# Lingaya's Vidyapeeth

Deemed-to-be-University u/s 3 of UGC Act 1956, Government of India
**NAAC ACCREDITED**
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## COURSE PLAN & COURSE DATA SHEET

| | |
|---|---|
| PROGRAM: B.Tech (AIML/CS) | DEGREE: B.Tech |
| COURSE: Internet of Things | SEMESTER: 4th CREDITS: 3 |
| COURSE CODE: CS-216 REGULATION: | COURSE TYPE: CORE |
| COURSE AREA/DOMAIN: Computer Applications | CONTACT HOURS: 44 |
| CORRESPONDING LAB COURSE CODE (IF ANY): - | LAB COURSE NAME (IF ANY): - |

### PROGRAM EDUCATIONAL OBJECTIVES:

Program Educational Outcomes for a course or program in the Internet of Things (IoT) focus on the skills, knowledge, and attributes that students are expected to achieve upon completion of their studies. Here are some potential PEOs for an IoT program:

1. **Technical Competence:** Graduates will demonstrate a high level of technical competence in understanding, designing, and implementing IoT systems, including sensor networks, communication protocols, and embedded systems.
2. **System Integration and Interoperability:** Graduates will possess the ability to integrate diverse IoT components and ensure interoperability across different devices and platforms, creating cohesive and scalable IoT solutions.
3. **Problem Solving and Innovation:** Graduates will be adept at identifying challenges in IoT applications and developing innovative solutions. They will apply critical thinking and problem-solving skills to address complex issues in IoT system design and implementation.
4. **Security Awareness:** Graduates will be knowledgeable about IoT security considerations and possess the skills to implement robust security measures, safeguarding IoT devices, networks, and data from potential threats and vulnerabilities.
5. **Data Management and Analytics:** Graduates will be proficient in managing and analyzing data generated by IoT devices. They will understand data storage, processing, and analytics techniques, extracting meaningful insights to support decision-making in various domains.

### SYLLABUS:

| UNIT | DETAILS | HOURS |
|---|---|---|
| I | IOT: What is the IoT and why is it important? Elements of an IoT ecosystem, Technology drivers, Business drivers, Trends and implications, Overview of Governance, Privacy and Security Issues. | 7 |
| II | IOT PROTOCOLS: Protocol Standardization for IoT – Efforts – M2M and WSN Protocols – SCADA and RFIDProtocols – Issues with IoT Standardization – Unified Data Standards – Protocols – IEEE802.15.4–BACNet Protocol– Modbus – KNX – Zigbee– Network layer – APS layer – Security. | 8 |
| III | IOT ARCHITECTURE: IoT Open source architecture (OIC)- OIC Architecture & Design principles- IoT Devices and deployment models- IoTivity : An Open source IoT stack - Overview- IoTivity stack architecture-Resource model and Abstraction. | 9 |
| IV | WEB OF THINGS: Web of Things versus Internet of Things – Two Pillars of the Web – Architecture Standardization for WoT– Platform Middleware for WoT – Unified Multitier WoT Architecture– WoT Portals and Business Intelligence. | 11 |
| V | IOT APPLICATIONS: IoT applications for industry: Future Factory Concepts, Brownfield IoT, Smart Objects, Smart Applications. Study of existing IoT platforms /middleware, IoT- A, Hydra etc. | 7 |
| | TOTAL HOURS | 42 |

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| **Teacher Centric Approach**<br>**TC1: Chalk and Talk, TC2: PPT, TC3: Video Lectures TC4: Blended learning** |
| **Learner Centric Approach:**<br>**LC1: Assignment. LC2: Mini project. LC3: Quiz/Class test. LC 4: Seminar on recent trends.**<br>**LC5: Group Task. LC6: Others** |

