM	EM	TM
1	20IO3EYY	**Elective-V**	3	0	0	3	25	75	100
2	20IO3OYY	**Open Elective**	3	0	0	3	25	75	100
3	20IO3P01	Project Work-I	-	0	0	12	100	--	100
					Total Credits	**18**	**150**	**150**	**300**

SEMESTER-IV

S. No.	Course Code	Course Title	L	T	P	C	IM	EM	TM
1	20IO4P01	Project Work-II	0	0	0	14	100	100	200
					Total Credits	**14**	**100**	**100**	**200**

Elective-I		**Elective-II**	
20IO1E01	Designing of IoT Applications	20IO1E04	Flexible and Wearable Sensor
20IO1E02	Measurements and Sensing Systems	20IO1E05	IoT Security and Trust
20IO1E03	Embedded IoT	20IO1E06	Mobile application Development

Elective-III		**Elective-IV**	
20IO2E01	Deep Learning-An approach to artificial Intelligence	20IO2E04	Energy harvesting technologies and power management for IoT Devices
20IO2E02	Fiber Optic sensors and photonics	20IO2E05	Smart grid technologies &IoT
20IO2E03	Automotive sensors & in vehicle Networking	20IO2E06	Big data Analysis for IoT

Elective-V		**Open Elective**	
20IO3E01	Beyond IoT – Ubiquitous sensing and Wireless Sensor Networks	20IO3O01	Real time opearating system & Embedded System
20IO3E02	Python for IoT	20IO3O02	Wireless sensor protocols and programming
20IO3E03	Communication technologies for IoT	20IO3O03	Micro electro mechanical systems

Audit Course 1 & 2		
S. No	**Subject Code**	**Subject**
1	20GSXA01	English for Research Paper Writing
2	20GSXA02	Disaster Management
3	20GSXA03	Sanskrit for Technical Knowledge
4	20GSXA04	Value Education
5	20GSXA05	Constitution of India
6	20GSXA06	Pedagogy Studies
7	20GSXA07	Stress Management by yoga
8	20GSXA08	Personality Development Through Life Enlightenment Skills

IO- Internet of Things

GR-General Research

GS-General Studies

T-Theory; L-Lab; M-Mandatory; A-Audit Course; E-Elective course; X-Semester; YY-Serial number of courses

Programme: M.Tech IoT Semester: I					
Course Code	Course Name	L	T	P	C
20IO1T01	Principles of Sensors and Signal Conditioning	3	0	0	3

COURSE OUTCOMES:

After successful completion of this course, students should be able to

CO1 : Use concepts in common methods for converting a physical parameter into an electrical quantity
.

CO2 : Evaluate performance characteristics of different types of sensors

CO3 : Locate different types of sensors used in real life applications and paraphrase their importance

CO4 : Create analytical design and development solutions for sensors

CO5 : Compete in the design, construction, and execution of systems for measuring physical quantities

SYLLABUS

UNIT-I : Sensor fundamentals, Optical Sources and Detectors

Sensor Classification, Performance and Types, Error Analysis characteristics
Electronic and Optical properties of semiconductor as sensors, LED, Semiconductor lasers, Fiber optic sensors, Thermal detectors, Photo multipliers, photoconductive detectors, Photo diodes, Avalanche photodiodes, CCDs.

UNIT-II : Strain, Force, Torque and Pressure sensors

Strain gages, strain gage beam force sensor, piezoelectric force sensor, load cell, torque sensor, Piezo-resistive and capacitive pressure sensor, optoelectronic pressure sensors, vacuum sensors. Design of signal conditioning circuits for strain gauges, piezo, capacitance and optoelectronics sensors

UNIT-III : Position, Direction, Displacement and Level sensors

Potentiometric and capacitive sensors, Inductive and magnetic sensor, LVDT, RVDT, eddy current, transverse inductive, Hall effect, magneto resistive, magneto strictive sensors. Fiber optic liquid level sensing, Fabry Perot sensor, ultrasonic sensor, capacitive liquid level sensor. Signal condition circuits for reactive and self-generating sensors.

UNIT-IV : Velocity and Acceleration sensors

Electromagnetic velocity sensor, Doppler with sound, light, Accelerometer characteristics, capacitive, piezo-resistive, piezoelectric accelerometer, thermal accelerometer, rotor, monolithic and optical gyroscopes.

UNIT-V : Flow, Temperature and Acoustic sensors

Flow sensors: pressure gradient technique, thermal transport, ultrasonic, electromagnetic and Laser anemometer. Micro flow sensor, coriolis mass flow and drag flow sensor. Temperature sensors-thermo resistive, thermoelectric, semiconductor and optical. Piezoelectric temperature sensor. Acoustic sensors- microphones-resistive, capacitive, piezoelectric, fiber optic, solid state -electrect microphone.

TEXT BOOKS:

1. Jacob Fraden, "Hand Book of Modern Sensors: physics, Designs and Applications", 2015, 3rd edition, Springer, New York.
2. Jon. S. Wilson, "Sensor Technology Hand Book", 2011, 1st edition, Elsevier, Netherland.

REFERENCE BOOKS:

1. GerdKeiser,"Optical Fiber Communications", 2017, 5th edition, McGraw-Hill Science, Delhi.
2. John G Webster, "Measurement, Instrumentation and sensor Handbook", 2017, 2nd edition, CRC Press, Florida.
3. Eric Udd and W.B. Spillman, "Fiber optic sensors: An introduction for engineers and scientists", 2013, 2nd edition, Wiley, New Jersey.
4. Bahaa E. A. Saleh and Malvin Carl Teich, "Fundamentals of photonics", 2012, 1st edition, John Wiley, New York.

Programme: M.Tech IoT Semester: I					
Course Code	Course Name	L	T	P	C
20IO1T02	Internet of things (IoT) Reference Architecture	3	0	0	3

COURSE OUTCOMES:

After successful completion of this course, students should be able to

CO1 : Understand the fundamental concepts of IoT reference architecture .

CO2 : Evaluate the various communication technique for various topologies

CO3 : Understand the various protocols of IoT

CO4 : Create the Iot frameworks and understand the privacy in IoT networks

CO5 : Analyze the various applications of Iot platform

SYLLABUS

UNIT-I : IoT Overview

Introduction to Internet of Things (IoT) - Sense, Communicate, Analyze and ACT, IOT Reference architecture - Sensors, Devices, Controllers, Connectivity, Data processing, Identity and Access, Data management and Analytics, Applications, Data privacy and security, standardization and regulatory limitations. Technology and business drivers, Trends and implications

UNIT-II : Sense and Communication

Fundamentals of Data Acquisition and digitilization, Analog and digital data acquisition, Sampling, Time avergaing, Static and dynamic characteristics, placement of sensors, Calibration and types of calibrations ,Fundamentals of communication, Signal Types and its characteristics, Data Transmission Types, Communication Techniques, Data Transmission Modes, Network Topologies and its applications, Communication packets - Header, Footer, Record Length, Integrity check (Checksum, CRC)

UNIT-III : IoT communication technologies and Protocols:

Internet and Web layering, Introduction to wired and wireless communicaton technologies for IoT, Edge connectivity and IoT protocols - MQTT, MQTT-SN, Constrained Application Protocol (CoAP), STOMP, AMQP, Comparison of protocols, Wireless sensor networks

UNIT-IV : IoT Reliability, Security, Privacy and Governance

Robustness and Reliability: Characteristics and reliability issues, addressing reliability Security and Privacy: Concepts, security overview, frameworks and privacy in IoT networks IoT Governance Models and Issues

UNIT-V : IoT Platform and Applications

Thingworx IoT Platform - Architecture overview, Connecting various sources, Modeling the System, Building Analytical Logics, Notifications and Interactions Case Studies**:** Air Quality Monitoring, Smart Farming, Smart Parking and Smart Home

TEXT BOOKS:

1. Internet of Things: Principles and Paradigms – Rajkumar Buyya, Amir Vahid Dastjerdi
2. Internet of Things for Architects: Architecting IoT solutions – Perry Lea

REFERENCE BOOKS:

1.Internet of Thing and Data Analytics Handbook – Hwaiyu Geng
2.Internet-of-Things (IoT) Systems: Architectures, Algorithms, Methodologies - Dimitrios Serpanos, Marilyn Wolf
3.Internet of Things Reference Architecture – White paper – Cisco.

Programme: M.Tech IoT Semester: I					
Course Code	Course Name	L	T	P	C
20IO1E01	Designing of IoT Applications	3	0	0	3

COURSE OUTCOMES:

After successful completion of this course, students should be able to

At the end of this course students will be able to

CO1. Explain concepts of IoT and Web technology.

CO2. Familiarize to the architecture features of M2M to IoT.

CO3. Illustrate architecture of IoT.

CO4. Classify various application areas of IoT.

CO5. Examine Privacy and Security constraints of IoT based applications.

SYLLABUS

UNIT I: IoT& Web Technology

The Internet of Things Today, Time for Convergence, Towards the IoT Universe, Internet of Things Vision, IoT Strategic Research and Innovation Directions, IoT Applications, Future Internet Technologies, Infrastructure, Networks and Communication, Processes, Data Management, Security, Privacy & Trust, Device Level Energy Issues, IoT Related Standardization.

UNIT II: IoT Architecture

State of the Art – Introduction, State of the art, Architecture Reference Model Introduction, Reference Model and architecture, IoT reference Model, IoT Reference Architecture-Introduction, Functional View, Information View, Deployment and Operational View.

UNIT III: M2M to IoT

A Basic Perspective– Introduction, Some Definitions, M2M Value Chains, IoT Value Chains, An emerging industrial structure for IoT, The international driven global value chain and global information monopolies. M2M to IoT-An Architectural Overview– Building an architecture, Main design principles and needed capabilities, An IoT architecture outline, standards considerations.

UNIT IV: IoT Applications: for Value Creations Introduction, IoT applications for industry

Future Factory Concepts, Brownfield IoT, Smart Objects, Smart Applications, Four Aspects in your Business to Master IoT, Value Creation from Big Data and Serialization, IoT for Retailing Industry, IoT For Oil and Gas Industry, Opinions onIoT Application and Value for Industry, Home Management, eHealth.

