**B.N.M. Institute of Technology**

**An Autonomous Institution under VTU**

For Internal Communication

**Department of Computer Science & Engineering**

**Course Name: Internet of Things Year of Study: 2022-2023**

**Course Code:18CS81 Faculty Name: Dr. Rajashree /A.K.Sreeja**

**Semester: VIII**

**Course Objectives:**

This course will enable students to

1. Interpret the impact and challenges posed by IoT networks leading to new architectural models.
2. Compare and contrast the deployment of smart objects and the technologies to connect them to network.
3. Appraise the role of IoT protocols for efficient network communication.
4. Elaborate the need for Data Analytics and Security in IoT.
5. Illustrate different sensor technologies for sensing real world entities and identify the applications of IoT in Industry.

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| ***Lecture Session*** | ***Unit / Module*** | ***Topics Covered*** | ***Applications in the present scenario*** | ***Text & Reference book*** |
| **Module title: Introduction to IoT** | | | | |
| 1 | 1 | Overview of the course outcomes, test pattern, assessment methods, vision and mission the of the dept. **Module 1:** What is IoT, Genesis of IoT, IoT and Digitization | *Application of IoT in daily routine:*  [*https://youtu.be/91aXs9E0qAI*](https://youtu.be/91aXs9E0qAI) | 1 |
| 2 | IoT Impact: connected Roadways, Connected Factory, Smart creatures, Smart connected building |
| 3 | Convergence of IT and IoT, IoT Challenges: Scale, Security, Privacy, Interoperability, Quiz |
| 4 | IoT Network Architecture and Design: Drivers Behind New Network Architectures |
| 5 | Comparing IoT Architectures: OneM2M, IoTWF, A Simplified IoT Architecture |
| 6 | The Core IoT Functional Stack |
| 7 | IoT Data Management and Compute Stack. |
| 8 | Review of Questions & answers |
| **Module title: Smart Objects** | | | | |
| 9 | 2 | **Module2:** Smart Objects: The “Things” in IoT | Life simplified with connected devices:  <https://youtu.be/NjYTzvAVozo> | 1 |
| 10 | Sensors: Active or passive, invasive, non invasive, contact or no contact, Sensor types, Actuators: Actuators type |
| 11 | Smart Objects: characteristics in smart objects, trends in smart objects |
| 12 | Sensor Networks: WSN’s, Communication protocols for WSN’s, Connecting Smart Objects: Communications Criteria, |
| 13 | IoT Access Technologies: IEEE 802.15.4, IEEE 802.15.4g and 802.15.4e, IEEE 1901.2a |
| 14 | IEEE 802.11ah, LoRaWAN |
| 15 | NB-IoT and Other LTE Variations |
| 16 | Review of Questions &Answers |
| **Module title: IoT Network Layer** | | | | |  | Review of questions and answers |
| 17 | **3** | **Module 3:** IP as the IoT Network Layer, The Business Case for IP | Protocol Stack/layers in IoT  <https://www.youtube.com/watch?v=phkdwmvTq8Q&t=715s> | 1 |
| 18 | The need for Optimization: Constrained Nodes, Constrained Networks, IP Versions |
| 19 | Optimizing IP for IoT: From 6LoWPAN to 6Lo, Header Compression, Fragmentation |
| 20 | Profiles and Compliances: Internet Protocol for Smart Objects (IPSO) Alliance |
| 21 | Wi-SUN Alliance, Thread, Application Protocols for IoT |
| 22 | The Transport Layer: TCP, UDP, IoT Application Transport Methods: SCADA, Message Queuing Telemetry Transport (MQTT), |
| 23 | IoT Application Layer Protocols: CoAP |
| 24 | Review of Questions &Answers |
| **Module title: Data and Analytics for IoT** | | | | |
| 25 | **4** | **Module 4:** Data and Analytics for IoT: An Introduction to Data Analytics for IoT: Structured Versus Unstructured Data, Data in Motion Versus Data at Rest | Amazon kinesis analytics  <https://youtu.be/WjgL2xu0cno> | 1 |
| 26 | Machine Learning: Machine Learning Overview, Supervised Learning, Unsupervised Learning, Neural Networks |
| 27 | Big Data Analytics Tools and Technology: Massively Parallel Processing Databases, NoSQL Databases, Hadoop, Apache Kafka, Apache Spark |
| 28 | Edge Streaming Analytics, Network Analytics: Flexible NetFlow Architecture |
| 29 | Securing IoT: A Brief History of OT, Common Challenges in OT Security |
| 30 | How IT and OT Security Practices and Systems Vary, Formal Risk Analysis Structures: OCTAVE and FAIR, The Phased Application of Security in an Operational Environment |
| 31 | **Practicals: Arduino Uno** |
| 32 | **Practicals: Arduino Uno** |
| **Module title: IoT Physical Devices and Endpoints** | | | | |
| 33 | **5** | **Module 5:** IoT Physical Devices and Endpoints - Arduino UNO, Introduction to Arduino, Arduino UNO, Installing the Software, Fundamentals of Arduino Programming | Installation of Arduino:  <https://youtu.be/5OtMqr5hGjE>  Configuring RaspberryPi:  <https://youtu.be/wvxCNQ5AYPg> | 1, 2 |
| 34 | **CGA: Practicals: NodeMCU** |
| 35 | **Practicals: NodeMCU** |
| 36 | IoT Physical Devices and Endpoints - RaspberryPi: Introduction to RaspberryPi, |
| 37 | About the RaspberryPi Board: Hardware Layout |
| 38 | Operating Systems on RaspberryPi, Configuring RaspberryPi |
| 39 | **CBS: Tinkercad** |
| 40 | Programming RaspberryPi with Python, Wireless Temperature Monitoring System Using Pi, DS18B20 Temperature Sensor |
| 41 | Remote access to RaspberryPi, Smart and Connected Cities |
| 42 | An IoT Strategy for Smarter Cities, Smart City IoT Architecture |
| 43 | Smart City Security Architecture, Smart City Use-Case Examples |
| 44 |  | Revision classes |  |  |
| 45 |  | Revision classes |  |  |

