Course Number : **EEE F411**

Course Title : **Internet of Things**

Instructor-In-Charge : **Sandeep Kumar**

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	Sources
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 8	**Class slides and notes.** (Optional -T1: Ch-1, 12, R3: Ch-1, R4: Ch-1)
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 9 - Lecture 14	**Class slides and notes.** (Optional -T1: Ch-15, R4: Ch-7)
Module 3: Programming IoT end points	Introduction to Arduino microcontroller for IoT applications, Programming with Arduino and prototype development (e.g. for smart farming, smart city applications etc.), Introduction to Raspberry Pi, Programming Raspberry Pi (Python), Introduction to Android platform and services, Android App development for IoT Applications	Lecture 15- Lecture 24	**Class slides and notes + Internet resources.**
Module 4: Communications and networking in IoT	Introduction to IoT Network, Communication & Networking Requirements in IoT, Network Models & Architecture (Client-server, P2P etc.), Wireless sensor networks, Other Ad Hoc networks (MANET, VANET), Common network standards (Bluetooth, NFC, LORA) etc.	Lecture 25 - Lecture 31	**Class slides and notes.** (Optional -T1: Ch-3, R3: Ch-4, R4: Ch-4)
Module 5: 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- Lecture 36	**Class slides and notes.** (Optional -T1: Ch-8,9, R3: Ch-10, R4: Ch-5,6)
Module 6: Security issues in IoT	Cyber-attacks on IoT- Case study, Security solutions for IoT: hardware/software	Lecture 37 - Lecture 38	**Class slides and notes.** (Optional -T1: Ch-10, R4: Ch-10)
Module 7: Emerging topics in the IoT	Smart-grid, Industrial IoT etc.	Lecture 39 - Lecture 41	**Class slides and notes.** (Optional -T1: Ch-16)

Lab:

Lab for the course would be once in a week for 2 - 3-hour duration. 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. The lab exercises will include:

- Programming Arduino/ Nodemcu (esp8266) 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.
- Interfacing Android mobile with Arduino/ Raspberry pi based applications.

Evaluation Scheme:

No	Evaluation Component & Type	Duration	Weightage	Marks (out of 300)	*Date, Time, Venue*	Remark
1	Midsem Examination (No Change)	1.5 hours	20%	60	05/03/2020, 2:00 – 3:30 PM in F102	CB
2	4 Quizzes (1 Surprise + **3 Announced**)	25 to 30 minutes each	30%	10+**20+30+30** = 90	(Dates + Syllabus) => Notice on email + CMS	**To be conducted on CMS**
3	Lab performance (No Change)	2 hours per lab	10%	30	TBA	OB
4	**Lab Project (Eliminated)**	-	-	-	-	**Eliminated**
5	Comprehensive Examination (No Change)	3 hours	40%	120	11/05/2020, FN	CB
	Total		100%	300		

Chamber Consultation Hour: To be announced in Class.

Notices: All notices regarding the course will be put up on CMS.

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

Academic Honesty and Integrity Policy: Academic honesty and integrity are to be maintained by all the students throughout the semester and no type of academic dishonesty is acceptable.

Instructor-in-charge