Name of Institute: Institute of Technology and Engineering
Name of Faculty: Asst. Prof Abhishek Vaghela

Course code: CE0706
Course name: IoT & Applications
Pre-requisites: Digital Electronics, Computer Architecture
Credit points: 4
Offered Semester: VII

Course coordinator (weeks 12)
Full name: Asst. Prof. Abhishek Vaghela
Department with siting location: EC Department, Signal Processing and Simulation Lab (Lab – 6)
Telephone: 3204
Email: abhishekvaghela.ec@indusuni.ac.in
Consultation times: Monday – Friday (4:00 PM to 4: 50 PM)

Course lecturer (weeks 12)
Full name: Asst. Prof. Abhishek Vaghela
Department with siting location: EC Department, Signal Processing and Simulation Lab (Lab – 6)
Telephone: 3204
Email: abhishekvaghela.ec@indusuni.ac.in
Consultation times: Monday – Friday (4:00 PM to 4: 50 PM)

Students will be contacted throughout the session via mail with important information relating to this course.

Course Objectives

By participating in and understanding all facets of this course a student will:

1) Be able to explain the Principles of Internet of Things
2) Be able to Identify the Challenges and Research Scope in the Wireless Communication Protocols used in IoT Applications
3) Be able to employ IoT Solutions to Real Time Engineering Problems
4) Be familiar with the Data Management Techniques, Architectures and various key enablers to enable practical IoT systems

Course Outcomes (CO)

1. To ***learn*** about IoT and M2M Systems, IoT Architecture and tools
2. To ***analyze*** basic wireless communication Protocols used in IoT Applications
3. To ***identify*** the design, development and security challenges in IoT Systems
4. To ***study*** IoT Applications in Different Domains and be able to ***measure*** their performance
5. To ***implement*** basic IoT Applications on Embedded Platforms

Course Outline

This course aims has been offered with the aim of providing the students with in depth knowledge about Internet of Things. The curriculum includes details about Sensors, Actuators, Sensor Networks, IoT Concept, Network & Communication in Sensor Networks and IoT Applications.

Method of delivery

Face to face lectures, self study material, Active Learning Techniques, PowerPoint Presentation and Assignments

Study time

Lecture hours: 3 hours
Lab hours: 2 hours

CO-PO Mapping (PO: Program Outcomes)

Program Outcomes (POs)

PO1. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2. **Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO6. **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7. **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9. **Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11. **Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12. Life-long learning: Recognize the need for and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcomes (PSOs)

At the end of the program, the Computer Engineering student:

PSO1. Basics of Computer System: Should able to understand the principles and working of computer systems. Students can assess the hardware and software aspects of computer systems.

PSO2. Program Design: Design and develop computer programs in the areas related to algorithms, networking, web design, cloud computing, IoT and data analytics.

PSO3.Software Development: Should able to understand the structure and development methodologies of software systems with the use of a various programming languages and open source platforms.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	-	-	-	2	-	-	-	-	1	-	-	1	-	-
CO2	-	3	-	2	-	-	-	-	-	-	-	-	-	2	-
CO3	2	-	-	3	-	2	3	-	-	-	-	-	-	2	-
CO4	2	3	2	3	-	2	3	-	-	2	-	-	-	2	-
CO5	2	-	3	-	3	3	-	-	-	-	2	3	1	3	3

Blooms Taxonomy and Knowledge retention (For reference)

(Blooms taxonomy has been given for reference)