UNIT V: Internet of Things Privacy, Security and Governance

Introduction, Overview of Governance, Privacy and Security Issues, Contribution from FP7 Projects, Security, Privacy and Trust in IoT-Data-Platforms for Smart Cities, First Steps Towards a Secure Platform, Smartie Approach. Data Aggregation for the IoT in Smart Cities,Security.

Text Books :

1. Cuno Pfister, “Getting Started with the Internet of Things”, OReilly Media, 2011.

2. Pethuru Raj and Anupama C. Raman “The Internet of Things: Enabling Technologies, Platforms, and Use Cases, CRC Press, 2017.

Reference Books:

1. Arshdeep Bahga and Vijay Madisetti, “Internet of Things: A Hands-on Approach”, Universities Press, 2013.

2. Francis DaCosta, “Rethinking the Internet of Things: A Scalable Approach to Connecting Everything”, 1st Edition, Apress Publications, 2013.

Programme: M.Tech IoT Semester: I					
Course Code	Course Name	L	T	P	C

20IO1E02	Measurements and Sensing Systems	3	0	0	3

COURSE OUTCOMES:

After successful completion of this course, students should be able to

CO1. Acquire the knowledge on types of sensors
CO2. Sensors working principles, selection procedure, applications of sensing systems
CO3. Select a sensor/sensing systems for a requirement
CO4. Able to test, install and collect the data from a group of sensors.
CO5. Able to derive sensor based solution for different applications.

UNIT I – Introduction to Measurement: Measurement units, applications, elements, choosing appropriate measuring instruments. **Instrument Types and Performance Characteristics:** Review of instrument types, Static characteristics, dynamic characteristics, necessity for calibration.

UNIT II - Errors During the Measurement process: Sources of systematic error, reduction and quantification of systematic errors, random errors, aggregation of measurement system errors. **Calibration:** Principles of calibration, control of calibration environment, calibration chain, traceability and records.

UNIT III - Temperature Sensors: Thermoresistive, Resistance Temperature Detectors, Silicon Resistive, Thermistors, Semiconductor, Optical, Acoustic, Piezoelectric **Humidity and Moisture Sensors:** Capacitive, Electrical Conductivity, Thermal Conductivity, Optical Hygrometer, Time Domain Reflectometer. **Pressure and Force Sensors:** Mercury Pressure, Bellows, Membranes, and Thin Plates, Piezoresistive, Capacitive, Optoelectronic, Vacuum, Strain Gauges, Tactile, Piezoelectric Force **Force, Strain, and Tactile Sensors :** Strain Gauges , Tactile Sensors , Piezoelectric Force Sensors **Applications:** Case studies in processing industries, indoor environment monitoring in offices, cold storages

UNIT IV - Occupancy and Motion Detectors: Ultrasonic, Microwave Motion, Capacitive Occupancy, Visible and Near-Infrared Light, Far-Infrared Motion, PIR Motion, Position, Displacement, and Level Sensors: Potentiometric, Gravitational , Capacitive , Inductive and Magnetic, Optical, Ultrasonic, Radar **Position, Displacement, and Level Sensors:** Potentiometric, Gravitational , Capacitive , Inductive and Magnetic, Optical, Ultrasonic, Radar. **Velocity and Acceleration Sensors:** Capacitive Accelerometers, Piezoresistive Accelerometers, Piezoelectric Accelerometers, Thermal Accelerometers, Heated-Plate Accelerometer, Heated-Gas Accelerometer, Gyroscopes , Piezoelectric Cables **Gas Sensors:** Carbon Dioxide, Carbon Monoxide, NOX, SOX, PM2.5, PM10, Volatile Organic Compounds **Applications:** Case studies in manufacturing industries, robotics

UNIT V - Flow Sensors: Pressure Gradient Technique, Thermal Transport, Ultrasonic, Electromagnetic, and Micro flow, Coriolis Mass Flow **Acoustic Sensors:** Resistive Microphones, Fiber-Optic, Piezoelectric, Solid-State microphone Light & Radiation Sensors: Photodiodes, Phototransistor, Photo resistors, Thermal detectors Chemical Sensors: Metal-Oxide Chemical , ChemFET, Electrochemical , Potentiometric , Conduct metric , Amperometric , Optical Chemical , Mass Detector **Applications:** Case studies in processing industries, oil and gas industries, water SCADA, pharmaceutical industries

TEXT BOOKS:
1. Measurement and Instrumentation Principles - Morris, Alan S
2. Sensor Technology Handbook, John S. Wilson

REFERENCE BOOKS:
1. Measurement of systems - Application and design - Earnest O. Doeblin
2. An Introduction to Error Analysis by John R. Taylor

Programme: M.Tech IoT Semester: I					
Course Code	Course Name	L	T	P	C

20IO1E03	Embedded IoT	3	0	0	3

COURSE OUTCOMES:

After successful completion of this course, students should be able to

CO1. Design and develop embedded programs for low power microcontrollers for sensor applications.

CO2. Develop ARM basic and advanced programs.

CO3. Interface and deploy analog and digital sensors

CO4. Develop communication system with sensor units

CO5. Program the single board computers to read sensor data and posting in cloud.

UNIT I – FUNDAMENTALS AND APPLICATIONS OF IoT

Introduction to Internet of Things (IoT)– Functional Characteristics – Recent Trends in the Adoption of IoT – Societal Benefits of IoT, Health Care — Machine to Machine (M2M) - Smart Transportation – Smart Living – Smart Cities- Smart Grid

UNIT II – IoT ARCHITECTURE
Functional Requirements - Components of IoT: Sensors – Actuators – Embedded Computation Units – Communication Interfaces – Software Development

UNIT III –COMMUNICATION PRINCIPLES
RFID – ZigBEE – Bluetooth – Internet Communication- IP Addresses - MAC Addresses - TCP and UDP – IEEE 802 Family of Protocols – Cellular-Introduction to EtherCAT.

UNIT IV–COMMUNICATION INTERFACE IN IoT
IEEE 802.11 Wireless Networks Attacks: Basic Types, WEP Key Recovery Attacks, Keystream Recovery Attacks against WEP – RFID Security – Security Issues in ZigBEE: Eavesdropping Attacks, Encryption Attacks – Bluetooth Security: Threats to Bluetooth Devices and Networks.

UNIT V –CLOUD SECURITYCONCEPTS
Confidentiality, privacy, integrity, authentication, non-repudiation, availability, access control, defence in depth, least privilege, how these concepts apply in the cloud, what these concepts mean and their importance in PAAS, IAAS and SAAS. e.g. User authentication in the cloud; Cryptographic Systems- Symmetric cryptography, stream ciphers, block ciphers, modes of operation, public-key cryptography, hashing, digital signatures, public-key infrastructures, key management, X.509 certificates, OpenSSL.

TEXT BOOKS:
1.Adrian McEwen and Hakim Cassimally, ―Designing the Internet of Things‖, John Wiley and Sons Ltd, UK, 2014.

2. Olivier Hersent, David Boswarthick and Omar Elloumi, ―The Internet of Things: Key Applications and Protocols‖, John Wiley and Sons Ltd., UK 2012.
3. Dieter Uckelmann, Mark Harrison, Florian Michahelles, ―Architecting the Internet of Things, Springer, New York, 2011.
4. Johnny Cache, Joshua Wright and Vincent Liu, ―Hacking Exposed Wireless: Wireless Security Secrets and Solutions‖, Tata McGraw Hill, New Delhi, 2010

REFERENCE BOOKS:

1.Himanshu Dwivedi, Chris Clark and David Thiel, ―Mobile Application Security‖, Tata McGraw Hill, New Delhi, 2010.

Programme: M.Tech IoT Semester: I					
Course Code	Course Name	L	T	P	C
20IO1E04	FLEXIBLE AND WEARABLE SENSORS	3	0	0	3

COURSE OUTCOMES:

After successful completion of this course, students should be able to

CO1 : Realize the technology developments in the flexible electronics technology

CO2 : Ability to identify the suitable materials and its processing for the development of thin film electronics

CO3 : Ability to design the pattern and develop with suitable patterning methods,

CO4 : Realize the process involved in the transformation of electronics from foils to textiles, Acquire the design knowledge for developing wearable sensors for physical and chemical parameters

CO5 : Gain the competency in transferring the conducting and semiconducting fibers to smart textiles

SYLLABUS

UNIT-I : Overview of flexible electronics technology

History of flexible electronics - Materials for flexible electronics: degrees of flexiblility, substrates, backplane electronics, front plane technologies, encapsulation - Fabrication technology for flexible electronics - Fabrication on sheets by batch processing, fabrication on web by Roll-toRoll processing - Additive printing.

UNIT-II : Amorphous and nano-crystalline silicon materials and Thin film transistors

Fundamental issues for low temperature processing - low temperature amorphous and nanocrystalline silicon - characteristics of low temperature dielectric thin film deposition - low temperature silicon nitride and silicon oxide characteristics - Device structures and materials processing - Device performance - Contacts for the device - Device stability.

UNIT-III Materials and Novel patterning methods for flexible electronics

Materials considerations for flexible electronics: Overview, Inorganics semiconductors and dielectrics, organic semiconductors and dielectrics, conductors - Print processing options for device fabrication: Overview, control of feature sizes of jet printed liquids, jet printing for etch mask patterning, methods for minimizing feature size, printing active materials

Flexible electronics from foils to textiles Introduction -Thin film transistors: Materials and Technologies - Review of semiconductors employed in flexible electronics - Thin film transistors based on IGZO - Plastic electronics for smart textiles - Improvements and limitations.

UNIT-IV : Wearable haptics

World of wearables - Attributes of wearables - Textiles and clothing: The meta wearable - Challenges and opportunities - Future of wearables - Need for wearable haptic devices - Categories of wearable haptic and tactile display.

Wearable Bio, Chemical and Inertial sensors

Introduction-Systems design - Challenges in chemical and biochemical sensing - Application areas -Wearable inertial sensors - obtained parameters from inertial sensors - Applications for wearable motion sensors.

UNIT-V Knitted electronic textiles

From fibers to textile sensors - Interlaced network -Textile sensors for physiological state monitoring - Biomechanical sensing - Noninvasive sweat monitoring by textile sensors and other applications. FBG sensor in Intelligent Clothing and Biomechanics

TEXT BOOKS:

1.Michael J. McGrath, Cliodhna Ni Scanaill, Dawn Nafus, “Sensor Technologies: Healthcare, Wellness and Environmental Applications”, 201, 1st Edition , Apress Media LLC, New York.

