DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

MINOR PROGRAM IN INTERNET OF THINGS (IOT)

Scheme of Instruction
(Effective from 2023-2024)

Scheme of MINOR PROGRAM IN INTERNET OF THINGS (IOT)

Course Structure						
S.No	Course Code	Course Structure	L	T	P	Credits
1	MIO01EC	Overview of Internet of Things	3	0	0	3
2	MIO02EC	Introduction to Sensors & Actuators	3	0	0	3
3	MIO03EC	Embedded systems for IoT	3	0	0	3
4	MIO04EC	Introduction to Secutity of Cyber Physical Systems	3	0	0	3
5	MIO05EC	Sensors and Applications Lab	0	0	2	1
6	MIO06EC	IoT Applications Lab	0	0	2	1
7	MIO07EC	Minor Mini Project	0	0	8	4
Total						18

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Detailed Syllabus

MINOR PROGRAM IN INTERNET OF THINGS (IOT)

Course Code	:	MIO01EC
Course Title	:	Overview of Internet of Things
Number of Credits	:	3 (L: 3; T: 0; P: 0)
Course Category	:	IoT

Course Objective: These course objectives and outcomes encompass the entire syllabus, ensuring that students develop a well-rounded understanding of IoT technology and its various dimensions, from foundational concepts to practical applications and governance considerations.

Course Objectives:

1. To provide students with a thorough grasp of IoT concepts, technologies, and applications, covering the entire spectrum of IoT-related knowledge.
2. To enable students to become adept in IoT architecture, including design principles, reference models, and architectural analysis, applicable to diverse IoT scenarios.
3. To equip students with the ability to identify, assess, and implement IoT applications across industries, emphasizing value creation and process enhancement.
4. To cultivate expertise in addressing IoT security, privacy, and governance challenges, ensuring responsible and secure IoT deployments.
5. To help students analyze and understand the evolution from Machine-to-Machine (M2M) to IoT, including value chain dynamics and the global role of IoT.

Course Outcomes: Students

1. will possess a comprehensive understanding of IoT, covering the entire syllabus and its various facets.
2. will master IoT architecture, with the ability to design, evaluate, and critique IoT architectures effectively.
3. will be competent in identifying, evaluating, and implementing IoT applications across industries for value creation.
4. will have the capability to assess and address IoT security, privacy, and governance issues responsibly.
5. will gain strategic insights into IoT's role in industry evolution and its impact on global information systems

Unit 1

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, Recommendations on Research Topics.

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Unit 2

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 3

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, Other Relevant architectural views.

Unit 4

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 on IoT Application and Value for Industry, Home Management, eHealth.

Unit 5

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, Smart Approach. Data Aggregation for the IoT in Smart Cities, Security.

Textbooks/References:

1. Nitesh Dhanjani, Abusing the Internet of Things, Shroff Publisher/O'Reilly Publisher.
2. Internet of Things, RMD Sundaram Shriram K Vasudevan, Abhishek S Nagarajan, John Wiley and Sons.
3. Internet of Things, Shriram K Vasudevan, Abhishek S Nagarajan, RMD Sundaram, John Wiley & Sons.
4. Cuno Pfister, "Getting Started with the Internet of Things", Shroff Publisher/Maker Media.
5. Francis daCosta, "Rethinking the Internet of Things: A Scalable Approach to Connecting Everything", 1 st Edition, Apress Publications.
6. Massimo Banzi, Michael Shiloh Make: Getting Started with the Arduino, Shroff Publisher/Maker Media Publishers.

Corresponding Online Resources:
1. https://www.coursera.org/specializations/internet-of-things

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Course Code		**MIO02EC**
Course Title		**Introduction to Sensors & Actuators**
Number of Credits		**3 (L: 3; T: 0; P: 0)**
Course Category		**IoT**

Course Objective:

1. To understand basic knowledge in transduction principles, sensors and measurement systems.
2. To learn the fundamental principles behind the operation of sensors.
3. To provide the knowledge of velocity and acceleration measurement methods
4. To deploy various measurement methods of physical and electrical Parameters
5. To Apply calibration methods for sensors attached with real time systems

Course Contents:

Unit 1
INTRODUCTION TO MEASUREMENT SYSTEMS
General concepts and terminology, measurement systems, sensor classifications: Analog Input and Output, Digital Input and Output, general input-output configuration, methods of correction. Passive Sensors Resistive Sensors: Potentiometers, Strain Gages, Resistive Temperature Detectors (RTDs),Thermistors, Light-dependent Resistors (LDRs), Resistive Hygrometers. Capacitive Sensors: Variable capacitor and Differential capacitor. Inductive Sensors: Reluctance variation sensors, Eddy current sensors, Linear variable differential transformers (LVDTs), Magneto elastic sensors, Electromagnetic sensors - Sensors based faraday's law of Electromagnetic induction, Touch Sensors: Capacitive, Resistive, Proximity Sensors.

