Marwadi University

FACULTY OF COMPUTER APPLICATIONS
B.Sc. (IT)

- **Sem.** : 5
- **Subject Code** : 05BS0506
- **Subject** : Internet of Things
- **Course Objectives** : After learning the course the students should be able to -
  1. Explain the basics of IoT, M2M, IoT enabling technologies, characteristics of IoT systems and IoT levels.
  2. Explain different state of art IoT reference models and architectures as well as Architecture Reference Model (ARM) for IoT.
  3. Explain the IoT protocols, IoT security aspects and generic design methodology.
  4. Discuss IoT applicability in various domains and interface IoT devices and Sensors with Arduino.
  5. Build real-life IoT based projects.
- **Prerequisites** : Basic knowledge of Computer Networks and programming.

Unit No	Topics Covered	No of lectures required

1	**Introduction to IoT and M2M**:
	• IoT Introduction
	  • Definition & Characteristics of IoT
	  • Physical Design of IoT
	  ○ Things in IoT
	  • Logical Design of IoT
	  ○ Functional Blocks , IoT
	  ○ Communication Models , IoT
	  ○ Communication APIs
	  • IoT Enabling Technologies
	  • IoT Levels & Deployment Templates
	• M2M Introduction
	  • From M2M to IoT
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	• M2M towards IoT – the global context • M2M value chains • IoT value chains • Differing characteristics	
2	**IoT Architecture:** • Introduction • State of the Art ○ European Telecommunications Standards Institute M2M/oneM2M ○ International Telecommunication Union Telecommunication sector view ○ Internet Engineering Task Force architecture fragments ○ Open Geospatial Consortium architecture • Architecture Reference Model ○ Introduction, ○ Reference model and architecture, ○ IoT reference model ▪ IoT domain model, Information model, Functional model, Communication model, Safety, privacy, trust, security model ○ IoT Reference Architecture ▪ Introduction, Functional view, Information view, Deployment and operational view	12
3	**IoT Platform Design Methodology and Domain Specific IoTs** • Introduction to IoT design methodology and its steps • Domain Specific IoTs • Home Automation ○ Smart Lighting ○ Smart Appliances ○ Intrusion Detection ○ Smoke/Gas Detectors • Cities ○ Smart Parking ○ Smart Lighting ○ Smart Roads ○ Structural Health Monitoring ○ Surveillance	08

	○ Emergency Response • Environment ○ Weather Monitoring ○ Air Pollution Monitoring ○ Noise Pollution Monitoring ○ Forest Fire Detection ○ River Floods Detection • Energy ○ Smart Grids ○ Renewable Energy Systems ○ Prognostics • Retail ○ Inventory Management ○ Smart Payments ○ Smart Vending Machines • Agriculture ○ Smart Irrigation ○ Green House Control • Industry ○ Machine Diagnosis & Prognosis ○ Indoor Air Quality Monitoring	
4	**IoT Protocols and Security:** • IoT Protocols : Protocol Standardization for IoT Efforts, M2M and WSN Protocols, SCADA and RFID Protocols, Issues with IoT Standardization, Unified Data Standards, Protocols – IEEE 802.15.4, BACnet Protocol, Modbus, KNX, Zigbee Architecture, Network layer, APS layer. • IoT Security: Need for IoT Security, IoT Vulnerabilities, Elements of IoT Security, IoT Security best practices, Threat Modeling an IoT system	**8**
5	**Open – Source Prototyping platform for IoT** • Arduino Basics • Arduino Programming • Interfacing IoT devices and Sensors with Arduino	**12**

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Course Outcomes : After completion of this course, student will be able to

Sr. No.	Outcome	Bloom Level
CO1	Compare M2M and IoT; discuss applicability of IoT enabling technologies, characteristics of IoT systems and IoT levels.	Understand
CO 2	Explain different state of art IoT reference models and architectures as well as Architecture Reference Model (ARM) for	Understand
CO 3	Analyze various protocols for IoT, IoT security aspects and generic design methodology	Analyze
CO 4	Build IoT application by interfacing IoT devices and Sensors with Arduino	Apply
CO5	Develop IoT based projects.	Apply