**CO-PO/PSO Mapping:**

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| **COs** | **Statement** | **Bloom’s Cognitive level** | **POs/PSOs** |
| 18CS81.1 | Identify the impact, challenges and the architectural models posed by IoT networks | Apply | PO1, PO2, PSO1 |
| 18CS81.2 | Apply the technologies for connecting smart objects and the role of different IoT protocols for efficient network communication. | Apply | PO2, PSO1 |
| 18CS81.3 | Identify the need and the use for Data Analytics and Security in IoT. | Apply | PO1, PO5, PSO1 |
| 18CS81.4 | Analyze different IoT Applications using Arduino UNO and RaspberryPi board | Analyze | PO1, PO3, PSO1 |
| 18CS81.5 | Design a real-world application scenario of IoT along with its societal and economic impact. | Create | PO1, PO2, PO3, PO7, PO8, PO9, PO10, PO11, PO12, PSO1 |

**Strength of CO Mapping to PO/PSOs with Justification:**

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|  | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO 10** | **PO 11** | **PO 12** | **PSO1** | **PSO2** |
| 18CS81.1 | 3 | 3 |  | 2 |  |  | 3 |  |  |  |  | 3 | 3 |  |
| 18CS81.2 | 3 | 3 |  | 2 |  |  | 3 |  |  |  |  | 3 | 3 |  |
| 18CS81.3 | 3 | 3 |  |  | 3 |  | 3 |  |  |  |  | 3 | 3 |  |
| 18CS81.4 | 3 | 3 | 3 |  |  |  | 3 | 2 | 3 | 3 | 2 | 3 | 3 |  |
| 18CS81.5 | 3 | 3 | 3 |  | 3 |  | 3 | 3 | 2 | 3 | 3 | 3 | 3 |  |