Unit 2
SELF-GENERATING SENSORS
Thermoelectric Sensors: Thermocouples, Thermo electric effects, Common thermocouples, Practical thermocouple laws, cold junction compensation in thermocouples circuits. Piezoelectric Sensors: Piezoelectric effect, piezoelectric materials, applications.

Unit 3
VELOCITY AND ACCELERATION MEASUREMENT
Relative velocity – Translational and Rotational velocity measurements – Revolution counters and Timers – Magnetic and Photoelectric pulse counting stroboscopic methods. Accelerometers-different types, Gyroscopes-applications

Unit 4
DENSITY, VISCOSITY AND OTHER MEASUREMENTS
Units of Viscosity, specific gravity scales used in Petroleum Industries, Different Methods of measuring consistency and Viscosity –Two float viscorator –Industrial consistency meter. Sound-Level Meters, Microphones, Humidity Measurement

Unit 5
CALIBRATION AND INTERFACING
Calibration using Master Sensors, Interfacing of Force, Pressure, Velocity, Acceleration, Flow,

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Density and Viscosity Sensors, Variable Frequency Drive

Text Books/References:

1. Sensors and Transducers: D. Patranabis, TMH 2003
2. Sensor Technology Hand Book – Jon Wilson, Newne 2004.
3. Instrument Transducers – An Introduction to their Performance and design – by Herman K.P.Neubrat, Oxford University Press.

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Course Code	:	MIO03EC
Course Title	:	Embedded Systems for IoT
Number of Credits	:	3 (L: 3; T: 0; P: 0)
Course Category	:	IoT

Course Objective:

1. To make students know the basic concept and architecture of embedded systems.
2. Different design platforms used for an embedded system for IoT applications.
3. To have knowledge about the IoT enabled technology.

Course Contents:

Unit 1

Purpose and requirement specification, IoT level specification, Functional view specification, Operational view specification, Device and component integration, Pillars of Embedded IoT and Physical Devices: The internet of devices.

Unit 2

Design of Embedded Systems: Common Sensors, Actuators, Embedded Processors, Memory Architectures, Software architecture.

Unit 3

Inputs and Outputs: Digital Inputs and Outputs, Digital Inputs, Digital Outputs, BusIn, BusOut, and BusInOut, Analog Inputs and Outputs, Analog Inputs, Analog Outputs, Pulse Width Modulation (PWM), Accelerometer and Magnetometer, SD Card, Local File System (LPC1768).

Unit 4

IoT Enabling Technologies: Communications, RFID and NFC (Near-Field Communication), Bluetooth Low Energy (BLE), LiFi, 6LowPAN, ZigBee, Z-Wave, LoRa, Protocols, HTTP, WebSocket, MQTT, CoAP, XMPP, Node-RED, Platforms, IBM Watson IoT—Bluemix, Eclipse IoT, AWS IoT, Microsoft Azure IoT Suite, Google Cloud IoT, ThingWorx, GE Predix, Xively, macchina.io, Carriots.

Unit 5

Web of Things and Cloud of Things: Web of Things versus Internet of Things, Two Pillars of the Web, Architecture Standardization for WoT, Platform Middleware for WoT, Cloud of Things. IoT Physical Servers,

Cloud Offerings and IoT Case Studies: Introduction to Cloud Storage Models, Communication API.

Text Books/References:

1. RMD Sundaram Shriram K Vasudevan, Abhishek S Nagarajan, Internet of Things, John Wiley and Sons.
2. Klaus Elk, “Embedded Software for the IoT”.

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3. Perry Xiao, “Designing Embedded Systems and the Internet of Things (IoT) with the ARM Mbed”.
4. Elizabeth Gootman et. al, “Designing Connected Products”, Shroff Publisher/O’Reilly Publisher.

Corresponding Online Resources:

1. Introduction to the Internet of Things and Embedded Systems, https://www.coursera.org/learn/iot

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Course Code	:	MIO04EC
Course Title	:	Introduction to Security of Cyber-Physical Systems
Number of Credits	:	3 (L: 3; T: 0; P: 0)
Course Category	:	IoT

Course Objective:

1. To learn the basics of security and various types of security issues.
2. To study different cryptography techniques available and various security attacks.
3. Explore network security and how they are implemented in real world.
4. To get an insight of various issues of Web security and biometric authentication.

Course Contents:

Unit 1

Overview of Security and Privacy in Information System.

Unit 2

Applied Cryptography & Intrusion Detection, Architecture of Applied Cryptography, One Way Hash Function and Integrity, Encryption Algorithms and Confidentiality, Digital Signature and Authentication (DH, RSA, 2 class), Intrusion Detection and Information Theory.

Unit 3

Internet of Things Security, Security and Privacy for IoT Case Study: Smart Home, Smart Grid Network, Modern Vehicle, Wearable Computing & BYOD, Mobile HealthCare.

