NIRMA UNIVERSITY

Institute:	Institute of Technology, School of Technology
Name of Programme:	MTech CSE, MTech CSE (Cyber Security)
Course Code:	6CS264ME22
Course Title:	Internet of Things
Course Type:	Department Elective-III
Year of Introduction:	2022-23

L	T	Practical Component				C
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Course Learning Outcomes (CLO):

At the end of the course, the students will be able to:

1. explain the fundamental concepts, architectures, and functional stacks of IoT (BL2)
2. analyse and implement communication protocols and access technologies (BL4)
3. analyse and compare different IoT network and application layer protocols to determine their suitability for various IoT applications (BL4)
4. design and implement an IoT-based system using machine learning, big data analytics, and lightweight web services to address real-world challenges. (BL6)

Unit	Contents	Teaching Hours (Total 45)
Unit-I	**Introduction to IoT**: Introduction, applications, need and scope of IoT, Various IoT architectures, functional stack, Processors and Operating Systems for resource-constrained devices	05
Unit-II	**IoT HW and Access Technologies:** Sensors and actuators, smart objects, Connecting objects, protocols and access technologies like IEEE802.15.4, LFNBPLC, LoRaWAN, WirelessHART, LTE-M, BLE, NB-IoT, Sigfox, White-Fi and HaLow	12
Unit-III	**IoT network layer**: IPv6: IPv6 structure, addressing, routing, interconnecting issues, 6LoWPAN: forwarding, addressing, header compression, neighbor discovery, Routing in LLN, RPL	07
Unit-IV	**Application layer protocols:** CoAP, MQTT, AMQP, XMPP, Integrating Internet Services with Interoperable data encoding with XML, JSON and CBOR, Sensor data models and representation, The Sensor Mark-up Language (SENML), lightweight web services for IoT	08
Unit-V	**Data analytics for IoT:** machine learning, big data analytics tools and technology like NoSQL, Hadoop	05
Unit-VI	**Securing IoT:** Challenges in IoT security, provisions for securing IoT network	04
Unit-VII	**Case studies on IoT applications:** Connected Vehicles, Autonomous Vehicles, Industrial Applications of IoT.	03

Self-Study:

The self-study contents will be declared at the commencement of the semester. Around 10% of the questions will be asked from self-study content.

Suggested Readings/ References:

1. David Hanes, G. Salgueiro, IoT Fundamentals - Networking Technologies, Protocols, and Use Cases for Internet of Things, Cisco Press
2. Jean-Philippe Vasseur, Adam Dunkels, Interconnecting Smart Objects with IP: The Next Internet, Morgan Kaufmann
3. Pethuru Raj, Anupama Raman, The Internet of Things - Enabling Technologies, Platforms and Use Cases, CRC Press
4. Robert Stackowiak, Art Licht, VenuMantha and Louis Nagode, Big Data and The Internet of Things, Apress
5. Peter Waher, Learning Internet of Things, Packt Publishing Ltd
6. Daniel Kellmereit, Daniel Obodovski, The Silent Intelligence: The Internet of Things, DND Ventures
7. Olivier Hersent, David Boswarthick, Omar Elloumi, The Internet of Things: Key Applications and Protocols, Wiley Publications.

Suggested List of Experiments:

Sr. No.	Name of Experiments/Exercises	Hours
1	Building basic electronic circuits using various components and exploring ESP8266, ESP32 and Arduino IDE	2
2	Programming with ESP8266/ESP32 boards	2
3	Access sensors and control actuator using HTTP protocol	2
4	Reverse parking sensor for car	2
5	Integrating Bluetooth, RFID, LoRa transceiver with different IoT platforms	4
6	Upload sensor data to cloud platform	2
7	Publish and Subscribe with MQTT	4
8	Application development using COAP	4
9	Interfacing IoT boards with platforms like IFTTT	4
10	Simulate IoT network on Cooja Simulator focusing on 6LowPAN.	4