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| **CO-PO/PSO** | **Justification** |
| CO1->PO1(3) | Applying the IoT fundamentals in finding the solution to real world problems. |
| CO1->PO2 (3) | Applying research literature with respect to the impact and challenges posed by IoT networks and smart objects. |
| CO1->PO4(2) | Applying fundamentals of IoT for research-based knowledge and research methods. |
| CO1->PO7(3) | Understanding the societal impact by demonstrating the knowledge of , and need for IoT. |
| CO1->PO12(3) | Applying the concepts of IoT for the ability to engage in independent and life-long learning. |
| CO1->PSO1(3) | Understanding the concepts of IoT in solving the technical issues. |
| CO2->PO1(3) | Applying technologies for connecting smart objects by identifying, formulating complex engineering problems. |
| CO2->PO2(3) | Applying research literature with respect to the impact and challenges posed by IoT networks and smart objects. |
| CO2->PO4(2) | Applying research-based knowledge and research methods for efficient network communication. |
| CO2->PO7(3) | Understand the impact of societal and environmental contexts, and apply technologies for connecting smart objects. |
| CO2->PO12(3) | Apply smart objects connecting technologies for the ability to engage in life-long learning. |
| CO2->PSO1(3) | Applying various protocols for effective network communication using smart objects. |
| CO3->PO1(3) | Applying the role of IoT protocols for efficient network communication. |
| CO3->PO2(3) | Identify and formulate problems about the need for data analytics. |
| CO3->PO5(3) | Applying modern tools to cater the real-world problems. |
| CO3->PO7(3) | Applying the need for data analytics based on environmental sustainability. |
| CO3->PO12(3) | Applying data analytics and security in IoT for life-long learning. |
| CO3->PSO1(3) | Applying the data collected using various IoT components and security related issues. |
| CO4->PO1 (3) | Understand the design principles of Aurdino and RaspberryPi board for developing any IOT application. |
| CO4->PO2(3) | Analyzing complex engineering problems using IoT applications. |
| CO4->PO3 (3) | Design and develop IOT applications using Aurdino and RaspberryPi board. |
| CO4->PO7 (3) | Analyz**e** IOT applications using Arduino and RaspberryPi board with the impact of societal contexts. |
| CO4->PO8 (2) | Applying ethical principles to analyze different IoT Applications. |
| CO4->PO9 (3) | Analyze different IoT Applications to function effectively as individual and team work. |
| CO4->PO10 (3) | Analyze different IoT Applications to communicate effectively on complex engineering activities. |
| CO4->PO11 (2) | Analyze different IoT Applications for project management and finance. |
| CO4->PO12 (3) | Analyze IoT Applications using Arduino UNO and RaspberryPi board to engage in life-long learning. |
| CO4->PSO1(3) | Applying the applications of Aurdino and RaspberryPi board. |
| CO5->PO1 (3) | Applying the various IoT applications and finding the solution for real world problems. |
| CO5->PO2 (3) | Applying research literature with respect to the impact and challenges posed by IoT networks and smart objects. |
| CO5->PO3 (3) | Design and development of IoT application with the usage of IoT protocols. |
| CO5->PO5 (3) | Design and development of IoT application with the usage of IoT protocols. |
| CO5->PO7 (3) | Analyzing the societal benefits of the smart objects, architecture for sensing real world entities. |
| CO5->PO8 (3) | Design and development of real time IoT application in an effective manner satisfying ethical principles |
| CO5->PO9 (2) | Function effectively as an individual to design an IOT application. |
| CO5->PO10 (3) | Design and development of IoT application with the usage of IoT protocols in effective manner. |
| CO5->PO11 (3) | Demonstrate the developed IoT application in an effective manner. |
| CO5->PO12 (3) | Lifelong learning of the IoT applications in analyzing the concepts and building an application. |
| CO5->PSO1 (3) | Demonstrate the developed IoT application in an effective manner. |

**List of Innovative teaching methods (Details to be attached)**

1. **Tool based learning (Tinkercad)**

**Teaching methodologies:**

1. **Flipped Teaching**
2. **Power point presentations**
3. **Blynk, Firebase-Tools for IoT**

**Assessment processes:**

**Three IAs will be conducted for 30 marks each & practical assessment for 20 marks. Average of three IA marks will be reduced to 20 Marks and practical assessment for 20 marks, totals to 40 marks as final maximum IA marks.**

**Assessment plan:**

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| **CO (Cognitive Level)** | **Test 1 addresses** | **Test 2 addresses** | **Test 3 addresses** |
| CO1 (Apply) | Apply |  |  |
| CO2 (Apply) | Apply | Apply |  |
| CO3 (Apply) |  | Apply | Apply |
| CO4 (Analyze) |  |  | Analyze |
| CO5 (Create) | Activity | | |

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| **Text/Reference Books** | | | | |
| Sl. No. | **Title** | Author | Publication | Edition  062062-1 |
| T1 | IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things | David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Robert Barton, Jerome Henry | Pearson Education (Cisco Press Indian Reprint) | 1st Edition |
| T2 | Internet of Things | Srinivasa K G | CENGAGE Leaning India | 2017 |
| R1 | Internet of Things (A Hands-on-Approach) | Vijay Madisetti and ArshdeepBahga | VPT | 1st Edition |
| R2 | Internet of Things: Architecture and Design Principles | Raj Kamal | McGraw Hill  Education | 1st Edition |

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| **Prepared by** | **Scrutinized by course coordinator and scrutinizer** | **Approved by HOD** |
| **Signature:** | **Signature:** | **Signature:** |
| **Name: Dr. Rajashree/A.K.Sreeja** | **Name:** | **Name: Dr. Chayadevi ML** |