Course Number : **EEE F411 (4 unit course)**

Course Title : **Internet of Things**

Instructor-In-Charge : **Dr. Vinay Chamola**

Note: This course is **discipline elective** for: **Undergraduate level**: B.E (EEE), B.E (E&I**). For other discipline, it will be considered as an open elective.**

1. Scope and Objective:

This module is designed to provide students with solid technical knowledge and skills to build Internet of Things (IoT) systems. Internet of things has evolved due to convergence of multiple technologies - embedded systems, sensor technology, real-time data analytics, machine learning etc. Traditional fields of embedded systems, wireless sensor networks, control systems, automation (including home and building automation), and others all contribute to enabling the IoT. This course comprehensively covers various technologies and tools used for enabling IoT solutions. Knowledge of various topics required for building IoT prototypes like sensors and actuators/ Communications and networking and data management is also imparted in this course. This course would also help the students understand the various IoT security challenges and solution to address them. The course will also give the students exposure to how various real world problems are being solved by IoT based solutions (like in applications for smart city, smart farming etc.). There would also be some hands on sessions where students would learn how to build and program IoT systems and make end-to-end solutions for different applications. Furthermore, assignments and projects in this course would help students build IoT prototypes and apply what they have learnt in the course to solve real world problems.

2. Text Book:

(T1) *Internet of Things: Principles and paradigms*. R. Buyya, and A.V Dastjerdi (Elsevier), 2016.

3. Reference Books:

(R1) "Precision - Internet Of Things", by Timothy Chou (Mc Graw Hill), 2017.
(R2) "The Internet of Things: Enabling Technologies, Platforms, and Use Cases", by Pethuru Raj and Anupama C. Raman (CRC Press), 2017.
(R3) "Internet of Things: A Hands-on Approach", by Arshdeep Bahga and Vijay Madisetti (Universities Press), 2014.
(R4) “Internet of Things” by Raj Kamal (Mc Graw Hill), 2017.
(R5) IEEE and ACM Transactions.

4. Course Plan

Lectures

Module	Topics covered	Lectures
Module 1: Introduction to IoT	Introduction to IoT & Cyber-Physical Systems, IoT applications - an overview, Different Levels of IoT Applications : Level 1 - 6 with examples, IoT Design Methodology & Life Cycle, Introduction to IoT Physical End Points & Platforms, IoT System Design Examples (for applications like fitness tracker, smart parking etc.).	Lecture 1- Lecture 4
Module 2: Sensors and Actuators for IoT	Introduction to sensors for IoT application development, Data Acquisition, Signal Conditioning and Processing, Multi Sensor fusion for IoT, Advanced sensing techniques (e.g. BCI/HCI), Actuators and Controllers for IoT	Lecture 5 - Lecture 8
Module 3: Programming IoT end points	Introduction to Arduino microcontroller & NodeMCU for IoT applications, Programming with Arduino & NodeMCU and prototype development (e.g. for smart farming, smart city applications etc.), Introduction to Raspberry Pi, Programming Raspberry Pi (Python), Rest API based hands on.	Lecture 8- Lecture 18
Module 4: Networking for IoT	Wireless sensor networks: Introduction, Deployment, Localization, Routing, MAC, Time synchronization and Multi-sensor-fusion for WSN	Lecture 18 - Lecture 23
Module 5: Communications and networking in IoT	Ad Hoc networks (MANET, VANET, FANET), Industrial IoT Networks, Common network standards (Bluetooth, NFC, LORA) etc., COAP and MQTT (including lab/ hands-on)	Lecture 24-31
Module 6: Data management in IoT	Data Management for IoT, Advanced optimization for processing sensor data, Machine learning for IoT data analytics, Introduction to IoT Cloud Services, Case studies of Cloud services for IoT and learning how to use them.	Lecture 32-36
Module 7: Security issues in IoT	Cyber-attacks on IoT- Case study, Security solutions for IoT: hardware/software	Lecture 37 - Lecture 40

Lab:

Lab for the course would be in-class labs during the class hours when the relevant topics are covered. Labs would consist of hands on session where the students will learn how to work with microcontrollers and raspberry pi and learn building IoT applications from the scratch. Some of the suggested lab exercises are:

- Programming Arduino/ Nodemcu (esp8266) microcontrollers.
- Blinking LED using the above microcontrollers.
- Interfacing sensors to microcontrollers.
- Connecting microcontrollers to the internet and streaming sensor data to cloud.
- Actuation using microcontrollers.
- Raspberry pi programming and application development.
- Rest API based hands on.
- Lab exercise based on COAP/ MQTT.

Evaluation Scheme:

Component	Duration	Weightage (%)	Date & Time
Midsem	1 hour	25	TBA
Lab Test	1 hour	20	Based on the lab exercises
Project (Prototype implementation)	Will be announced	25	Continuous Evaluation
Comprehensive Examination	120mins	30	TBA

Chamber Consultation Hour: To be announced in Class.

Notices: All notices regarding the course will be mailed.

Make-up Policy: No make-up without prior permission.

Instructor-in-charge