20ES003 - Design of Internet of Things

UNIT –I

Introduction to IoT

Definitions - IoT, Sensors, Cloud, Edge computing, AI/ML, Machine to machine communication, Wireless communication protocols, Low Bandwidth requirements, Low power requirements in Industry, Battery life calculation.

UNIT - II

Microcontrollers, Sensors and Actuators

Difference between analog and digital sensors and interface methods, Interfacing sensors in Power saving modes and best practices. Prototyping boards - Arduino, Raspberry Pi. STM32 ARM based microcontrollers coding in C for interface protocols - USART, ADC, SPI, I2C, DMA.

UNIT - III

IoT : communication protocols and firmware OTA updates

Sockets - TCP/IP, UDP, Bluetooth. MQTT, CoAP, HTTPS vs MQ - Why low bandwidth devices are best suited for IoT, IEEE 802.11, Bluetooth classic vs BLE 5.0 (Beacons, Services and Characteristics),NFC, LoRa, Zigbee, 2G/3G/4G , NB-IoT. Firmware OTA. Bandwidths and energy limitations of wireless protocols - Govt standards.

UNIT -IV

IoT Cloud and Security

Introduction to application server/cloud computing, Encryption, MQTT over TLS1.2, Vulnerabilities, DDoS and Man in the middle attacks on IoT devices, Hardening of Embedded Linux/RTOS.

UNIT - V

IoT Case studies.

NB - IoT, IoT in global smart cities, Connected cows, IIoT vs Consumer IoT. Industrial automation: PLC and SCADA, Industry 4.0: Smart factory initiative

Textbooks:

1. IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things- David Hanes, CCIE No. 3491 Gonzalo Salgueiro, CCIE No. 4541 Patrick Grossetete Robert Barton, CCIE No. 6660, CCDE No. 2013:6 Jerome Henry, CCIE No. 24750
2. IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Thingsby David Hanes, Gonzalo Salgueiro, Rob Barton
3. STM32 Arm Programming for Embedded Systems: Using C Language with STM32 Nucleo Muhammad Ali Mazidi
4. STM32 Arm Programming for Embedded Systems (Volume 6) by Muhammad Ali Mazidi.
5. Internet of Things: Converging Technologies for Smart Environments and Integrated Ecosystems, Dr.OvidiuVermesan, Dr. Peter Friess, River Publishers.

LIST OF EXPERIMENTS:(Any 10 Experiments)

1. Familiarization with Arduino / Raspberry pi, and perform necessary software installation.
2. To interface motor using relay with Arduino / Raspberry Pi and write a program to turn on motor when push button is pressed.
3. Write a program on Arduino / Raspberry Pi to retrieve temperature and humidity data from things speak cloud.
4. To Install MYSQL database on Raspberry Pi and perform basic SQL queries.
5. Write a program on Arduino / Raspberry Pi to publish temperature data to MQTT broker.
6. Write a program to create TCP server on Arduino /Raspberry Pi and respond with humidity data to TCP client when requested.
7. Write a program on Arduino / Raspberry Pi to subscribe to MQTT broker for temperature data and print.
8. Write a program to create UDP server on Arduino / Raspberry Pi and respond with humidity data to UDP Client when requested.
9. Interfacing sensors on STM32 using protocols
   a)SPI,
   b) I2C,
   c) UART,
   d) ADC protocols
   Use CubeMX tool for code initialization and Keil uV5 software.
10. To log data (temperature and moisture) measurements in the cloud and display these measurements on an online dash board using ESP8266 Wi-Fi module.
11. .To control devices (LED here) through cloudfrom anywhere in the world using the ESP8266 Wi-Fimodule.
12. Using ESP8266 data is posted to Twitter, Facebook post is created and weather data from Yahoo isobtained.
13. To send notifications (email, message or push notifications) using ESP8266.
14. .To carry out M2M (machine-to-machine) communications using the ESP8266 module.