Programme: **Master of Technology (Artificial Intelligence)**

Semester: **I**

Course Code: **202401201**

Course Title: **Internet of Things - Architecture and Protocols**

Course Group: **Program Elective - II**

Course Objectives: This course aims to provide theoretical foundation, systematic knowledge, and practical skills in the IoT platform and system design. The course focuses on understanding the vision of IoT from a global perspective, understanding its applications, determining market perspective, using gateways, devices and data management, building state of art architecture in IoT and its Applications to build automation and solve real time problems. The course also provides understanding of IoT Privacy and security concepts for a secured IoT environment.

Teaching & Examination Scheme:

Contact hours per week			Course Credits	Examination Marks (Maximum / Passing)				
				Theory		J/V/P*		Total
Lecture	Tutorial	Practical		Internal	External	Internal	External	
3	0	2	4	50 / 20	50 / 20	25 / 10	25 / 10	150 / 60

* **J**: Jury; **V**: Viva; **P**: Practical

Detailed Syllabus:

Sr.	Contents	Hours
1	**Introduction to Internet of Things (IoT):** Introduction, Genesis of IoT, IoT and digitization, IoT Ecosystem, IoT Impact, Convergence of IT and OT, IoT Challenges. IoT Network architecture and design, Drivers of IoT, Comparing IoT Architecture, OneM2M IoT Standardized Architecture, IoT World Forum Standardized Architecture, IT and OT responsibilities in IoT Reference Model, A simplified IoT Architecture, The Core IoT Functional Stack, IoT Data Management and Compute Stack, Fog Computing, Edge Computing and Cloud Computing.	5
2	**Smart Object : Thing in IoT** Introduction, Sensors, actuators, Microelectromechanical Systems (MEMS), Smart Object, Trends in Smart Objects, Sensor Network, Communication criteria, constrained Devices, Constrained node Networks, Topology, Power Consumption, Data Rate, Throughput, Overhead and Payload.	5

3	**IoT Data Link Layer Protocols:**	8
	Introduction, IoT Access Technologies, IEEE 802.11, IEEE 802.15, Bluetooth low Energy, Wireless HART, Z-Wave, Zigbee Smart Energy	
4	**IoT Network Layer Protocols:**	8
	Introduction, IP, Adoption and Adaptation of the Internet Protocol, IPv4, IPv6, Optimizing IP for IoT, 6LoWPAN, DHCP, ICMP, 6TiSCH, RPL.	
5	**IoT Transport Layer, Session Layer and Application Layer Protocols:**	8
	Introduction, Transport Layer Protocol - TCP, UDP, DCCP, SCTP, MPTCP , TLS, DTLS, Session Layer - HTTP, XMPP, Application Layer - SCADA, Adapting SCADA for IP, SCADA protocol Translation, CoAP and Message Queuing Telemetry Transport (MQTT).	
6	**Data and Analytics in IoT:**	3
	Introduction to Data analytics for IoT, Data in Motion vs Data in Rest, IoT Data Analytics Challenges, Machine Learning, Big Data Analytics Tools and Technology for IoT, Edge Streaming Analytics, Network Analytics.	
7	**IoT Security and Case Studies:**	3
	Security, Privacy and Trust in IoT Data Platforms, Challenges of OT Security, Security Protocol - DNP3, ICCP, Formal Risk Analysis Structures - OCTAVE and FAIR. Case Studies - Smart Cities, Smart Health Care, Oil and Gas, Smart Transportation, Smart Utility Systems.	
	Total	40

List of Practicals / Tutorials:

1	Study working of Raspberry Pi / SenseNut-WSN Simulator.
2	Study working of Arduino Uno/ Hardware Devices of SenseNuts Toolkits.
3	Write a program for LED Blink using arduino/ Raspberry Pi/SenseNuts Toolkit.
4	Write a Program for RGB LED using Arduino/ Raspberry Pi/ SenseNuts ToolKits.
5	Write a program for detecting fire in a room using Arduino/ SenseNuts Toolkits.
6	Write a program for monitoring the temperature of a room using Arduino/ SenseNuts Toolkit.
7	Design and Implement Home Automation system.
8	Design and Implement to measure toxic gas level in the room.
9	Design and Implement RFID based parking system.
10	Design and implement a smart metering system.
11	Design a system to demonstrate a street traffic light system.
12	Design a system to control LED using remote control.
13	Study about Proactive and Reactive Routing Protocols
14	Implement Level Based routing in SenseNuts Toolkit.
15	Implement MAC based routing in SenseNuts Toolkits.

Reference Books:

1	IoT Fundamentals, Networking Technologies, Protocols and Use Cases for the Internet of Things, David Hanes, Gonzalo Salguerio, Patrick Grossetete, Rob Barton, Jerome Henry Forwarded by Rowan Trollope, Ciscopress.com, Pearson.
2	Internet of Things (A Hands-on-Approach), Vijay Madisetti and Arshdeep Bahga, 1st Edition, VPT, 2014.
3	Rethinking the Internet of Things: A Scalable Approach to Connecting Everything. Francis daCosta, 1st Edition, Apress Publication, 2013.
4	Interconnecting Smart Objects with IP: The Next Internet, Jean-Philippe Vasseur, Adam Dunkels, Morgan Kaufman.

Supplementary learning Material:

1	www.arduino.cc
2	www.raspberrypi.org
3	https://nptel.ac.in/courses/106/105/106105166/

Pedagogy:
- Lectures will be conducted with the aid of multimedia projector, black board, OHP etc.
- Assignments based on the course content will be given to the students for each unit and will be evaluated at regular interval evaluation.
- Surprise tests/Quizzes/Seminar/tutorial will be conducted having a sharing of marks in the overall internal evaluation.
- Mini projects are the best suitable method for the subject to provide learning opportunities to students.

Suggested Specification table with Marks (Theory) (Revised Bloom's Taxonomy):

Distribution of Theory Marks in %						R: Remembering; U: Understanding; A: Applying; N: Analyzing; E: Evaluating; C: Creating
R	U	A	N	E	C	
10%	20%	30%	10%	10%	20%	

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

Course Outcomes (CO):

Sr.	Course Outcome Statements	%weightage
CO-1	Understand the fundamentals of IoT and its architectures.	10
CO-2	Understand the Smart objects and its context.	10
CO-3	Understand the Data Link and Network Layer Protocol of IoT with its aspects and rules.	15
CO-4	Understand the use of IoT Devices, Gateways and Data Management in Various Network Layer Protocols.	15
CO-5	Understand Transport layer and Session Layer Protocol of IoT.	15
CO-6	Understand Application Layer Protocol and Impact of it.	15
CO-7	Able to Develop IoT Applications to solve Problems.	10

CO-8	Able to understand application of IoT in Industrial and Commercial Automation and Real World Design Constraints.	**10**

Curriculum Revision:	
Version:	2
Drafted on (Month-Year):	June-2022
Last Reviewed on (Month-Year):	-
Next Review on (Month-Year):	June-2025