COURSE CODE	COURSE TITLE	L	T	P	C
1152CS209	Internet of Things	3	0	2	4

Course Category: Program Elective

A. Preamble :

The core modules of this elective course include introduction to IoT, Elements of IoT, Data Analytics and IoT Platform. This course aims to teach the student to understand the concepts of Internet of Things(IoT) and can able to practice the same with practical kits to build IoT applications.

B. Prerequisite Courses:

Sl No	Course Code	Course Name
1	1151CS104	Digital Electronics

C. Related Courses:

Sl No	Course Code	Course Name
1	1156CS601	Minor Project
2	1156CS701	Major Project

D. Course Outcomes :

Upon the successful completion of the course, students will be able to:

CO Nos.	Course Outcomes	Knowledge Level (Based on revised Bloom's Taxonomy)
CO1	Understand the basic concepts and Architectures of Internet of Things.	K2
CO2	Extend their knowledge in Data Management, Smart Objects and Communication Criteria of IoT	K2
CO3	Explain the IEEE standards and basic protocols of IoT	K2
CO4	Summarize the data analytics and securing concepts in IoT	K2
CO5	Develop the project for the given scenario.	K3

E. Correlation of COs with POs :

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M	L		M					M			
CO2	M	L		M					M			
CO3	M											
CO4	M	L		L								
CO5	H	M	M	M	M	L	L	L	M	L	M	M

F. Course Content :

Unit I Introduction and Architecture of IoT **9**

Introduction – Definition and characteristics of IoT – Physical and Logical Design of IoT - Communication models and APIs – Challenges in IoT - Evolution of IoT – Comparing IoT Architectures: The oneM2M IoT Standardized Architecture, The IoT World Forum (IoTWF) Standardized Architecture : Physical Devices and Controllers Layer, Connectivity Layer - Edge Computing Layer, Upper Layers - A Simplified IoT Architecture – Core IoT Functional Stack.

Unit II Data Management, Smart Objects and Communication Criteria **9**

IoT Data Management and Compute Stack - Fog Computing - Edge Computing - The Hierarchy of Edge, Fog, and Cloud - Sensors , Actuators, Micro-Electro-Mechanical Systems (MEMS), Smart Objects - Wireless Sensor Networks (WSNs) - Communication Protocols for Wireless Sensor Networks - Communications Criteria : Range, Frequency Bands, Power Consumption, Topology, Constrained Devices, Constrained - Node Networks, Data Rate and Throughput, Latency and Determinism, Overhead and Payload.

Unit III Access Technologies and Application Protocols for IoT **9**

IEEE 802.15.4 – IEEE 1901.2a - IEEE 802.11ah – IEEE 802.11ab – LoRaWAN - The Transport Layer - IoT Application Transport Methods : Application Layer Protocol Not Present, SCADA, Background on SCADA, Adapting SCADA for IP, Tunneling Legacy SCADA over IP Networks, SCADA Protocol Translation, SCADA Transport over LLNs with MAP-T, Generic Web-Based Protocols, IoT Application Layer Protocols, CoAP, Message Queuing Telemetry Transport (MQTT).

Unit IV Analytics Concepts and Securing IoT **9**

Data Analytics - Edge streaming Analytics – Network Analytics - Securing IoT: Common Challenges in OT Security, Erosion of Network Architecture, Pervasive Legacy Systems, Insecure Operational Protocols, Modbus, Distributed Network Protocol, Inter-Control Center Communications Protocol, OLE for Process Control, International Electro-technical Commission Protocols.

Unit V Smart City and Public Safety **9**

Smart City IoT Architecture- Smart City Security Architecture - Smart City Use-Case Examples - Overview - An IoT Blueprint for Public Safety - Emergency Response IoT Architecture - IoT Public Safety Information Processing - School Bus Safety – Case Study.

Total: 45 Hours

Lab Experiments: (30 Hours)

1. Study about Arduino interfaces and Raspberry PI interfaces
2. Study the basic fundamental components of IoT
3. Create interface between Arduino board and system
4. Verify the blinking LED and turn on/off the LEDs in a sequential manner using Arduino Uno.

5. To control the LED using a Potentiometer.

6. To control the RGB LED using a Arduino Uno.

7. Interface GSM module with Arduino Uno to communicate with the Mobile devices.

8. To interface the ultrasonic sensor with the Arduino Uno to determine the distance of an object from the sensor.

9. To interface the DS18B20 temperature sensor with the Arduino UNO to sense the temperature and print it on the serial monitor.

10. To interface the FC-51 Infrared sensor (IR) sensor with the Arduino Uno to sense the path is clear/ indicate the presence of any obstacles.

11. To build traffic lights controller using Arduino Mega.

12. To control servo motor Using Rasberry Pi.

13. To interface HC-05/HC-06 Bluetooth module with the Arduino Uno to communicate with mobile phone over short distances.

14. Case Study:
    Develop any smart automation application using IoT components (Arduino Nano, HC-06 Bluetooth, Xbee Pro, Sensors)

G. Learning Resources

i. Text Books

1. David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Rob Barton and Jerome Henry, "IoT Fundamentals: Networking Technologies, Protocols and Use Cases for Internet of Things", Cisco Press, 2017.
2. Honbo Zhou, The Internet of Things in the Cloud: A Middleware Perspective,CRC Press, 2012

ii. References

1. Arshdeep Bahga, Vijay Madisetti, "Internet of Things (A Hands-On-Approach)", VPT, 2014.
2. Olivier Hersent, David Boswarthick, Omar Elloumi, "The Internet of Things – Key applications and Protocols", Wiley, 2012.
3. Michael Margolis, "Arduino Cookbook" OReilly, Second Edition, 2011.

iii. Online Resources

1. https://www.arduino.cc
2. http://www.theinternetofthings.eu/what-is-the-internet-of-things