11 Aug, 2023

Course Number:	**EEE F411**
Course Name:	**Internet of Things**
Instructor and IC:	**Dr. Atri Mukhopadhyay**
Lab TAs and Instructors:	**Dr. Ponnalagu R N, Ritesh Kumar Singh, and Krishnapriya G B, K Dasharath, Dr. Atri Mukhopadhyay**

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

Lecture No.	Learning objectives	Topics to be covered	Chapter in the Text Book
Lecture 1- Lecture 8	Introduction to IoT, IoT Ecosystem, Architectures, Resource Management, and Application Levels.	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.).	Class slides and notes. **(T1: Ch-1, 12, R3: Ch-1, R4: Ch-1)**
Lecture 9 - Lecture 14	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	Class slides and notes. **(T1: Ch-15, R4: Ch-7)**
Lecture 15- Lecture 24	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	Class slides and notes + Internet resources.
Lecture 25 - Lecture	Communications and networking	Introduction to IoT Network, Communication & Networking	Class slides and notes. **(T1: Ch-3, R3:**

31	in IoT	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.	**Ch-4, R4: Ch-4)**
Lecture 32- Lecture 36	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.	Class slides and notes**. (T1: Ch-8,9, R3: Ch-10, R4: Ch-5,6)**
Lecture 37 - Lecture 38	Security issues in IoT	Cyber-attacks on IoT- Case study, Security solutions for IoT: hardware/software	Class slides and notes. **(T1: Ch-10, R4: Ch-10)**
Lecture 39 - Lecture 41	Emerging topics in the IoT	Smart-grid, Industrial IoT etc.	Class slides and notes. **(T1: Ch-16)**

Labs: Lab for the course would be once in a week for 2 hour of duration. It would consist of the demo sessions where the students will learn how to work with microcontrollers and raspberry pi and learn building IoT applications starting from the scratch. The list of experiments to be conducted along with the schedule and evaluation scheme is as follows:

S No	Name of Experiment	Week	Evaluation Method
1	Introduction to Raspberry-pi 3 and Python Programming.	1st	Performance in lab sessions and lab assignment.
2	Interfacing the Raspberry-pi with smartphones and Android Apps for smart home applications. [circuit design, coding and demonstration]	2nd	
3	Home Security Systems with Raspberry-pi, sensors, actuators and the cloud computing platforms. [circuit	3rd	

	design, coding and demonstration]		
4	Web-Socket programming and implementation by using Raspberry-pi client interfaced with DTH sensor, and Spyder-enabled desktop server. [circuit design, coding and demonstration]	4th	
5	Design of a temperature dependent auto-cooling system using Raspberry-pi, DHT sensor and a cooling fan. [circuit design, coding and demonstration]	5th	
6	Pi-Camera interfacing with Raspberry-pi and implementation of SMTP protocol for sending the captured images to email addresses. [circuit design, coding and demonstration]	6th	
7	Introduction to BOLT IoT kit and its interfacing with sensors, actuators and smartphones.	7th	
8	Internet-based remote control of the home appliances by using BOLT IoT kit, sensors, actuators, Android App and the cloud computing platform. [circuit design, coding and demonstration]	8th	
9	Introduction to Arduino microcontroller and its programming.	9th	
10	Controlling of traffic lights using Raspberry Pi and Arduino uno.	10th	

Overall Evaluation Scheme:

S. No	Evaluation Component	Weightage	Marks (out of 300)	Duration	Date and Time	Nature of Component
1	Mid-Semester Test	30 %	90	90 minutes	11/10 - 4.00 - 5.30PM	Closed book

2	Quizzes **No Makeup for any quiz**	10 %	30	To be announced	To be announced	Closed book
3	Lab Sessions	10 %	30	Each of 2 hours	As per time table	Open book
4	Lab Assignment	10 %	30	To be announced	To be announced	Open book
5	Comprehensive Exam	40 %	120	3 hours	13/12 AN	Closed book
	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 will be provided without prior permission from the Instructor-In-charge (IC).

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.

(Dr. Atri Mukhopadhyay)

Instructor-in-charge