**DETAILED SESSION PLAN**

| Lecture session/ Number | Topics to be covered | CO addressed | Teacher Centric Approach | Learner Centric Approach | References | Relevance with POs and PSOs |
|---|---|---|---|---|---|---|
| 1 | What is Iot and its features? | | TC1, TC2 | LC1,LC3 | T1/T2/W1 | PO1,PO2,PO3, PSO1,PSO2 |
| 2 | Why iot is important? | | TC1,TC2 | LC1,LC3 | T1/R3/W1 | PO1,PO3, PSO1,PSO2 |
| 3 | Characteristics and significance of iot | | TC1,TC2 | LC1,LC3 | T1/R2 | PO1,PO2,PO3 |
| 4 | Iot Architecture | | TC1,TC2 | LC1,LC3 | T2/W3 | PO1,PO4,PO5, PSO1,PSO2 |
| 5 | Elements of iot ecosystem and how it is different from natural ecosystem | | TC1,TC2 | LC1,LC3 | T1/R2/W3 | PO2,PO3,PO4, PSO1,PSO3 |
| 6 | Technology drivers and business drivers of iot | | TC1 | LC3 | T1/T3/W2 | PO1,PO2,PSO2,PSO3 |
| 7 | Recent trends of iot system | | TC1,TC2 | LC1,LC3 | T1/R2 | PO4,PO5, PSO1,PSO3 |
| 8 | Implications of iot in current times | | TC1,TC2 | LC1,LC3 | T1/R2 | PO1,PO2 |
| 9 | Overview of goverance | | TC1,TC2 | LC1,LC3 | T2/R2/W3 | PO1,PO2,PO3,PO4,PO5, PSO1,PSO2,PSO3 |

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| 10 | Privacy and security issues of iot | | TC1,TC2 | LC1,LC3 | T1/R2/W1 | PO2,PO3,PO4,PO5, PSO1,PSO2,PSO3 |
| 11 | Different iot protocols | | TC1,TC2 | LC1,LC3 | T1/R1/W1 | PO1,PO2,PO4,PO5, PSO1,PSO3 |
| 12 | Protocol standardization for iot systems | | TC1,TC2 | LC1,LC3 | T2/W1 | PO4,PO5, PSO2,PSO3 |
| 13 | Efforts made in building these protocols | | TC1,TC2 | LC1,LC3 | T1/W1 | PO1,PO2,PO5, PSO1,PSO2 |
| 14 | Hurdles that were overcome while overcoming designing issues | | TC1,TC2 | LC1,LC3 | T1/R2 | PO1,PO2,PO3,PO4,PO5,PSO1,PSO2,PSO3 |
| 15 | M2M and WSN Protocols | | TC1,TC3 | LC1,LC3 | T1/T2/W3 | PO4,PO5,PSO2,PSO3 |
| 16 | What is SCADA and its applications | | TC1,TC2 | LC1,LC3 | T1/T2/W1 | PO2,PO3,PO4,PO5,PSO1,PSO2,PSO3 |
| 17 | RFID Protocol | | TC1,TC2 | LC1,LC3 | T1/R2/W1 | PO1,PO2,PO4,PSO1,PSO2,PSO3 |
| 18 | Issues with iot standardization | | TC1,TC2 | LC1,LC3 | T1/R1 | PO1,PO2,PO4,PSO1,PSO2,PSO3 |
| 19 | Unified data standards | | TC1,TC2 | LC1,LC3 | T1/W1 | PO1,PO2,PO4,PSO1,PSO2,PSO3 |
| 20 | Various application layer and network layer protocols | | TC1,TC2 | LC1,LC3 | T2/W3 | PO1,PO2,PO4,PSO1,PSO2,PSO3 |
| 21 | IEEE802.15.4 BACNet Protocol | | TC1,TC2 | LC1,LC3 | T1/T2/W1 | PO1,PO2,PO4,PSO1,PSO2,PSO3 |
| 22 | Modbus protocol | | TC1,TC2 | LC1,LC3 | T1/W1 | PO1,PO2,PO4,PSO1,PSO2,PSO3 |
| 23 | KNX protocol | | TC1,TC2 | LC1 | T2/W3 | PO1,PO2,PO4,PSO1,PSO2,PSO3 |
| 24 | Zigbee protocol | | TC1,TC2 | LC1,LC3 | T1/W1 | PO1,PO2,PO4,PSO1,PSO2,PSO3 |
| 25 | APS layer in iot | | TC1,TC2 | LC1,LC3 | T2/R1/W1 | PO2,PO3,PO4,PSO2,PSO3 |
| 26 | Security issues and resolution in iot | | TC1,TC2 | LC1,LC3 | T1/R1/W3 | PO1,PO2,PO3,PO4 PSO1,PSO2 |