2. William S. Wong, Alberto Salleo, Flexible Electronics: Materials and Applications, 2011, 1st Edition, Springer, New York.

REFERENCE BOOKS:

1.Edward Sazonov, Michael R. Newman, “Wearable Sensors: Fundamentals, Implementation and Applications”, 2014, 1st Edition, Academic Press, Cambridge.

2.Kate Hartman, “Make: Wearable Electronics: Design, prototype, and wear your own interactive garments”, 2014, 1st Edition, Marker Media, Netherlands.

3.Guozhen Shen, Zhiyong Fan, “Flexible Electronics: From Materials to Devices”, 2015, 1st Edition, World Scientific Publishing Co, Singapore.

Programme: M.Tech IoT Semester: I					
Course Code	Course Name	L	T	P	C
20IO1E05	IoT Security and Trust	3	0	0	3

COURSE OUTCOMES:

After successful completion of this course, students should be able to

CO1 : Design and implement cryptography algorithms using C programs. Solve network security problems in various networks

CO2 : Build security systems using elementary blocks

CO3 : Build Trustable cloud based IoT systems

CO4 : Solve IoT security problems using light weight cryptography

CO5 : Appreciate the need for cyber security laws and methods

SYLLABUS

UNIT-I : Fundamentals of encryption for cyber security.

Cryptography – Need and the Mathematical basics- History of cryptography, symmetric ciphers, block ciphers, DES – AES. Public-key cryptography: RSA, Diffie-Hellman Algorithm,Elliptic Curve Cryptosystems, Algebraic structure, Triple Data Encryption Algorithm (TDEA) Block cipher. IOT security frame work, Security in hardware, Bootprocess, OS & Kernel, application, run time environment and containers. Need and methods of Edge Security, Network Security: Internet, Intranet, LAN, Wireless Networks, Wireless cellular networks, Cellular Networks and VOIP.

UNIT-II : Position, Direction, Displacement and Level sensors

Potentiometric and capacitive sensors, Inductive and magnetic sensor, LVDT, RVDT, eddy current, transverse inductive, Hall effect, magneto resistive, magnetostrictive sensors. Fiber optic liquid level sensing, Fabry Perot sensor, ultrasonic sensor, capacitive liquid level sensor. Signal condition circuits for reactive and self generating sensors.

UNIT-III Identity Management and Trust Establishment

Trust management lifecycle, Identity and Trust, Web of trust models. Establishment: Cryptosystems – Mutual establishment phases – Comparison on security analysis. Identity management framework

UNIT-IV : Access Control in IoT and light weight cryptography

Capability-based access control schemes, Concepts, identity-based and identity-driven, Light weight cryptography, need and methods , IoT use cases, **Security and Digital Identity in Cloud Computing,** Cloud security , Digital identity management in cloud, Classical solutions, alternative solutions, Management of privacy and personal data in Cloud.

UNIT-V Cyber crimes

Cyber Crimes, Hackers and Forensics**,**Cyber Crimes and Laws – Hackers – Dealing with the rise tide of Cyber Crimes – Cyber Forensics and incident Response – Network Forensics

TEXT BOOKS:

1.John R. Vacca, "Computer and Information Security Handbook", Elsevier, 2013. Parikshit Narendra Mahalle , Poonam N. Railkar, "Identity Management for Internet of Things", River Publishers, 2015.

2.William Stallings, "Cryptography and Network security: Principles and Practice", 5th Edition, 2014, Pearson Education, India.

3.Jon. S. Wilson, "Sensor Technology Hand Book", 2011, 1st edition, Elsevier, Netherland.

REFERENCE BOOKS:

1.Christof Paar and Jan Pelzl, "Understanding Cryptography – A Textbook for Students and Practitioners", Springer, 2014

2.Behrouz A.Forouzan : Cryptography & Network Security – The McGraw Hill Company, 2007.

3.Charlie Kaufman, Radia Perlman, Mike Speciner, Network Security: "Private Communication in a public World", PTR Prentice Hall, Second Edition, 2002.

4.Alasdair Gilchrist, "IoT security Issues", Oreilly publications, 2017.

Programme: M.Tech IoT Semester: I					
Course Code	Course Name	L	T	P	C
20IO1E06	Mobile Application Development	3	0	0	3

COURSE OUTCOMES:

After successful completion of this course, students should be able to

CO1	:	Introduce mobile communication and enabling technologies
CO2	:	Explore the Android Software Development Platform
CO3	:	Impart the knowledge to log the sensor data and to perform further data analytics
CO4	:	Realize the process Displaying Pictures.
CO5	:	Fundamental Concepts in Windows Phone Development

SYLLABUS

UNIT-I Android Architecture

Android Architecture Overview and Creating an Example Android Application**:** The Android Software Stack, The Linux Kernel, Android Runtime - Dalvik Virtual Machine, Android Runtime – Core Libraries, Dalvik VM Specific Libraries, Java Interoperability Libraries, Android Libraries, Application Framework, Creating a New Android Project.

UNIT-II Android Software Development Platform

Understanding Java SE and the Dalvik Virtual Machine , The Directory Structure of an Android Project , Common Default Resources Folders , The Values Folder , Leveraging Android XML, Screen Sizes , Launching Your Application: The AndroidManifest.xml File ,Creating Your First Android Application. Android Framework Overview, Android Application Components, Android Activities: Defining the UI, Android Services:

UNIT-III Designing for Android Devices

Designing for Different Android Devices, Views and View Groups, Android Layout Managers, The View Hierarchy, Designing an Android User Interface using the Graphical Layout Tool **,** Graphical User Interface Screen with views**,** Displaying Text with TextView, Retrieving Data from Users, Using Buttons, Check Boxes and Radio Groups, Getting Dates and Times from Users, Using Indicators to Display Data to Users, Adjusting Progress with SeekBar, Working with Menus using views

UNIT-IV : Image analysis

Gallery, ImageSwitcher, GridView, and ImageView views to display images, Creating Animation, Files, Content Providers, and Databases Saving and Loading Files, SQLite Databases, Android Database Design, Exposing Access to a Data Source through a Content Provider, Content Provider Registration, Native Content Providers

UNIT-V Fundamental Concepts in Windows Phone Development

Understanding the Role of XAP Files, the Windows Phone Capabilities Model, the Threading Model for XAML-Based Graphics and Animation in Windows Phone, Understanding the Frame Rate Counter, The Windows Phone Application Analysis Tool, Reading Device Information, Applying the Model-View-ViewModel Pattern to a Windows Phone App, Property Change Notification, Using Commands

TEXT BOOKS:

1. William S. Wong, Alberto Salleo, Flexible Electronics: Materials and Applications, 2011, 1st Edition, Springer, New York.

REFERENCE BOOKS:

1.Edward Sazonov, Michael R. Newman, “Wearable Sensors: Fundamentals, Implementation and Applications”, 2014, 1st Edition, Academic Press, Cambridge.
2.Kate Hartman, “Make: Wearable Electronics: Design, prototype, and wear your own interactive garments”, 2014, 1st Edition, Marker Media, Netherlands.

Programme: M.Tech IoT Semester: II					
Course Code	Course Name	L	T	P	C
20GR1M01	Research Methodology & IPR	2	0	0	2

COURSE OUTCOMES:

After successful completion of this course, students should be able to

CO1 : Understand the research problems and find the scope of the solution
.

CO2 : Analyzing the research proposals based on the problem identification

CO3 : Understand the process and development of the Nature of Intellectual Property

CO4 : Understand the scope of the patent rights.

CO5 : Understand the Administration of Patent System for new developments in IPR

SYLLABUS

UNIT-I : Research Problem And Scope For Solution

Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations

UNIT-II : Format

Effective literature studies approaches, analysis, Plagiarism, Research ethics. Effective technical writing, how to write report, Paper Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee

UNIT-III : Process And Development

Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, patenting under PCT.

UNIT-IV : Patent Rights

Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications.

UNIT-V : New Developments In IPR

New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs.

TEXT BOOKS:

1.Stuart Melville and Wayne Goddard, "Research methodology: an introduction for science & engineering students"
2.Wayne Goddard and Stuart Melville, "Research Methodology: An Introduction"
3.Ranjit Kumar, 2nd Edition, "Research Methodology: A Step by Step Guide for beginners"

REFERENCE BOOKS:

1. Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd ,2007.
2. Mayall, "Industrial Design", McGraw Hill, 1992.
3. Niebel, "Product Design", McGraw Hill, 1974.
4. Asimov, "Introduction to Design", Prentice Hall, 1962.
5. Robert P. Merges, Peter S. Menell, Mark A. Lemley, " Intellectual Property in New Technological Age", 2016.
6. T. Ramappa, "Intellectual Property Rights Under WTO", S. Chand, 2008

Programme: M.Tech IoT Semester: II					
Course Code	Course Name	L	T	P	C
20GS1A02	Disaster Management	2	0	0	0

COURSE OUTCOMES:

After successful completion of this course, students should be able to

CO1 : Understand the basic factors and significance of the disaster management .

CO2 : Analyzing the various Repercussions Of Disasters And Hazards

CO3 : Understand about various disaster prone areas in india

CO4 : Monitoring Of Phenomena Triggering A Disaster Or Hazard.

CO5 : Understand the Risk assessment and disaster mitigation in india

SYLLABUS

UNIT-I : Introduction

Disaster: Definition, Factors And Significance; Difference Between Hazard And Disaster; Natural And Manmade Disasters: Difference, Nature, Types And Magnitude.

UNIT-II : Repercussions Of Disasters And Hazards

Human And Animal Life, Destruction Of Ecosystem. Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts And Famines, Landslides And Avalanches, Man- made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks And Spills, Outbreaks Of Disease And Epidemics, War And Conflicts.

UNIT-III : Disaster Prone Areas In India

Study Of Seismic Zones; Areas Prone To Floods And Droughts, Landslides And Avalanches; Areas Prone To Cyclonic And Coastal Hazards With Special Reference To Tsunami; Post-Disaster Diseases And Epidemics

UNIT-IV : Disaster Preparedness And Management

Preparedness: Monitoring Of Phenomena Triggering A Disaster Or Hazard; Evaluation Of Risk: Application Of Remote Sensing, Data From Meteorological And Other Agencies, Media Reports: Governmental And Community Preparedness.