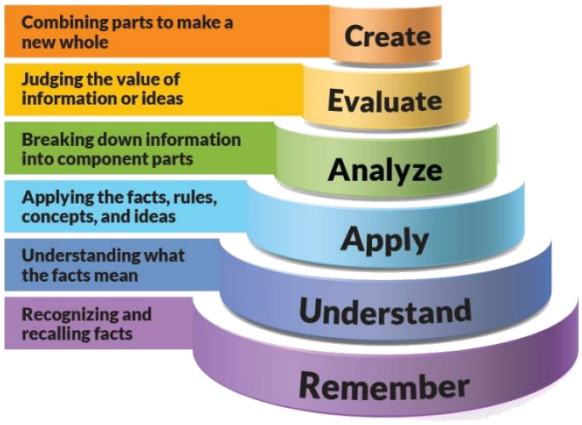

Figure 1: Blooms Taxonomy

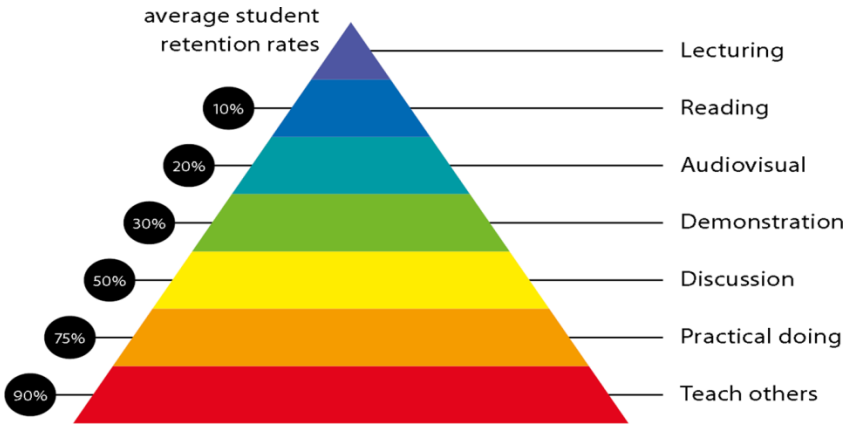

Figure 2: Knowledge retention

Practical work:

	Lab Number	Practical	CO Addressed
	1	**Study of Arduino development board**	3
	2	**Study of IoT protocols MQTT and CoAP**	2
	3	**Study of ESP8266 and NodeMCU development board**	1
	4	**Blink LED at a fixed interval with - Arduino, NodeMCU**	5
	5	**Interface analog sensor (temperature sensor LM35) with - Arduino and test simulation in Proteus, NodeMCU**	5
	6	**Configure ESP8266/NodeMCU in Station and in Access Point modes**	5
	7	**Develop offline Webserver to control GPIO: Demonstrate offline web server using HTML webpage which can be accessed from web browser and through which LED can be toggled**	5
	8	**Using IoT protocol: Demonstrate simple publish subscribe mechanism of MQTT protocol using MQTT protocol**	2, 5
	9	**Using IoT with NodeRED and Raspberry Pi: Implement a visitor counter which counts the visitors using motion (PIR) sensor and publishes the counts to an android phone using MQTT protocol. Interface PIR sensor with Raspberry Pi and implement the logic using Node RED**	2, 5
	10	**Using IoT with NodeRED and Raspberry Pi: Implement a visitor counter which counts the visitors using motion (PIR) sensor and publishes the counts to an android phone using MQTT protocol. Interface PIR sensor with Raspberry Pi and implement the logic using Node RED**	2, 5

Lecture/tutorial times

(Give lecture times in the format below)

Example:

Lecture	Monday	12:20 PM to 01:20 PM
	Thursday	12:20 PM to 01:20 PM
	Friday	12:20 PM to 01:20 PM

Attendance Requirements

The University norms states that it is the responsibility of students to attend all lectures, tutorials, seminars and practical work as stipulated in the course outline. Minimum attendance requirement as per university norms is compulsory for being eligible for semester examinations.

Details of referencing system to be used in written work

Text books

1. Internet of Things Principles and Paradigms, Edited By Rajkumar Buyya, Amir Vahid Dastjerdi, Morgan Kaufmann, ELSEVIER

Reference books

1. Fundamentals of Wireless Sensors Networks Theory and Practice, Waltenegus Dargie and Christian Poellabauer, WILEY Series
2. Rethinking the Internet of Things A Scalable approach to connecting everything, Francis daCosta, Apress Open
3. Arduino Cookbook, Michael Margolis, O'REILLY
4. Internet of Things - From Research and Innovation to Market Deployment, Edited By Ovidiu Vermesan and Peter Friess, River Publishers

Additional Materials

1. NPTEL- Lecture
   https://nptel.ac.in/courses/106105166/

ASSESSMENT GUIDELINES

Your final course mark will be calculated from the following:

Example:	
Attendance	5%
Quiz I	5%
Assignment	**5%**
Assignment	**5%**
Mid semester	40%
Final exam (*closed book*)	40%

SUPPLEMENTARY ASSESSMENT

Students who receive an overall mark less than 40% in internal component or less than 40% in the end semester will be considered for supplementary assessment in the respective components (i.e internal component or end semester) of semester concerned. Students must make themselves available during the supplementary examination period to take up the respective components (internal component or end semester) and need to obtain the required minimum 40% marks to clear the concerned components.