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|---|---|---|---|---|---|
| 27 | Iot architecture and its design | TC1,TC2 | LC1,LC3 | T1/R2 | PO1,PO2 |
| 28 | Iot open sourse architecture | TC1,TC2 | LC1,LC3 | T1/R1/W3 | PO1,PO2,PO3,PO4 PSO1,PSO2 |
| 29 | OIC Architecture and design principles | TC1,TC2 | LC1,LC3 | T1/W1 | PO1,PO2,PO3,PO4 PSO1,PSO2 |
| 30 | Various iot devices and their applications | TC1, TC2 | LC1,LC3 | T1/T2/W1 | PO1,PO2,PO3, PSO1,PSO2 |
| 31 | Various deployment models of iot | TC1,TC2 | LC1,LC3 | T1/R3/W1 | PO1,PO3, PSO1,PSO2 |
| 32 | Iotivity an open source iot stack | TC1,TC2 | LC1,LC3 | T1/R2 | PO1,PO2 |
| 33 | Overview of iotivity stack architecture | TC1,TC2 | LC1,LC3 | T2/W3 | PO1,PO4,PO5, PSO1,PSO2 |
| 34 | Resourse model and abstraction | TC1,TC2 | LC1,LC3 | T1/R2/W3 | PO2,PO3,PO4, PSO1,PSO3 |
| 35 | Web of things versus internet of things | TC1 | LC3 | T1/T3/W2 | PO1,PO2,PSO2,PSO3 |
| 36 | Different pillars of the web | TC1,TC2 | LC1,LC3 | T1/R2 | PO4,PO5, PSO1,PSO3 |
| 37 | Architecture standardization for web of things | TC1,TC2 | LC1,LC3 | T1/R2 | PO1,PO2,PO3,PO4,PO5,PSO1 |
| 38 | Platform middleware for wot | TC1,TC2 | LC1,LC3 | T2/R2/W3 | PO1,PO2,PO3,PO4,PO5, PSO1,PSO2,PSO3 |
| 39 | Unified multitier wot architecture-wot portals and business intelligence | TC1,TC2 | LC1,LC3 | T1/R2/W1 | PO2,PO3,PO4,PO5, PSO1,PSO2,PSO3 |
| 40 | Iot applications for industry | TC1,TC2 | LC1,LC3 | T1/R1/W1 | PO1,PO2,PO4,PO5, PSO1,PSO3 |
| 41 | Future factory concepts | TC1,TC2 | LC1,LC3 | T2/W1 | PO4,PO5, PSO2,PSO3 |
| 42 | Brownfield iot and smart objects | TC1,TC2 | LC1,LC3 | T1/W1 | PO1,PO2,PO5, PSO1,PSO2 |

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| 43 | Smart applications and study of existing iot platforms | | TC1,TC2 | LC1,LC3 | T1/R2 | PO1,PO2,PO3,PO4,PO5,PSO1,PSO2,PSO3 |
| 44 | What is middleware and its significance | | TC1,TC3 | LC1,LC3 | T1/T2/W3 | PO4,PO5,PSO2,PSO3 |

**TEXT/REFERENCE BOOKS:**

| T/R | BOOK TITLE/AUTHORS/PUBLICATION |
|---|---|
| 1 | Dieter Uckelmann, Mark Harrison, Michahelles, Florian (Eds), "Architecting the Internet of Things", Springer, 2011. |
| 2 | David Easley and Jon Kleinberg, "Networks, Crowds, and Markets: Reasoning About a Highly Connected World", Cambridge University Press, 2010. |
| 3 | Olivier Hersent, David Boswarthick, Omar Elloumi , "The Internet of Things – Key applications and Protocols", Wiley, 2012. |
| 4 | Honbo Zhou, "The Internet of Things in the Cloud: A Middleware Perspective", CRC Press, 2012. |
| 5 | Vijay Madisetti and Arshdeep Bahga, "Internet of Things (A Hands-on-Approach)",1st Edition, VPT, 2014 |

**# WEB SOURCE REFERENCES (W):**

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|---|---|
| 1 | Geeksforgeeks |
| 2 | www.coursera.com |
| 3 | www.simplilearn.com |

**COURSE PRE-REQUISITES:**

| C.CODE | COURSE NAME | DESCRIPTION | SEM |
|---|---|---|---|
| - | Basic knowledge of computers | - | - |
| - | - | - | - |

**COURSE OBJECTIVES:**

1. **Ethical and Social Responsibility:** Graduates will recognize the ethical implications of IoT technologies and demonstrate a commitment to responsible and ethical practices in the design, implementation, and use of IoT systems. They will also consider the societal impact of IoT applications.
2. **Lifelong Learning:** Graduates will have a foundation for continuous learning and professional development in the rapidly evolving field of IoT. They will stay informed about emerging technologies, standards, and best practices throughout their careers.
3. **Entrepreneurship and Leadership:** Graduates will have the skills and mindset to explore entrepreneurial opportunities in the IoT ecosystem. They will also exhibit leadership qualities, capable of guiding teams and making informed decisions in the dynamic IoT landscape.
4. **Global and Cultural Awareness:** Graduates will understand the global implications of IoT technologies and be aware of cultural considerations when developing and deploying IoT solutions in diverse international settings.
5. **Environmental Sustainability:** Graduates will consider environmental sustainability in IoT design and implementation. They will be conscious of energy efficiency, resource utilization, and the environmental impact of IoT solutions.