UNIT-V : Risk Assessment & Disaster Mitigation

Disaster Risk: Concept and Elements, Disaster Risk Reduction, Global And National Disaster Risk Situation. Techniques Of Risk Assessment, Global Co-Operation In Risk Assessment And Warning, People's Participation In Risk Assessment. Strategies for Survival. Meaning, Concept And

Strategies Of Disaster Mitigation, Emerging Trends In Mitigation. Structural Mitigation And Non-Structural Mitigation, Programs Of Disaster Mitigation In India.

TEXT BOOKS:

1.R. Nishith, Singh AK, "Disaster Management in India: Perspectives, issues and strategies "'New Royal book Company.
2.Sahni, PardeepEt.Al. (Eds.)," Disaster Mitigation Experiences And Reflections", Prentice Hall Of India, New Delhi.
3.Goel S. L. , Disaster Administration And Management Text And Case Studies" ,Deep &Deep Publication Pvt. Ltd., New Delhi.

Programme: M.Tech IoT Semester: I					
Course Code	Course Name	L	T	P	C
20IO1L01	IoT Laboratory-I	0	0	4	2

COURSE OUTCOMES:

After successful completion of this course, students should be able to

CO1. Understand various interfacing module with IoT architecture.

CO2. Interface various sensor devices with Raspberry Pi using Python Programming.

CO3. Implement a gateway service references with IoT toolkit

List of Experiments:

1.Node MCU/ESP 32 - Temperature Sensor Interfacing (LM35) - Bluetooth Interfacing (HC05)-Motor driver Interfacing (L298) -LCD Interfacing (HD44780)

2.IMPLEMENTATION OF IoT using BLYNK/CAYENNE - –Installation and Activation - Blinking an LED -Reading Analog Voltage - LCD Interfacing (HD44780) –Project

3. IMPLEMENTATION OF IoT using Google Assistant – Arest server - Creating own server – Project

4. IMPLEMENTATION OF IoT using Raspberry Pi & Python Programming: - LCD Interfacing (HD44780) - Motor driver Interfacing (L298) – Camera interface

5. API Gateway service reference implementation in IoT Toolkit.

6. Experiment on application framework and embedded software agents for IoT Toolkit.

Programme: M.Tech IoT Semester: I					
Course Code	Course Name	L	T	P	C
20IO1L02	Sensors and Devices lab	0	0	4	2

COURSE OUTCOMES:

After successful completion of this course, students should be able to

CO1. Understand IoT sensors and technological challenges faced by IoT devices, with a focus on wireless, energy, power, and sensing modules

CO2. Understanding of IoT value chain structure (device, data cloud), application areas and technologies involved.

CO3. Explore and learn about Internet of Things with the help of preparing projects designed for Raspberry Pi

List of Experiments:

1. Connect an LED to GPIO pin 25 and control it through command line.
2. Connect an LED to GPIO pin 24 and a Switch to GPIO 25 and control the LED with the switch.
3. The state of LED should toggle with every press of the switch Use DHT11 temperature sensor and print the temperature and humidity of the room with an interval of 15 seconds
4. Use joystick and display the direction on the screen
5. Use Light Dependent Resistor (LDR) and control an LED that should switch-on/off depending on the light.
6. Create a traffic light signal with three colored lights (Red, Orange and Green) with a duty cycle of 5-2-10 seconds.
7. Switch on and switch of a DC motor based on the position of a switch.
8. Convert an analog voltage to digital value and show it on the screen.
9. Create a door lock application using a reed switch and magnet and give a beep when the door is opened. 10. Control a 230V device (Bulb) with Raspberry Pi using a relay.
11. Control a 230V device using a threshold temperature, using temperature sensor.
12. Create an application that has three LEDs (Red, Green and white). The LEDs should follow the cycle (All Off, Red On, Green On, White On) for each clap (use sound sensor).

Programme: M.Tech IoT Semester: II					
Course Code	Course Name	L	T	P	C
20IO2T01	Wireless Sensor Networks and IoT	3	0	0	3

COURSE OUTCOMES:

After successful completion of this course, students should be able to

CO1 : Assess the applicability and limitations of communication protocols for a real time WSN application.
.

CO2 : Proactive in understating the routing protocols function and their implications on data transmission delay and bandwidth.

CO3 : Contribute appropriate algorithms to improve existing or to develop new wireless sensor network applications.

CO4 : Familiarize the protocol, design requirements, suitable algorithms, and the state-of-the-art cloud platform to meet the industrial requirement.

CO5 : Solve network security problems in various networks

SYLLABUS

UNIT-I : Network for embedded systems & Protocols

RS232, RS485, SPI, I2C, CAN, LIN, FLEXRAY , Bluetooth, Zigbee, Wifi, MiWi, Nrf24, Wireless LAN &PAN, UWB

UNIT-II : Wireless sensor network (WSN) & MAC

Characteristic and challenges, WSN vs Adhoc Networks, Sensor node architecture, Physical layer and transceiver design considerations in WSNs, Energy usage profile, Choice of modulation scheme, Dynamic modulation scaling, Antenna considerations. Fundamentals of MAC protocols - Low duty cycle protocols and wakeup concepts, Contention Based protocols, Schedule-based protocols - SMAC – BMAC, Traffic-adaptive medium access protocol (TRAMA), The IEEE 802.15.4 MAC protocol.

UNIT-III : Sensor Network Architecture

Data Dissemination, Flooding and Gossiping-Data gathering Sensor Network Scenarios, Optimization Goals and Figures of Merit, Design Principles for WSNs- Gateway Concepts, Need for gateway, WSN and Internet Communication, WSN Tunneling

UNIT-IV : IP based WSN

Circuit switching, packet switching, concept of IPV4, IPV6, 6LOWPAN and IP, IP based WSN, 6LOWPAN based WSN.

UNIT-V : IoT security framework

IIOT security frame work, Security in hardware, Bootprocess, OS & Kernel, application,run time environment and containers. Need and methods of Edge Security, Network Security: Internet, Intranet, LAN, Wireless Networks, Wireless cellular networks, Cellular Networks and VOIP.

TEXT BOOKS:

1. Holger Karl, Andreas Willig, “Protocols and Architectures for Wireless Sensor Networks” 2011, 1st ed., John Wiley & Sons, New Jersey.
2. Jun Zheng, Abbas Jamalipour, “Wireless Sensor Networks: A Networking Perspective”, 2014, 1st ed., Wiley-IEEE Press, USA.
3 John R. Vacca, “Computer and Information Security Handbook”, Elsevier, 2013.
4. Parikshit Narendra Mahalle , Poonam N. Railkar, “Identity Management for Internet of Things”, River Publishers, 2015.

REFERENCE BOOKS:

1.Waltenegus W. Dargie, Christian Poellabauer, "Fundamentals of Wireless Sensor Networks: Theory and Practice", 2014, 1st ed., John Wiley & Sons, New Jersey.
2.Ian F. Akyildiz, Mehmet Can Vuran, "Wireless Sensor Networks", 2011, 1st ed., John Wiley & Sons, New Jersey.
3.Zach Shelby, Carsten Bormann, "6LoWPAN: The Wireless Embedded Internet", 2009, 1st ed., John Wiley & Sons, New Jersey.

Programme: M.Tech IoT Semester: II					
Course Code	Course Name	L	T	P	C
20IO2T02	Microcontrollers for IoT Prototyping	3	0	0	3

COURSE OUTCOMES:

After successful completion of this course, students should be able to

CO1 : Design and develop embedded programs for low power microcontrollers for sensor applications
.

CO2 : Develop ARM basic and advanced programs

CO3 : Interface and deploy analog and digital sensors

CO4 : Design develop IoT systems using Wi-Fi CC3200.

CO5 : Devise multidisciplinary case to case modelling and execute wide range of application.

SYLLABUS

UNIT-I : MSP430 microcontrollers

Architecture of the MSP430, Memory, Addressing modes, Reflections on the CPU instruction set. Clock system, Exceptions: Interrupts and resets. Functions and subroutines, Mixing C and assembly language, Interrupts, Interrupt service routines, Issues associated with interrupts, Low-power modes of operation.

UNIT-II : ARM Cortex MX microcontroller

ARM Cortex M4: Assembly language basics, Thumb-2 Technology, ARM Instruction set, Cortex M4 architecture, advantages, peripherals, instruction set, floating point operations, Advanced Cortex MX Microcontroller, core, architecture, on-chip wi-fi.

UNIT-III : Display and Communication modules & Sensors interfacing

GPIO, LCD display, graphical display, relays, Peripheral programming SPI, I2C, UART, Zigbee controller. Sensors interfacing techniques- Port Programming, ADC, SPI thermometer, I2C thermometer, PWM generation and demodulation, DTH11, single wire thermometer, Frequency counters.

UNIT-IV : Microcontrollers for IoT & Single board computers

ESP8266, NodeMCU,TI-CC3200,Access point and station point mode, HTTP, MQTT, transmission and receiving, Intel-Gallileo boards. Raspberry pi board, porting Raspbian, sensor interface examples, Python programming for cloud access, sensor systems using Arduino boards

UNIT-V : Applications in IoT enabled Smart Cities & Healthcare applications

Energy Consumption Monitoring, Smart Energy Meters, Home automation, Smart Grid and Solar Energy Harvesting, Intelligent Parking, Data lake services scenarios. Architecture of IoT for Healthcare, Multiple views coalescence, SBC-ADL to construct the system architecture. Use Cases : Wearable devices for Remote monitoring of Physiological parameter, ECG, EEG, Diabetes and Blood Pressure.