Practical Work Report/Laboratory Report:

A report on the practical work is due the subsequent week after completion of the class by each group.

Late Work

Late assignments will not be accepted without supporting documentation. Late submission of the reports will result in a deduction of -% of the maximum mark per calendar day

Format

All assignments must be presented in a neat, legible format with all information sources correctly referenced. **Assignment material handed in throughout the session that is not neat and legible will not be marked and will be returned to the student.**

Retention of Written Work

Written assessment work will be retained by the Course coordinator/lecturer for two weeks after marking to be collected by the students.

University and Faculty Policies

Students should make themselves aware of the University and/or Faculty Policies regarding plagiarism, special consideration, supplementary examinations and other educational issues and student matters.

Plagiarism - Plagiarism is not acceptable and may result in the imposition of severe penalties. Plagiarism is the use of another person's work, or idea, as if it is his or her own - if you have any doubts at all on what constitutes plagiarism, please consult your Course coordinator or lecturer. Plagiarism will be penalized severely.

Do not copy the work of other students.
Do not share your work with other students (except where required for a group activity or assessment)

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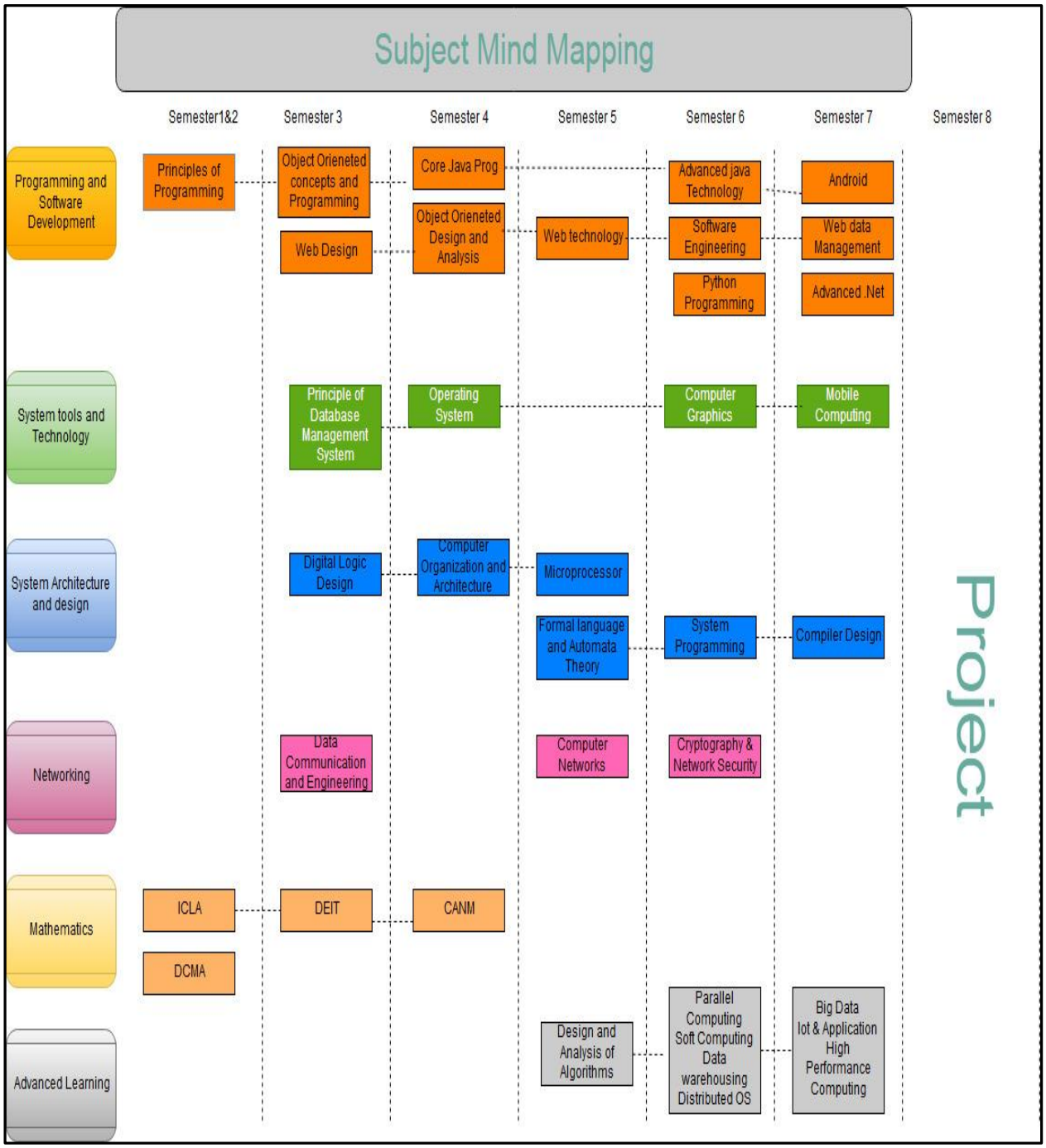
Course schedule (subject to change)