**COURSE OUTCOMES:**

| S.NO | DESCRIPTION | PO(1..12) MAPPING | PSO(1..3) MAPPING |
|---|---|---|---|
| CO1 | To Use real IoT protocols for communication. | PO1,PO2 | PSO1 |
| CO2 | To Secure the elements of an IoT device. | PO1,PO2,PO3 | PSO1,PSO2 |
| CO3 | To Design an IoT device to work with a Cloud Computing infrastructure. | PO1,PO2,PO3,PO4,PO5 | PSO1,PSO2 |
| CO4 | Transfer IoT data to the cloud and in between cloud providers. | PO1,PO2,PO3 | PSO1,PSO2 |
| CO5 | To Define the infrastructure for supporting IoT deployments. | PO1,PO2,PO3,PO4,PO5 | PSO1,PSO2 |
| COURSE OVERALL PO/PSO MAPPING: | | | |

**COURSE OUTCOMES VS POs MAPPING (**DETAILED; HIGH:3; MEDIUM:2; LOW:1**):**

| S.NO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 2 | 1 | - | - | - | - | - | - | 1 | - | - | - | 2 | - | 1 |
| CO2 | 2 | 1 | 1 | 2 | - | - | 1 | 1 | - | - | 1 | - | 2 | 1 | - |
| CO3 | 2 | 2 | 1 | 1 | 1 | - | - | 2 | - | 1 | - | - | 2 | 2 | - |
| CO4 | 2 | 1 | 1 | - | - | 1 | 1 | 1 | - | - | 1 | 1 | 2 | 2 | 1 |
| CO5 | 2 | 1 | 1 | 1 | 1 | - | - | - | 1 | 1 | 1 | - | 2 | 2 | - |

** For Entire Course, PO & PSO Mapping*

**POs & PSO REFERENCE:**

| | | | | | |
|---|---|---|---|---|---|
| PO1 | Engineering Knowledge | PO7 | Environment & Sustainability | PSO 1 | Foundation of mathematical concepts: To use mathematical methodologies to crack problem using suitable mathematical analysis, data structure and suitable algorithm. |
| PO2 | Problem Analysis | PO8 | Ethics | PSO 2 | Foundation of Computer System: The ability to interpret the fundamental concepts and methodology of computer systems. Students can understand the functionality of hardware and software aspects of computer systems. |
| PO3 | Design & Development | PO9 | Individual & Team Work | PSO 3 | Foundations of Software development: The ability to grasp the software development lifecycle and methodologies of software systems. Possess competent skills and knowledge of software design process. Familiarity and practical proficiency with a broad area of programming concepts and provide new ideas and innovations towards research. |
| PO4 | Investigations | PO10 | Communication Skills | | |
| PO5 | Modern Tools | PO11 | Project Mgt. & Finance | | |
| PO6 | Engineer & Society | PO12 | Life Long Learning | | |

**COs VS POs MAPPING JUSTIFICATION:**

| S.NO | PO/PSO MAPPED | LEVEL OF MAPPING | JUSTIFICATION |
|---|---|---|---|

| | | | |
|---|---|---|---|
| Cxxx.1 | | | |
| Cxxx.2 | | | |
| Cxxx.3 | | | |
| Cxxx.4 | | | |
| Cxxx.5 | | | |
| Cxxx* | | | |

**GAPS IN THE SYLLABUS - TO MEET INDUSTRY/PROFESSION REQUIREMENTS, POs & PSOs:**

| SNO | DESCRIPTION | PROPOSED ACTIONS |
|---|---|---|
| 1 | **Edge Computing:** Explore edge computing concepts and the role of edge devices in processing and analyzing data locally, reducing latency and bandwidth usage in IoT applications. | Need to be Covered in extra session |
| 2 | **Fog Computing:** Understand fog computing as an extension of cloud computing that brings computation closer to the data source, enabling real-time processing and analysis in distributed IoT environments. | Need to be Covered in extra session |
| 3 | **Blockchain and IoT Security:** Investigate how blockchain technology can enhance security in IoT applications, ensuring data integrity, authentication, and secure transactions in decentralized IoT networks. | Need to be Covered in extra session |
| 4 | **5G and IoT Connectivity:** Study the impact of 5G networks on IoT connectivity, including increased data rates, low latency, and the ability to connect a massive number of devices simultaneously. | Need to be Covered in extra session |
| 5 | **Digital Twins:** Explore the concept of digital twins, which involves creating virtual models of physical objects or systems in the IoT, enabling monitoring, analysis, and simulation for improved decision-making. | Need to be Covered in extra session |