TEXT BOOKS:

1.John H. Davies, “MSP430 Microcontroller Basics”, 2011, 2nd ed., Newnes publishing, New York.
2.Jacob Fraden, “Hand Book of Modern Sensors: physics, Designs and Applications”, 2014, 4th ed., Springer, New York.
3.Subhas Chandra Mukhopadhyay, Smart Sensing Technology for Agriculture and Environmental Monitoring, 2012, Springer, ISBN-10: 3642276377

REFERENCE BOOKS:

1.Sergey Y. Yurish,”Digital Sensors and Sensor Systems: Practical Design”, 2011, 1st ed., IFSA publishing, New York.
2.Jonathan W Valvano, “Introduction to ARM Cortex –M3 Microcontrollers”, 2012, 5th ed., Create Space publishing, New York.
3.Muhammad Ali Mazidi, Shujen Chen, SarmadNaimi, SepehrNaimi, “TI ARM Peripherals Programming and Interfacing: Using C Language”, 2015, 2nd ed., Mazidi and Naimi publishing, New York.

Programme: M.Tech IoT Semester: II					
Course Code	Course Name	L	T	P	C
20IO2E01	Deep Learning-An approach to artificial Intelligence	3	0	0	3

COURSE OUTCOMES:

After successful completion of this course, students should be able to

CO1	:	Gain knowledge about basic concepts of machine learning algorithms and identify machine learning techniques suitable for the given problem.
CO2	:	Understand the differences between shallow neural networks and deep neural networks for supervised and unsupervised learning.
CO3	:	Develop and train neural networks for classification, regression and clustering.
CO4	:	Understand the foundations of neural networks, how to build neural networks and learn how to lead successful machine learning projects
CO5	:	Identify the deep feed forward, convolution and recurrent neural networks which are more appropriate for various types of learning tasks in various domains

SYLLABUS

UNIT-I : Foundations of Machine Learning-I

Supervised and unsupervised learning, parametric vs non-parametric models, parametric models for classification and regression- Linear Regression, Logistic Regression, Naïve Bayes classifier, simple non-parametric classifier-K-nearest neighbour,support vector machines.

UNIT-II : Foundations of Machine Learning-II

Clustering- distance based- K-means, density based, association rule mining, validation techniques-cross validations, feature selection and dimensionality reduction, principal component analysis-Eigen values, Eigen vectors, Orthogonality- challenges motivating deep learning

UNIT-III : Neural Networks for Classification and Regression

ANN as a technique for regression and classification, structure of an artificial neuron, activation functions- linear activation, sigmoid and softmax. Feed forward neural networks- shallow model-single layer perceptron,multi-layer perceptron as complex decision classifier- learning XOR-Gradient based learning, Back propagation algorithm, risk minimization, loss function, regularization, heuristics for faster training and avoiding local minima.

UNIT-IV : Deep Feed Forward Neural Networks

Feed forward neural networks- deep model- output units and hidden units, training deep models-hyper parameters and validation sets-cross validation, capacity, over fitting and under fitting, bias vs variance trade off, cross validation - vanishing gradient problem, new optimization methods (adagrad, adadelta, rmsprop, adam), regularization methods (dropout, batch normalization, dataset augmentation), early stopping.

UNIT-V : Convolutional Neural Networks

Convolution operation- kernel and feature map, sparse connectivity, equivariance through parameter sharing, pooling function for invariant representation, convolution and pooling as strong prior, convolution with stride, effect of zero padding, single-channel and multi-channel data types used in ConvNet, variants of basic convolution- locally connected, tiled ConvNet- spatial separable and depthwise separable convolutions, fully connected layers, ConvNet architecture- layer patterns, layer sizing parameters,case studies- LeNet, AlexNet

TEXT BOOKS:

1. Bengio, Yoshua, Ian J. Goodfellow, and Aaron Courville. "Deep learning" 2015, MIT Press

2. Josh Patterson and Adam Gibson, “Deep Learning- A Practitioner’s Approach” O’Reilly Media Inc., 2017, USA.

REFERENCE BOOKS:

1.Bishop, C. ,M., Pattern Recognition and Machine Learning, Springer, 2011
2.Rich E and Knight K, “Artificial Intelligence”, 2011, 2nd ed., TMH, New Delhi

Programme: M.Tech IoT Semester: II					
Course Code	Course Name	L	T	P	C
20IO2E02	Fibre Optic sensors and photonics	3	0	0	3

COURSE OUTCOMES:

After successful completion of this course, students should be able to

CO1 : Attainment of basic knowledge of optical waveguides and optical devices employed in optical sensors.
CO2 : Will be conversance in optical parameters involved in active and passive components
CO3 : Entrust the characteristics of a suitable optical materials for the sensing device in a given application.
CO4 : Identify and apply the knowledge in designing interferometric devices which is more effectively used in sensing.
CO5 : Will be aware of different polymers and their chemical, optical characteristics to formulate miniaturized optical devices.

SYLLABUS

UNIT-I : Theory of Optical Waveguides

Wave theory of optical waveguides, formation of guided modes, Slab waveguide, Rectangular waveguide, Radiation fields from waveguide, Effective index method, Marcatili's method, Beam propagation method. Basic characteristic of Optical Fiber Waveguides, Acceptance angle, Numerical aperture, skewrays- Electromagnetic Modes in Cylindrical Waveguides.

UNIT-II : Active and Passive Optical Components

Electro-optic and acousto optic wave guide devices, directional couplers, optical switch, phase and amplitude modulators,filtersetc,Yjunction,powersplitters,arrayedwaveguidedevices,fiberpigtailing, end-fiber prism coupling, FBG and fabrication of FBG,Tapered couplers.

UNIT-III : Intensity and Polarization Sensors

Intensity sensor: Transmissive concept –Reflective concept-Micro bending concept–Transmission and Reflection with other optic effect-Interferometers –Mach Zehnder-Michelson-Fabry-Perot and Sagnac–Phase sensor: Phase detection-Polarization maintaining fibers. Displacement and temperature sensors: reflective and Micro bending Technology- Applications of displacement and temperature sensors.

UNIT-IV : Interferometric Sensors

Pressure sensors: Transmissive concepts, Microbending –Intrinsic concepts–Interferometric concepts, Applications. Flow sensors: Turbine flowmeters- Differential pressure flowsensors –Laser Doppler

UNIT-V : Polymer based waveguide in sensing

Polymer based waveguide, materials, properties, fabrication process of polymer based waveguide, Polymer based optical components - Passive, Active polymer devices, Ring Resonator, structure, theory, Filter using Ring Resonator-application in sensing

TEXT BOOKS:

1.David A. Krohn, Trevor W. MacDougall, Alexis Mendez, "Fiber Optic Sensors: Fundamentals and Applications" SPIE Press, 4th ed. 2015. ISBN: 1628411805.

2.Eric Udd , William B. Spillman Jr., "Fiber Optic Sensors: An Introduction for Engineers and Scientists", Wiley, 2nd Ed., 2011. ISBN: 0470126841

REFERENCE BOOKS:

1.Zujie Fang & et. al., "Fundamentals of Optical Fiber Sensors" Wiley, 1st Ed., 2012.ISBN: 0470575409

2.Shizhuo Yin, Paul B. Ruffin, and Francis T.S. Yu, "Fiber Optic Sensors",CRC Press, 2 Ed, 2017. ASIN: B078JN75QW

Programme: M.Tech IoT Semester: II					
Course Code	Course Name	L	T	P	C
20IO2E03	Automotive sensors & in vehicle Networking	3	0	0	3

COURSE OUTCOMES:

After successful completion of this course, students should be able to

CO1 : Identify and understand the basic automotive parts and the requirement of sensors and their integration in different automotive systems.

CO2 : Discus and identify the basics of various Power train sensors.

CO3 : Comprehend and analyze various systems like ABS, ESP, TCS, etc for understanding vehicle dynamics and stability.

CO4 : Comprehend the various sensors for vehicle body management, convenience & security systems.

CO5 : Identify various technologies developed for passenger convenience, Air Bag deployment and Seat Belt Tensioner System, etc with the students

SYLLABUS

UNIT-I : Introduction to Automotive Engineering, Automotive Management systems

Power-train, Combustion Engines, Transmission, Differential Gear, Braking Systems, Introduction to Modern Automotive Systems and need for electronics in Automobiles, Application areas of electronics in the automobiles, Possibilities and challenges in the automotive industry, Enabling technologies and Industry trends.

UNIT-II : Power train Sensors

λ sensors, exhaust temperature sensor, NOx sensor, PM sensor, fuel quality sensor, level sensor, torque sensor, speed sensor, mass flow sensor, manifold pressure sensor.

UNIT-III : Sensors for Chassis management

Wheel speed sensors/direction sensors, steering position sensor (multi turn), acceleration sensor (inertia measurement), brake pneumatic pressure sensor, ABS sensor, electronic stability sensor.

UNIT-IV : Air Bag and Seat Belt Pre tensioner Systems

Principal Sensor Functions, Distributed Front Air Bag sensing systems, Single-Point Sensing systems, Side-Impact Sensing, and Future Occupant Protection systems.

UNIT-V : Passenger Convenience Systems

Enabling Connectivity by Networking:-In vehicle communication standards (CAN & LIN), Telematic solutions, Portable or embedded connectivity- Endorsing Dependability in Drive-by-wire systems:- Terminology and concepts , Why by-wire, FLEXRAY, Requirements on cost and dependability, Drive-by-wire case studies- prototype development-future of In vehicle communication.

TEXT BOOKS:

1. Automotive Electrics, Automotive Electronics: Systems & Components, 2014, 5th Edition, BOSCH.

2. John Turner, Automotive Sensors, 2010, 1st Edition, Momentum Press, New York.

REFERENCE BOOKS:

1. Automotive Sensors Handbook, 8th Edition, 2011, BOSCH.

2.Jiri Marek, Hans-Peter Trah, Yasutoshi Suzuki, IwaoYokomori, Sensors for Automotive Technology, 2010, 4th Edition, Wiley, New York.

Programme: M.Tech IoT Semester: II					
Course Code	Course Name	L	T	P	C
20IO2E04	Energy Harvesting Technologies And Power Management For Iot Devices	3	0	0	3

After successful completion of this course, students should be able to

CO1	:	Get acquainted with energy harvesting systems
CO2	:	Understand Piezo-Electric Energy Harvesting And Electromechanical Modeling
CO3	:	Realize Electromagnetic Energy Harvesting Andnon-Linear Techniques
CO4	:	Analyze Energy Harvesting Wireless Sensors
CO5	:	Identify different case studies.