(Mention quiz, assignment submission, breaks etc as well in the table under the Teaching Learning Activity Column)

	Week #	Topic & contents	CO Addressed	Teaching Learning Activity (TLA)
	Weeks 1	Defining IoT, Characteristics of IoT, Physical design of IoT, Logical design of IoT, Functional blocks of IoT, Communication models & APIs, Machine to Machine, IoT versus Machine to Machine	1	Assignment, Quiz
	Weeks 2	Challenges in IoT: Design challenges, Development challenges, Security challenges;	1, 3	Assignment, Quiz
	Week 3	Application of IoT: Home automation, Industry applications, Surveillance applications	4	Project
	Week 4	Wireless medium access issues, MAC protocol survey, Survey routing protocols	2	Quiz, Assignment
	Week 5	Sensor deployment & Node discovery	2	Quiz, Assignment
	Week 6	Data Aggregation & Dissemination	2	Quiz, Assignment
	Week 7	Introduction, OpenIoT Architecture for IoT/Cloud Convergence	1,3,4	Quiz, Assignment
	Week 8	Scheduling Process and IoT Service Lifecycle	1, 3	Quiz, Assignment
	Week 9	Scheduling and Resource Management, Device/Cloud Collaboration Framework	1, 3, 4	Quiz, Assignment
	Week 10	Applications of Device/Cloud Collaboration	2, 3, 4	Quiz, Assignment
	Week 11	Message Passing in Devices, Survey of IoT Programming Framework, Virtualization and Real Time	3, 4	Quiz, Assignment

	Week 12	Stream Processing in the System Architecture of IoT, Continuous Logic Processing System, Challenges in Stream Processing	3, 4	Case Study


Subject Mind Mapping
Semester1&2
Semester 3
Semester 4
Semester 5
Semester 6
Semester 7
Semester 8
Programming and Software Development
Principles of Programming
Object Orieneted concepts and Programming
Web Design
Core Java Prog
Object Orieneted Design and Analysis
Web technology
Advanced java Technology
Software Engineering
Python Programming
Android
Web data Management
Advanced .Net
System tools and Technology
Principle of Database Management System
Operating System
Computer Graphics
Mobile Computing
System Architecture and design
Digital Logic Design
Computer Organization and Architecture
Microprocessor
Formal language and Automata Theory
System Programming
Compiler Design
Networking
Data Communication and Engineering
Computer Networks
Cryptography & Network Security
Mathematics
ICLA
DCMA
DEIT
CANM
Advanced Learning
Design and Analysis of Algorithms
Parallel Computing Soft Computing Data warehousing Distributed OS
Big Data Iot & Application High Performance Computing
Project