Course Outcomes – Program Outcomes Mapping Table:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	M						M	
CO2	M	L				M	M	
CO3	M	L	L			H	M	
CO4	H	M	H	M	M	M	H	H
CO5	H	H	H	M	H	H	H	H

Text Book :

1. Arshdeep Bahga and Vijay Madisetti, “Internet of Things - A Hands-on-Approach”, 1 st Edition, VPT, 2014
2. From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence, Jan Holler, Vlasios Tsiatsis, Catherine Mulligan, Stefan Aves and Stamatis Karnouskos, David Boyle, ELSEVIER
3. The Internet of Things in the Cloud:A Middleware Perspectiv,By Honbo Zhou
4. IoT Security for Dummies, Lawrence Miller, John Wiley & Sons Ltd.
5. Make: Learn electronics with Arduino, Jodi Culkin and Eric Hagan, Maker Media

Reference Books :

1. Practical Internet of Things Security, Brian Russell, Drew Van Duren, PACKT publishing
2. Getting Started with the Internet of Things, CunoPfister
3. Programming Arduino: Getting started with sketches, Simon Monk , TMH
4. Getting Started with Arduino: A Beginners Guide, Brad Kendal
5. Make: Getting Started with Arduino, Massimo Banzi, Michael Shiloh, Makermedia

6. Make: Getting Started with Sensors, Kimmo Karvinen, Tero Karvinen, Makermedia

Web References :

1. https://www.arduino.cc/
2. https://nptel.ac.in/courses/106105166
3. https://onlinecourses.swayam2.ac.in/aic20_sp04/preview
4. http://www.tinkercad.com
5. https://www.makerspaces.com/15-simple-arduino-uno-breadboard-projects/

App References :

1. Udemy
2. Coursera

Syllabus Coverage from text /reference book & web/app reference:

Unit #	Chapter Numbers
1	Book 1 : 1, Book 2: 2,3
2	Book 2 : 6,7,8
3	Book 1 : 2,5
4	Book 3 : 6, Book 4: 2,3,6
5	Book 5 : 1 to 9

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PRACTICALS	
NOTE: 1. All Programs to be done using Simulation Tool like Tinkercad or any other simulation tool.	
Practical No	**Problem Statement**
1	Program to blink Arduino onboard LED and To interface external LED with Arduino and write a program to turn ON LED for 1 sec after every 2 seconds.
2	To interface 5 LED's with Arduino and write a program to blink 6 LEDs, one at a time, in a back and forth formation.
3	To interface Push button with Arduino and write a program to turn ON LED when push button is pressed.
4	To interface Push button, Speaker/buzzer with Arduino and write a program to turn ON LED and generate a note or tone when push button is pressed.
5	To interface 2 Push buttons, a Speaker with Arduino and write a program to turn ON LED and generate a 2 different notes on two button keyboard.
6	To interface Seven Segment Display (SSD) with Arduino and write a program to blink SSD.
7	To interface Seven Segment Display (SSD) with Arduino and write a program to print numbers from 1 to 4 on SSD.
8	To interface LCD, push button, potentiometer with Arduino and write a program to display message on LCD when push button is pressed.
9	To interface LCD, push button, potentiometer with Arduino and write a program to display the no. of times (count) the push button is pressed on LCD.
10	To interface LED's, potentiometer with Arduino and write a program to turn on or off more of the LEDs by turning the potentiometer knob.
11	To interface LED, Photoresistor (LDR) with Arduino and write a program to increase and decrease the brightness of the LED based on the amount of light present.
12	To interface LED's with Arduino and write a program to show the fading effect on LED's.
13	To interface DHT11 sensor with Arduino and write a program to display temperature and humidity data on serial monitor.
14	To interface PIR/ Ultrasonic sensor with Arduino and write a program to turn on and off LED depending on motion detection/sound detection.
15	To interface servo motor/DC motor with Arduino and write a program to sweep a servo back and forth through its full range of motion/ to control a DC motor.
16	To build a mini project based on interfacing any combination of sensors with Arduino.