SYLLABUS

UNIT 1 – Energy Harvesting Systems

Introduction – Energy sources – energy harvesting based sensor networks –photovoltaic cell technologies – generation of electric power in semiconductor PV cells– types

UNIT 2 – Piezo-Electric Energy Harvesting And Electromechanical Modeling

Piezoelectric materials – transducers – harvesters – microgenerators – strategies forenhancing the performance of energy harvesters. Electromechanical modeling ofLumped parameter model and coupled distributed parameter models and closed-formsolutions

UNIT 3 – Electromagnetic Energy Harvesting Andnon-Linear Techniques

Basic principles – micro fabricated coils and magnetic materials – scaling – powermaximations – micro and macro scale implementations. Non-linear techniques –vibration control & steady state cases

UNIT 4 – Energy Harvesting Wireless Sensors

Power sources for WSN – Power generation – conversion – examples – case studies.Harvesting microelectronic circuits – power conditioning and losses

UNIT 5 – CASE STUDY

Case studies for Implanted medical devices – Bio-MEMS based applications –harvesting for RF sensors and ID tags – powering wireless SHM sensor nodes

TEXT BOOKS:

1. Carlos Manuel Ferreira Carvalho, Nuno Filipe Silva VeríssimoPaulino, "CMOSIndoor Light Energy Harvesting System for Wireless Sensing Applications",springer, 2016
2. Danick Briand, Eric Yeatman, Shad Roundy ,"Micro Energy Harvesting", 2015

REFERENCES:

1.Carlos Manuel Ferreira Carvalho, Nuno Filipe Silva VeríssimoPaulino, "CMOS Indoor Light Energy Harvesting System for Wireless Sensing Applications", springer

2. Danick Briand, Eric Yeatman, Shad Roundy ,"Micro Energy Harvesting"

Programme: M.Tech IoT Semester: II					
Course Code	Course Name	L	T	P	C
20IO2E05	Smart Grid Technologies and IOT	3	0	0	3

After successful completion of this course, students should be able to

CO1	:	Understand technologies for smart grid
CO2	:	Appreciate the smart transmission as well distribution systems
CO3	:	Locate the smart distribution systems
CO4	:	Realize the distribution generation and smart consumption
CO5	:	Know the regulations and market models for smart grid

SYLLABUS

UNIT – I: Introduction to Smart Grids:

Definition, justification for smart grids, smart grid conceptual model, smart grid architectures, Interoperability, communication technologies, role of smart grids standards, intelligrid initiative, national smart grid mission (NSGM) by Govt. of India

UNIT – II: Smart Transmission Technologies:

Substation automation, Supervisory control and data acquisition (SCADA), energy management system (EMS), phasor measurement units (PMU), Wide area measurement systems (WAMS)

UNIT – III: Smart Distribution Technologies:

Distribution automation, outage management systems, automated meter reading (AMR), automated metering infrastructure (AMI), fault location isolation and service restoration (FLISR), Outage Management Systems (OMS), Energy Storage, Renewable Integration

UNIT – IV: Distributed Generation and Smart Consumption:

Distributed energy resources (DERs), smart appliances, low voltage DC (LVDC) distribution in homes / buildings, home energy management system (HEMS), Net Metering, Building to Grid B2G, Vehicle to Grid V2G, Solar to Grid, Microgrid

UNIT – V: Regulations and Market Models for Smart Grid:

Demand Response, Tariff Design, Time of the day pricing (TOD), Time of use pricing (TOU), Consumer privacy and data protection, consumer engagement etc. Cost benefit analysis of smart grid projects.

TEXT BOOKS:

1. Clark W Gellings, "The Smart Grid, Enabling Energy Efficiency and Demand Side Response"- CRC Press, 2009.
2. Jean Claude Sabonnadière, Nouredine Hadjsaïd, "Smart Grids", Wiley-ISTE, IEEE Press, May 2012
3. James Momoh, Smart Grid: Fundamentals of Design and Analysis, IEEE Computer• Society Press (2012).
4. EkanayakeJ.,Jenkins N., Liyanage K., Wu, J., Yokoyama A., Smart Grid: Technology and applications, Wiley Publications.

REFERENCES:

1. Janaka Ekanayake, Kithsiri Liyanage, Jianzhong. Wu, Akihiko Yokoyama, Nick Jenkins, "Smart Grid: Technology and Applications"- Wiley, 2012.
2. James Momoh, "Smart Grid: Fundamentals of Design and Analysis" – Wiley, IEEE Press, 2012.

Programme: M.Tech IoT Semester: I					
Course Code	Course Name	L	T	P	C
20IO2E06	**BIG DATA ANALYTICS FOR IoT**	3	0	0	3

COURSE OUTCOMES:

After successful completion of this course, students should be able to

CO1 : Use concepts in big data challenges and requirements coming from different Smart City applications.

CO2 : Evaluate performance characteristics of different types of RFID false authentications

CO3 : Locate different platforms for IOT and analysis

CO4 : Create Web Enhanced Building Automation Systems

CO5 : Compete in the design, construction, and execution of sustainability data and analytics in cloud-based m2m systems

SYLLABUS:

UNIT I - BIG DATA PLATFORMS FOR THE INTERNET OF THINGS

Big Data Platforms for the Internet of Things: network protocol- data dissemination – current state of art- Improving Data and Service Interoperability with Structure, Compliance, Conformance and Context Awareness: interoperability problem in the IoT context- Big Data Management Systems for the Exploitation of Pervasive Environments - Big Data challenges and requirements coming from different Smart City applications

UNIT II - RFID FALSE AUTHENTICATIONS

On RFID False Authentications: YA TRAP – Necessary and sufficient condition for false authentication prevention - Adaptive Pipelined Neural Network Structure in Self-aware Internet of Things: self-healing systems- Role of adaptive neural network-Spatial Dimensions of Big Data: Application of Geographical Concepts and Spatial Technology to the Internet of Things- Applying spatial relationships, functions, and models

UNIT III - FOG COMPUTING

Fog Computing: A Platform for Internet of Things and Analytics: a massively distributed number of sources - Big Data Metadata Management in Smart Grids: semantic inconsistencies – role of metadata

UNIT IV - WEB ENHANCED BUILDING

Toward Web Enhanced Building Automation Systems: heterogeneity between existing installations and native IP devices - loosely-coupled Web protocol stack –energy saving in smart building- Intelligent Transportation Systems and Wireless Access in Vehicular Environment Technology for Developing Smart Cities: advantages and achievements- Emerging Technologies in Health Information Systems: Genomics Driven Wellness Tracking and Management System (GO-WELL) – predictive care – personalized medicine

UNIT V - SUSTAINABILITY DATA AND ANALYTICS

Sustainability Data and Analytics in Cloud-Based M2M Systems - potential stakeholders and their complex relationships to data and analytics applications - Social Networking Analysis - Building a useful understanding of a social network - Leveraging Social Media and IoT to Bootstrap Smart Environments : lightweight Cyber Physical Social Systems - citizen actuation

Text Books

1. Stackowiak, R., Licht, A., Mantha, V., Nagode, L.," Big Data and The Internet of Things Enterprise Information Architecture for A New Age", Apress, 2015.

2. Dr. John Bates , "Thingalytics - Smart Big Data Analytics for the Internet of Things", john Bates, 2015.

Programme: M.Tech IoT Semester: II					
Course Code	Course Name	L	T	P	C
20GS2A01	**English For Research Paper Writing**	3	0	0	3

COURSE OUTCOMES:

After successful completion of this course, students should be able to

CO1 : Understand that how to improve your writing skills and level of readability

CO2 : Learn about what to write in each section

CO3 : Understand the skills needed when writing a Review of the Literature

CO4 : Understand skills are needed when writing the Methods

CO5 : Understand the skills needed when writing a Title Ensure the good quality of paper at very first-time submission

SYLLABUS

UNIT-I

Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness

UNIT-II

Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticising, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts. Introduction , Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check.

UNIT-III

key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed when writing a Review of the Literature

UNIT-IV

skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions

UNIT-V

useful phrases, how to ensure paper is as good as it could possibly be the first- time submission

TEXT BOOKS:

1. Goldbort R (2006) Writing for Science, Yale University Press (available on Google Books)
2. Day R (2006) How to Write and Publish a Scientific Paper, Cambridge University Press

REFERENCE BOOKS:

1. Highman N (1998), Handbook of Writing for the Mathematical Sciences, SIAM. Highman’sbook
2. Adrian Wallwork , English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011

Programme: M.Tech IoT Semester: III					
Course Code	Course Name	L	T	P	C
20IO2L01	IoT Laboratory-II	0	0	4	2

After successful completion of this course, students should be able to

CO1 : Investigate a variety of emerging devices and technologies such as smart sensing, pervasive connectivity, virtual interfaces & ubiquitous computing and their potential applications in consumer, retail, healthcare and industrial contexts

CO2 : Collaborate on research with industry partners to address significant and complex challenges surrounding IoT technologies and applications

CO3 : Used as a platform for conducting consultancy work required by government/Private organizations in around Coimbatore

CO4 : Enable faculty learning, research and hands-on experimentation to discover and demonstrate the promise of the Internet of Things

CO5 : Provide students unique interdisciplinary learning and innovation experiences with IoT technologies

List of Experiments:

1. To interface Push button/Digital sensor (IR/LDR) with Arduino/Raspberry Pi and write a program to turn ON LED when push button is pressed or at sensor detection.
2. To interface DHT11 sensor with Arduino/Raspberry Pi and write a program to print temperature and humidity readings.
3. To interface motor using relay with Arduino/Raspberry Pi and write a program to turn ON motor when push button is pressed.
4. To interface OLED with Arduino/Raspberry Pi and write a program to print temperature and humidity readings on it.
5. To interface Bluetooth with Arduino/Raspberry Pi and write a program to turn LED ON/OFF when ‘1’/’0’ is received from smartphone using Bluetooth.
6. Write a program on Arduino/Raspberry Pi to upload temperature and humidity data to thing speak cloud.
7. To install MySQL database on Raspberry Pi and perform basic SQL queries.

8. Write a program on Arduino/Raspberry Pi to publish temperature data to MQTT broker.
9. Write a program on Arduino/Raspberry Pi to subscribe to MQTT broker for temperature data and print it.
10. Write a program to create TCP server on Arduino/Raspberry Pi and respond with humidity data to TCP client when requested.
11. Write a program to create UDP server on Arduino/Raspberry Pi and respond with humidity data to UDP client when requested.