Unit 4

Software-Defined Networks, Introduction of Software-Defined Networks, Security for Software-Defined Networks, Privacy Leakages for Software-Defined Networks, Case Studies: How to Attack Software-Defined Networks.

Unit 5

Cyber-Physical Systems (CPS), CPS - Platform components, CPS implementation issues, Intelligent CPS, Secure Deployment of CPS.

Text Books/References:

1. Cyber Security, Nina Godbole, John Wiley & Sons.
2. Li Da Xu, Shancang Li, "Securing the Internet of Things", Syngress.
3. Alasdair Gilchrist, "IoT Security Issues", De Gruyter
4. Sean Smith, "The Internet of Risky Things", Sean Smith, Shroff Publisher/O'Reilly Publisher

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Course Code	:	MIO05EC
Course Title	:	Sensors and Actuators Lab
Number of Credits	:	1 (L: 0; T: 0; P: 2)
Course Category	:	IoT

List of Experiments:

1. To sense the Available Networks Using Arduino.
2. To study the digital response an IR motion sensor and to determine its range.
3. To design a motion sensitive intruder alarming system.
4. To measure the distance of an object using SONAR principle by ultrasonic proximity Sensor and to determine the accuracy of the instrument
5. To study the operation of digital humidity sensor and to calculate the accuracy of the device.
6. Measure the Distance Using Ultrasonic Sensor and Make Led Blink Using Arduino.
7. To detect the Vibration of an Object Using Arduino.
8. Connect with the Available Wi-Fi Using Arduino.
9. Sense a Finger When it is Placed on Board Using Arduino.
10. Temperature Notification Using Arduino.
11. LDR to Vary the Light Intensity of LED Using Arduino.
12. MySQL Database Installation in Raspberry Pi.
13. SQL Queries by Fetching Data from Database in Raspberry Pi.
14. Switch Light On and Off Based on the Input of user using Raspberry Pi.

Text books:

1. Intelligent Sensing, Instrumentation and Measurements- Mukhopadhyay, Subhas Chandra
2. LabView Tutorials for Clad – GK publication pvt. limited
3. Arduino programming-Mark Torvalas

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Course Code	:	MIO06EC
Course Title	:	IoT Applications Lab
Number of Credits	:	1 (L: 0; T: 0; P: 2)
Course Category	:	IoT

List of Experiments:

1. Smart Home Assistant with cloud integration
2. Intelligent and Weather Adaptive Street Lighting system
3. Development of Agricultural IoT Gateway
4. Connected Agri Warehouses cloud enabled infrastructure
5. Soldier health & Position tracking system with LORA Communication
6. e-health monitoring system for remote patient health monitoring
7. Smart Biometric Attendance System with Raspberry Pi
8. Cloud integrated smart attendance system
9. Automatic Vehicle Accident Alert System using AWS IoT.
10. Design and implement a RFID based smart attendance system.
11. Design and implement a smart liquid level monitoring system.
12. Design a Smart factory for Industry 4.0 (Sketch)

Supplementary Learning Material:

- Introduction to Industry 4.0 and Industrial Internet of Things - Course (nptel.ac.in)
- https://onlinecourses.nptel.ac.in/noc21_cs63/preview

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Course Code	:	MIO07EC
Course Title	:	Minor Mini Project
Number of Credits	:	4 (L: 0; T: 0; P: 8)
Course Category	:	IoT

Course objectives:
The main objective of Mini Project is to let the students apply the knowledge of theoretical concepts which they have learnt as a part of the curriculum of the minor degree using real time problems or situations.

Guidelines:

1. The mini project is desirable to be done in a group of maximum 3 students. Each group must prepare a title related to any engineering discipline, and the title must emulate any real-world problem.
2. Submit an early proposal. This proposal is a 1-2page(s) report, describes what the project is about and the final product's output. The project proposal will be submitted to the respective guide.
3. **The projects could be of the following types:**
   a) Literature search (LS) type: Studying about an aspect of robotics, say, vision, robot kinematics, dynamic, controls, etc.
   b) Algorithm development (AD) type: Analyse, say, a robot kinematics using Robo Analyzer or MATLAB/ Scilab or similar software or write an algorithm using any programming language (Python, etc.). For example, writing forward kinematics of a robot or image processing in Vision.
   c) Design/synthesis (DS) type: Proposing a new type of system/device for performing certain task. For example, a mobile robot for Covid-19 isolation wards.
4. The teams will be asked to contact their team members within a week and decide their topic with two weeks, i.e., within first 3 weeks of the starting of the course.
5. Students MUST spend about 4 hours in a week to discuss their progress together, study together or individually, write programs, fabricate circuits, etc.
6. During the project session the coordinators will explain how to do literature survey, how to find the sources of hardware, which software to use for a particular purpose, how to select an electric motor, etc., present case studies, etc.
7. At the end of the course duration, each team will submit no more than 10 slides in .pdf file and/or not more than a video of one min to showcase their project hardware/software/plots, etc. generated during the project to a cloud (say, Google Drive).

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