*PROPOSED ACTIONS: TOPICS BEYOND SYLLABUS/ASSIGNMENT/INDUSTRY VISIT/GUEST LECTURER/NPTEL ETC*

**# TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN:**

| | |
|---|---|
| 1 | Explore edge computing concepts and the role of edge devices in processing and analyzing data locally, reducing latency and bandwidth usage in IoT applications. |
| 2 | Understand fog computing as an extension of cloud computing that brings computation closer to the data source, enabling real-time processing and analysis in distributed IoT environments. |
| 3 | Investigate how blockchain technology can enhance security in IoT applications, ensuring data integrity, authentication, and secure transactions in decentralized IoT networks. |

| | |
|---|---|
| 4 | Study the impact of 5G networks on IoT connectivity, including increased data rates, low latency, and the ability to connect a massive number of devices simultaneously. |
| 5 | Explore the concept of digital twins, which involves creating virtual models of physical objects or systems in the IoT, enabling monitoring, analysis, and simulation for improved decision-making. |

**DELIVERY/INSTRUCTIONAL METHODOLOGIES:**

| | | | |
|---|---|---|---|
| ☐ CHALK & TALK | ☐ STUD. ASSIGNMENT | ☐ WEB RESOURCES | ☐ NPTEL/OTHERS |
| ☐ LCD/SMART BOARDS | ☐ STUD. SEMINARS | ☐ ADD-ON COURSES | ☐ WEBNIARS |

**ASSESSMENT METHODOLOGIES-DIRECT**

| | | | |
|---|---|---|---|
| ☐ ASSIGNMENTS | ☐ STUD. SEMINARS | ☐ TESTS/MODEL EXAMS | ☐ UNIV. EXAMINATION |
| ☐ STUD. LAB PRACTICES | ☐ STUD. VIVA | ☐ MINI/MAJOR PROJECTS | ☐ CERTIFICATIONS |
| ☐ ADD-ON COURSES | ☐ OTHERS | | |

**ASSESSMENT METHODOLOGIES-INDIRECT**

| | |
|---|---|
| ☐ ASSESSMENT OF COURSE OUTCOMES (BY FEEDBACK, ONCE) | ☐ STUDENT FEEDBACK ON FACULTY (TWICE) |
| ☐ ASSESSMENT OF MINI/MAJOR PROJECTS BY EXT. EXPERTS | ☐ OTHERS |

**# INNOVATIONS IN TEACHING/LEARNING/EVALUATION PROCESSES:**

1. **Technology Integration:** Embrace and integrate technology tools in the classroom to enhance the learning experience. This can include interactive whiteboards, educational apps, virtual reality, and online collaboration platforms. Utilizing technology allows for more dynamic and interactive lessons, catering to diverse learning styles.
2. **Personalized Learning Paths:** Implement personalized learning approaches that cater to individual student needs and pace of learning. Adaptive learning platforms and data analytics can help tailor educational content, assignments, and assessments based on the strengths and weaknesses of each student, promoting a more customized learning experience.
3. **Active Learning Strategies:** Move away from traditional lecture-based approaches and incorporate active learning strategies. This involves engaging students in hands-on activities, group discussions, problem-solving exercises, and real-world projects. Active learning fosters critical thinking, collaboration, and practical application of knowledge.
4. **Blended Learning Models:** Adopt blended learning models that combine face-to-face instruction with online resources. This allows for flexibility in learning, enabling students to access materials at their own pace outside the classroom. Flipped classrooms, where students learn new concepts online and engage in discussions and activities during class, are an example of a blended learning approach.
5. **Assessment Innovation:** Rethink assessment methods to go beyond traditional exams and quizzes. Explore alternative forms of assessment, such as project-based assessments, portfolios, presentations, and peer assessments. Additionally, incorporate formative assessments and feedback throughout the learning process to help students track their progress and make improvements.

**Prepared by**
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**Approved by**
**(HOD)**