Programme: M.Tech IoT Semester: III					
Course Code	Course Name	L	T	P	C
20IO2L02	Advanced Computer Networks Lab	0	0	4	2

After successful completion of this course, students should be able to

CO1 : Investigate a variety of emerging devices and technologies such as smart sensing, pervasive connectivity, virtual interfaces & ubiquitous computing and their potential applications in consumer, retail, healthcare and industrial contexts

CO2 : Collaborate on research with industry partners to address significant and complex challenges surrounding IoT technologies and applications

CO3 : Used as a platform for conducting consultancy work required by government/Private organizations in around Coimbatore

CO4 : Enable faculty learning, research and hands-on experimentation to discover and demonstrate the promise of the Internet of Things

CO5 : Provide students unique interdisciplinary learning and innovation experiences with IoT technologies

List of Experiments.

1.Introduction about discrete events simulation and its tools

2. Installation of NS3 in linux

3. Program in NS3 to connect two nodes

4. Program in NS3 for connecting three nodes considering one node as a central node.

5. Program in NS3 to implement star topology

6. Program in NS3 to implement a bus topology.

7. Program in NS3 for connecting multiple routers and nodes and building a hybrid topology.

8. Installation and configuration of NetAnim

9. Program in NS3 to implement FTP using TCP bulk transfer.

10. Program in NS3 for connecting multiple routers and nodes and building a hybrid topology and then calculating network performance

11. To analyse network traces using wireshark software.

Programme: M.Tech IoT Semester: III					
Course Code	Course Name	L	T	P	C
20IO3E01	**Beyond IoT – Ubiquitous sensing and Wireless Sensor Networks**	3	0	0	3

COURSE OUTCOMES:

After successful completion of this course, students should be able to

CO1 : Understand various concepts of ubiquitous sensing.

CO2 : Apply Wireless Sensor Networks Principles in IoT

CO3 : Evaluate various protocols designed for WSN

CO4 : Analyze the challenges in routing and data dissemination in WSN

CO5 : Knowledge of the wireless networks needed for design and implementation of a typical IoT system.

SYLLABUS

UNIT-I : UBIQUITOUS SENSING (Part-1)

Architecture: New Devices and Communications, Software Architectures, Wireless Standards & Protocols for Ubiquitous Networks: Near field communication (NFC), Bluetooth Classic, Bluetooth Low Energy (BLE), WiFi, WiFi Direct

UNIT-II : UBIQUITOUS SENSING (Part-2)

Integrating the Physical and The Virtual Worlds: Sensing and Actuation, Awareness and Perception, Context Aware Computing: Introduction, Issues and Challenges, Developing Context Aware Applications, System Architecture.

UNIT-III : INTRODUCTION TO WSN

WSN: Coverage & Placement, Topology Management in Wireless Sensor Network, Mobile WSNs, Medium Access Control in Wireless Networks, Routing in WSNs, Enabling Technologies for WSNs

UNIT-IV : ARCHITECTURE OF WSN

Single Node Architecture: Hardware Components, Energy Consumption of Sensor Nodes, Operating Systems and Execution Environments. Network Architecture: Sensor Network Scenarios, Optimization Goals, Figures of Merit, Design Principles for WSNs, Service Interfaces of WSNs Gateway Concepts

UNIT-V : CHALLENGES IN WSN

Data Dissemination and Gathering: Routing Challenges in WSN, Flooding, Flat Based Routing, SAR, Directed Diffusion. Hierarchical Routing: LEACH, PEGASIS, Query Based Routing, Negotiation Based Routing Geographical Based Routing: Transport Layer, Protocol Design issues and Performance. Congestion and Flow Control, Security of Wireless Sensor Networks, Hardware Design of Sensor Node, Real Life Deployment of WSN

TEXT BOOKS:

1.Ubiquitous Computing Fundamentals, John Krumm, CRC Press, 2010
2.Wireless Sensor Networks Technology: Protocols, and Applications, KazemSohraby, Daniel Minoli, TaiebZnati, Wiley

REFERENCE BOOKS:

1. Wireless Sensor Networks: From Theory to Applications, Ibrahiem M. M. El Emary, S. Ramakrishnan, 1st Edition, CRC Press.
2. Fundamentals of Wireless Sensor Networks Theory and Practice, WaltenegusDargie, Christian Poellabauer, Wiley.

Programme: M.Tech IoT Semester: III					
Course Code	Course Name	L	T	P	C
20IO3E02	**PYTHON FOR IOT**	3	0	0	3

COURSE OUTCOMES:

After successful completion of this course, students should be able to

CO1 : Understand the concept of Internet of Things and connected world.

CO2 : Explore on use of various hardware and sensing technologies to build IoT applications

CO3 : Illustrate the architecture of Internet of Things and python.

CO4 : Understand the working with python on intel galileo gen.

CO5 : Explore on Interacting with digital outputs with python.

SYLLABUS

UNIT-I : Python Concepts, Data Structures, Classes

Interpreter – Program Execution – Statements – Expressions – Flow Controls – Functions - Numeric Types – Sequences - Strings, Tuples, Lists and - Class Definition – Constructors – Inheritance – Overloading – Text & Binary Files - Reading and Writing.

UNIT-II : Data Wrangling

Combining and Merging Data Sets – Reshaping and Pivoting – Data Transformation – String Manipulation, Regular Expressions.

UNIT-III : Data Aggregation, Group Operations, Time series & Web Scrapping

Goup By Mechanics – Data Aggregation – GroupWise Operations and Transformations – Pivot Tables and Cross Tabulations – Date and Time Date Type tools – Time Series Basics – Data Ranges, Frequencies and Shifting.

Data Acquisition by Scraping web applications –Submitting a form - Fetching web pages – Downloading web pages through form submission – CSS Selectors.

UNIT-IV : Visualization in Python

Matplot lib package – Plotting Graphs – Controlling Graph – Adding Text – More Graph Types – Getting and setting values – Patches.

UNIT-V : Implementation using Raspberry Pi

Working with Raspberry Pi 3 Model - Installing OS and Designing Systems using Raspberry pi - Configuring Raspberry Pi for VNC Connection - Getting introduced to Linux OS Basic Linux commands and uses - Getting Started with Python - Interface sensor and Actuator with Raspberry Pi

TEXT BOOKS:

1.Jacob Fraden, “Hand Book of Modern Sensors: physics, Designs and Applications”, 2015, 3rd edition, Springer, New York.

REFERENCE BOOKS:

1. Jon. S. Wilson, “Sensor Technology Hand Book”, 2011, 1st edition, Elsevier, Netherland.

Programme: M.Tech IoT Semester: III					
Course Code	Course Name	L	T	P	C
20IO3E03	**Communication technologies for IoT**	3	0	0	3

COURSE OUTCOMES:

After successful completion of this course, students should be able to

CO1 : To make student to acquire knowledge about transferring data using various Wired/Wireless communication technologies.
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CO2 : Able to design communication architecture

CO3 : Able to work with various communication technologies (Wired/Wireless)

CO4 : Able to work with various protocols 4) Configure and test communication technologies

CO5 : Basic knowledge on Digital numbering system; Micro Controller Peripheral Programming, Communication interfaces and protocols

SYLLABUS

UNIT-I : Introduction to Communication and Networking

Communications, Signal Types and its characteristics (Analog/Digital), Data Transmission Types (Serial/Parallel), Communication Techniques (Asynchronous, Synchronous),Data Transmission Modes (Simplex, Half/Full Duplex), Network Topologies (Star, Ring, Mesh, Point to Point, Tree, Bus, Daisy chain, Multi drop) and its applications, Modulation need and types.

UNIT-II : OSI Layers

Communication Layers and its applications, Communication media (Twisted Pair, Coaxial, Fiber Optics), Introduction to Errors (Error types, Detection, Correction) and Flow Control and its applications.

UNIT-III : Wired Communication Protocols and standards

Ethernet (Types, Socket, MAC, IP, ARP, ICMP, TCP, UDP, DHCP), CAN, Modbus(RTU, ASCII), UART (RS485,RS232), OFC and Advantages, Disadvantages and its applications, Introduction to Dial up Modems, Leased line modems.

UNIT-IV : Wireless Communication Protocols and Standards

Zigbee, Bluetooth, Wi-Fi, GPRS ,GSM, NFC, IR, LoRa, NB-IoT, Satellite Communication. Advantages, Disadvantages and its applications. **IoT Protocols & procedures:** MQTT, COAP, STOMP, AMQP ,Addressing, configuration & re-configuration, fault detection, Recovery

UNIT-V : Network Types

Introduction to LAN, WAN, PAN, Internet and Intranet, sensor networks (wired/wireless) and its applications, Introduction to NAT, PAT, DNS, Network Routing algorithms, Introduction to Switch,Hub, Bridges and its working, Network Security and Introduction to Firewall and its applications.

TEXT BOOKS:

1.Introduction to data communication and networking by Wayne Tomasi
2.Introduction to data communication and networking by Behrouz Forouzan
3.Basics of data communications by William Stallings
4Basics of computer networking by Thomas Robertazzi

REFERENCE BOOKS:

1. Wireless Networking Absolute Beginner’s Guide by Michael Miller:
2. Designing and Deploying 802.11n Wireless Networks by Jim Geier
3. CAN System Engineering from Theory to Practical Applications
4. Communication (NFC) From Theory to Practice by Vedat Coskun, Kerem Ok.

Programme: M.Tech IoT Semester: III					
Course Code	Course Name	L	T	P	C
20IO3O01	Real time opearating system & Embedded System	3	0	0	3

COURSE OUTCOMES:

After successful completion of this course, students should be able to

CO1	:	Understand the Essentials of Open Source RTOS and their usage.
CO2	:	Know the proper technique to design a Real-Time System.
CO3	:	Understand VxWorks RTOS and real time application programming with it.
CO4	:	Gain the knowledge to build the device driver and kernel internal for Embedded OS and RTOS earn and apply the knowledge of Memory systems.
CO5	:	Understand the aspects of Real Time Embedded concepts.

