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18.6. Detailed Syllabus

(i) Introduction to Internet of Things – Applications/Devices, Protocols and Communication Model

Introduction - Overview of Internet of Things(IoT), the characteristics of devices and applications in IoT ecosystem, building blocks of IoT, Various technologies making up IoT ecosystem, IoT levels, IoT design methodology, The Physical Design/Logical Design of IoT, Functional blocks of IoT and Communication Models, Development Tools used in IoT.

(ii) Things and Connections

Working of Controlled Systems, Real-time systems with feedback loop e.g. thermostat in refrigerator, AC, etc. Connectivity models – TCP/IP versus OSI model, different type of modes using wired and wireless methodology, The process flow of an IoT application.

(iii) Sensors, Actuators and Microcontrollers

Sensor - Measuring physical quantities in digital world e.g. light sensor, moisture sensor, temperature sensor, etc.

Actuator – moving or controlling system e.g. DC motor, different type of actuators

Controller – Role of microcontroller as gateway to interfacing sensors and actuators, microcontroller vs microprocessor, different type of microcontrollers in embedded ecosystem.

(iv) Building IoT applications

Introduction to Arduino IDE – writing code in sketch, compiling-debugging, uploading the file to Arduino board, role of serial monitor.

Embedded ‘C’ Language basics - Variables and Identifiers, Built-in Data Types, Arithmetic operators and Expressions, Constants and Literals, assignment.

Conditional Statements and Loops - Decision making using Relational Operators, Logical Connectives - conditions, if-else statement, Loops: while loop, do while, for loop, Nested loops, Infinite loops, Switch statement.

Arrays – Declaring and manipulating single dimension arrays

Functions - Standard Library of C functions in Arduino IDE, Prototype of a function: Formal parameter list, Return Type, Function call.

Interfacing sensors – The working of digital versus analog pins in Arduino platform, interfacing LED, Button, Sensors-DHT, LDR, MQ135, IR. Display the data on Liquid Crystal Display(LCD), interfacing keypad

Serial communication – interfacing HC-05(Bluetooth module)

Control/handle 220V AC supply – interfacing relay module.

(v) Security and Future of IoT Ecosystem

Need of security in IoT - Why Security? Privacy for IoT enabled devices- IoT security for consumer devices- Security levels, protecting IoT devices

Future IoT eco system - Need of power full core for building secure algorithms, Examples for new trends - AI, ML penetration to IoT

(vi) Soft skills-Personality Development

Personality Development - Determinants of Personality- self-awareness, motivation, self-discipline, etc., building a positive personality, gestures.

Self-esteem - self-efficacy, self-motivation, time management, stress management, Etiquettes & manners.

Communication and writing skills- objective, attributes and categories of communication, Writing Skills – Resume, Letters, Report, Presentation, etc. Interview skills and body language.

18.7. Use-case for building IoT based Applications

A. Using Arduino and sensors/actuators

- i. Interfacing Light Emitting Diode(LED)- Blinking LED :
This use case will be used for familiarizing the GPIO peripheral of atmega micro controller. The LED will be used as a device and GPIO will work as output mode.
- ii. Interfacing Button and LED – LED blinking/glow when button is pressed
This use case will help to understand the GPIO in two different modes, Input - Button and LED - output mode.
- iii. Interfacing Light Dependent Resistor (LDR) and LED, displaying automatic night lamp

- This use case will help to understand ADC peripheral and how to read analog data from sensors.
- iv. Interfacing Temperature Sensor(LM35) and/or humidity sensor (e.g. DHT11)
This use case will help to connect traditional environmental monitoring sensors (Temperature and humidity) to the Arduino development board. Also use the suitable libraries for implementing these case studies.
 - v. Interfacing Liquid Crystal Display(LCD) – display data generated by sensor on LCD
This case study will demonstrate how to provide local display unit with Arduino micro controller. Use suitable libraries for implementing these case studies.
 - vi. Interfacing Air Quality Sensor-pollution (e.g. MQ135) - display data on LCD, switch on LED when data sensed is higher than specified value.
This use case will help to understand how to use traditional smart pollution management sensors with Arduino platform for developing applications as a part of smart city projects.
 - vii. Interfacing Bluetooth module (e.g. HC05)- receiving data from mobile phone on Arduino and display on LCD
This use case will help to understand the connectivity solution to Arduino to a gadget like mobile phone. Bluetooth is used as connectivity solution in this application.
 - viii. Interfacing Relay module to demonstrate Bluetooth based home automation application. (using Bluetooth and relay).
This use case will enable the IoT node capability of Arduino development boards by integrating actuator (relay connected to GPIO) to Arduino board and remote connectivity (Using Bluetooth) using a mobile phone with the help of a readily available Bluetooth serial application.

18.8. Reference Books/Study Material

1. Macro Schwartz, “Internet of Things with Arduino- Cookbook”, Packt 2016
2. Arshdeep Bajga and Vijay Madiseti, “Internet of Things- A Hands-on Approach” Universities Press, 2014
3. Massimo Banzi, “Getting started with Arduino”, 2nd Edition, Oreilly, 2011 [Make:Makezine.com]
4. Macro Schwartz, “Internet of Things with Arduino”, Open Home Automation
5. Michael Margolis, “Arduino Cookbook”, Oreilly, 2011

19. Sample Practical Assignments

19.1. Information Technology Tools and Network Basics (M1-R5)

- i. Do the following settings
 - a. Display pointer trails
 - b. Change the normal pointer of a mouse to another pointer
 - c. Set the date advanced by 2 months
 - d. Reset the system date & time
 - e. Set the system time late by 2 hrs: 40 minutes.