SYLLABUS

UNIT I - OPEN SOURCE RTOS

Basics of RTOS: Real-time concepts, Hard Real time and Soft Real-time, Differences between General Purpose OS & RTOS, Basic architecture of an RTOS, Scheduling Systems, Inter-process communication, Performance Matric in scheduling models, Interrupt management in RTOS environment, Memory management, File systems, I/O Systems, Advantage and disadvantage of RTOS. POSIX standards, RTOS Issues Selecting a Real-Time Operating System, RTOS comparative study.

UNIT II – REAL TIME KERNEL BASICS

Converting a normal Linux kernel to real time kernel, Xenomai basics. Overview of Open source RTOS for Embedded systems (Free RTOS/ ChibiosRT) and application development. Real Time Operating Systems: Event based, process based and graph based models, Petrinet models. Real time languages, real time kernel, OS tasks, task states, task scheduling, interrupt processing, clocking, communication and Synchronization. Control blocks, memory requirements and control, kernel services, basic design using RTOS.

UNIT III – VXWORKS / FREE RTOS

VxWorks/ Free RTOS Scheduling and Task Management – Realtime scheduling, Task Creation, Intertask Communication, Pipes, Semaphore, Message Queue, Signals, Sockets, Interrupts I/O Systems General Architecture, Device Driver Studies, Driver Module explanation, Implementation of Device Driver for a peripheral.

UNIT IV – CASE STUDY

Software Development and Tools: Simulators, debuggers, cross compilers, in circuit emulators for the microcontrollers. Interface Issues Related to Embedded Systems: A/D, D/A converters, FPGA, ASIC, diagnostic port. Cross compilers, debugging Techniques, Creation of binaries & porting stages for Embedded Development board (Beagle Bone Black, Rpi or similar), Porting an Embedded OS/ RTOS to a target board, Testing a real-time application on the board.

UNIT V - EMBEDDED OS INTERNALS

Linux internals: Process Management, File Management, Memory Management, I/O Management. Overview of POSIX APIs, Threads – Creation, Cancellation, POSIX Threads Inter Process Communication – Semaphore, Pipes, FIFO, Shared Memory Kernel: Structure, Kernel Module Programming Schedulers and types of scheduling. Interfacing: Serial, Parallel Interrupt Handling Linux Device Drivers: Character, USB, Block & Network.

TEXT BOOKS:

1. VenkateswaranSreekrishnan, "Essential Linux Device Drivers", Ist Kindle edition, Prentice Hall, 2008.
2. Jerry Cooperstein , "Writing Linux Device Drivers: A Guide with Exercises", J. Cooperstein publishers, 2009.
3. Qing Li and CarolynYao, "3Real Time Concepts for Embedded Systems – Qing Li, Elsevier ISBN:1578201241 CMP Books 2003.

REFERENCE BOOKS:

1. KVK Prasad, "Embedded/Real Time Systems Concepts, Design and Programming Black Book", Wiley India 2003.
2. Seppo J. Ovaska Phillip A. Laplante,"Real-Time Systems Design and Analysis:Tools for the Practitioner", 4ed Paperback – 17 May 2013.
3. Ward, Paul T & Mellor, Stephen, "Structured Development for Real – Time Systems v1, v2,V3 : Implementation Modeling Techniques " Prentice hall, 2015.

Programme: M.Tech IoT Semester: III					
Course Code	Course Name	L	T	P	C
20IO3O02	Wireless sensor protocols and programming	3	0	0	3

COURSE OUTCOMES:

After successful completion of this course, students should be able to

CO1	:	Understand basic sensor network concepts
CO2	:	Understand the time synchronization protocols
CO3	:	Know physical layer issues, understand and analyze Medium Access Control Protocols
CO4	:	Comprehend network and transport layer characteristics and protocols and implement conventional protocols
CO5	:	Understand the network management and Middleware services

SYLLABUS

UNIT I – FUNDAMENTALS OF SENSOR NETWORKS

Introduction to computer and wireless sensor networks and Overview of the syllabus- Motivation for a network of Wireless Sensor nodes- Sensing and sensors-challenges and constraints - node architecture-sensing subsystem, processor subsystem communication interfaces- prototypes, Application of Wireless sensors- Introduction of Tiny OS Programming and TOSSIM Simulator.

UNIT II- COMMUNICATION CHARACTERISTICS AND DEPLOYMENT MECHANISMS

Wireless Transmission Technology and systems-Radio Technology Primer-Available Wireless Technologies - Hardware- Telosb, Micaz motes- Time Synchronization-Clock and the Synchronization Problem - Basics of time synchronization-Time synchronization protocols - Localization- Ranging Techniques- Range based Localization-Range Free Localization- Event driven Localization

UNIT III- MAC LAYER

Overview-Wireless Mac Protocols-Characteristics of MAC protocols in Sensor networks – Contention free MAC Protocols- characteristics- Traffic Adaptive Medium Access-Y-MAC, Low energy Adaptive Clustering - Contention based MAC Protocols-Power Aware Multi-Access with signaling, Sensor MAC-Timeout MAC-Data gathering MAC- Case study –Implementation and Analysis of MAC player protocol in Tiny OS.

UNIT IV- ROUTING IN WIRELESS SENSOR NETWORKS

Design Issues in WSN routing- Data Dissemination and Gathering-Routing Challenges in WSN - Flooding-Flat Based Routing – SAR, Directed Diffusion, Hierarchical Routing- LEACH, PEGASIS - Query Based Routing- Negotiation Based Routing Geographical Based Routing- Transport layer- Transport protocol Design issues-Performance of Transport Control Protocols. Case study- Implementation and analysis of Routing protocol or transport layer protocol in Tiny OS.

UNIT V - MIDDLEWARE AND SECURITY ISSUES

WSN middleware principles-Middleware architecture-Existing middleware operating systems for wireless sensor networks-performance and traffic management Fundamentals of network security-challenges and attacks - Protocols and mechanisms for security. Case study- Handling attacks in Tiny OS

TEXT BOOKS:

1. Waltenegus Dargie, Christian Poellabauer , “Fundamentals of Wireless Sensor Networks, Theory and Practice”, Wiley Series on wireless Communication and Mobile Computing, 2011.
2. Kazem Sohraby, Daniel manoli , “Wireless Sensor networks- Technology, Protocols and Applications”, Wiley InterScience Publications 2010.

REFERENCE BOOKS:

1.Bhaskar Krishnamachari , “ Networking Wireless Sensors”, Cambridge University Press, 2005

2.C.S Raghavendra, Krishna M.Sivalingam, Taiebznati , “Wireless Sensor Networks”, Springer Science 2004.

Programme: M.Tech IoT Semester: III					
Course Code	Course Name	L	T	P	C
20IO3O03	Micro electro mechanical systems	3	0	0	3

COURSE OUTCOMES:

After successful completion of this course, students should be able to

CO1 : Understand basics of Micro Electro Mechanical Systems

CO2 : Understand the working principle of various sensors and actuators used in MEMS

CO3 : Know the knowledge on Principle of MOEMS technology

CO4 : Know the properties of Magnetic materials for MEMS

CO5 : Understand the principle and various devices of Fluidic, bio and chemical systems.

SYLLABUS

UNIT I – INTRODUCTION

Introduction to MEMS, MEMS history and development, micro machining, lithography principles & methods, structural and sacrificial materials, thin film deposition, impurity doping, etching, surface micro machining, wafer bonding, LIGA.
MECHANICAL SENSORS AND ACTUATORS: Principles of sensing and actuation: beam and cantilever, capacitive, piezo electric, strain, pressure, flow, pressure measurement by micro phone, MEMS gyroscopes, shear mode piezo actuator, gripping piezo actuator, Inchworm technology.

UNIT II- THERMAL SENSORS AND ACTUATORS
Thermal energy basics and heat transfer processes, thermisters, thermo devices, thermo couple, micro machined thermo couple probe, peltier effect heat pumps, thermal flow sensors, micro hot plate gas sensors, MEMS thermo vessels, pyro electricity, shape memory alloys (SMA), U-shaped horizontal and vertical electro thermal actuator, thermally activated MEMS relay, micro spring thermal actuator, data storage cantilever.

UNIT III- MICRO-OPTO-ELECTRO MECHANICAL SYSTEMS
Principle of MOEMS technology, properties of light, light modulators, beam splitter, micro lens, micro mirrors, digital micro mirror device (DMD), light detectors, grating light valve (GLV), optical switch, wave guide and tuning, shear stress measurement.

UNIT IV- MAGNETIC SENSORS AND ACTUATORS
Magnetic materials for MEMS and properties, magnetic sensing and detection, magneto resistive sensor, more on hall effect, magneto diodes, magneto transistor, MEMS magnetic sensor, pressure sensor utilizing MOKE, mag MEMS actuators, bydirectional micro actuator, feedback circuit integrated magnetic actuator, large force reluctance actuator, magnetic probe based storage device.

UNIT V - MICRO FLUIDIC SYSTEMS
Applications, considerations on micro scale fluid, fluid actuation methods, dielectro phoresis (DEP), electro wetting, electro thermal flow, thermo capillary effect, electro osmosis flow, opto electro wetting

(OEW), tuning using micro fluidics, typical micro fluidic channel, micro-fluid dispenser, micro needle, molecular gate, micro pumps.

RADIO FREQUENCY (RF) MEMS: RF – based communication systems, RF MEMS, MEMS inductors, varactors, tuner/filter, resonator, clarification of tuner, filter, resonator, MEMS switches, phase shifter.

CHEMICAL AND BIO MEDICAL MICRO SYSTEMS: Sensing mechanism & principle, membrane-transducer materials, chem.-lab-on-a-chip (CLOC) chemoresistors, chemocapacitors, chemotransistors, electronic nose (E-nose), mass sensitive chemosensors, fluroscence detection, calorimetric spectroscopy.

TEXT BOOK:

1. MEMS, Nitaigour Premchand Mahalik, TMH Publishing co.

REFERENCE BOOKS:

1. Foundation of MEMS, Chang Liu, Prentice Hall Ltd.
2. MEMS and NEMS, Sergey Edwrd Lyshevski, CRC Press, Indian Edition.
3. MEMS and Micro Systems: Design and Manufacture, Tai-Ran Hsu, TMH Publishers.
4. Introductory MEMS, Thomas M Adams, Richard A Layton, Springer International Publishers.