SYLLABUS FOR THE BATCH FROM YEAR 2025 TO 2026

FOR

Certificate/Diploma in Internet of Things (IoT)

(Credit Based Evaluation and Grading System)

Semester: I-II

EXAMINATIONS: 2025-2026

Programme Offered:

- **Certificate Course in Internet of Things (6 Months duration)**
- **Diploma in Internet of Things (6+6 = 12 Months duration)**

Program Outcomes:

- **Fundamental Knowledge of IoT and Computer Applications:** Develop a strong foundation in IoT concepts, embedded systems, and computer applications, enabling effective use of software tools for IoT development.
- **Enhanced Technical Skills in IoT Development:** Gain proficiency in IoT programming, database management, networking protocols, and security, preparing students for real-world IoT implementations.
- **Hands-on Practical Experience:** Apply IoT concepts through hands-on projects, working with hardware, cloud platforms, and AI integration to solve real-world problems.
- **Career Readiness & Employability:** Acquire industry-relevant IoT skills, making students job-ready for roles in IoT system development, smart automation, and data-driven decision-making.

Department of Electronics Technology

In collaboration with

Directorate of Open & Distance Learning and Online Studies

GURU NANAK DEV UNIVERSITY AMRITSAR

Certificate/Diploma Program in Internet of Things (IoT) (Semester System) Offered by Department of Electronics Technology in collaboration with Directorate of Open & Distance Learning and Online Studies, Guru Nanak Dev University, Amritsar

Eligibility

- +2 or equivalent examination
- Any student pursuing Bachelor Degree, Master Degree, M.Phil., Ph.D. from GNDU campus constituted or affiliated college.

SEMESTER-I

Paper Code	Subject	Marks			Credits
		Internal Assessment	End Term	Total	
ODIT101T	IoT Technology and Applications	30	70	100	4
ODIT102T	IoT Communication Protocols	30	70	100	4
ODIT103T	Embedded Systems for IoT	30	70	100	4
ODIT104S	Seminar-I	-	100	100	2
ODIT105P	Project-I	-	100	100	2
Total Marks & Credits		**90**	**410**	**500**	**16**

SEMESTER-II

Paper Code	Subject	Marks			Credits
		Internal Assessment	End Term	Total	
ODIT201T	Cloud Computing for IoT	30	70	100	4
ODIT202T	Data Analytics in IoT	30	70	100	4
ODIT203T	IoT Security	30	70	100	4
ODIT204S	Seminar-II	-	100	100	2
ODIT205P	Project-II	-	100	100	2
Total Marks & Credits		**90**	**410**	**500**	**16**

Certificate/Diploma Program in Internet of Things (IoT) (Semester System) Offered by Department of Electronics Technology in collaboration with Directorate of Open & Distance Learning and Online Studies, Guru Nanak Dev University, Amritsar

Subject Name: IoT Technology and Applications

Subject Code: ODIT101T

(Semester – I)

Time: 03 Hours **Max. Marks: 100 Marks**

Internal Assessment: 30 Marks

End Term: 70 Marks

Instructions for the Paper-Setter/examiner:

1. Question paper shall consist of **Four sections**.
2. Paper setter shall set **Eight questions** in all by selecting **Two questions** of equal marks from each section. However, a question may have sub-parts (not exceeding four sub-parts) and appropriate allocation of marks should be done for each sub-part.
3. Candidates shall attempt **Five questions** in all, by at least selecting **One question** from each section and the **5th question** may be attempted from any of the **Four sections**.
4. The question paper should be strictly according to the instructions mentioned above. In no case a question should be asked outside the syllabus.

Section – A

Introduction to IoT: Definition and Overview of IoT, Key Characteristics of IoT, IoT Architecture: Layers and Components, Benefits and Challenges of IoT, Emerging Trends in IoT.

Section – B

Sensors, Actuators, and Devices: Types of Sensors and Actuators in IoT, Working Principles of Common Sensors (Temperature, Motion, Light, etc.), Actuator Mechanisms (Motors, Relays, Solenoids), Sensor and Actuator Interfacing with IoT Devices, Power Management in IoT Devices.

Section – C

Computing in IoT: Introduction to Cloud Computing in IoT, Edge Computing vs. Fog Computing in IoT

Role of AI and ML in IoT Data Processing, IoT Data Storage and Processing Methods, Distributed Computing for IoT.

Section – D

IoT Applications: Smart Homes and Building Automation, Industrial IoT (IIoT) and Smart Manufacturing, Wearable Technology and Healthcare IoT, Smart Agriculture and Environmental Monitoring, IoT in Transportation and Smart Cities.

Reference Books:

- Internet of Things: A Hands-On Approach, Arshdeep Bahga, Vijay Madisetti, Universities Press, 1st Edition (2014).
- The Internet of Things: Key Applications and Protocols, Olivier Hersent, David Boswarthick, Omar Elloumi, Wiley, 2nd Edition (2018).
- IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things, David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Cisco Press, 1st Edition (2017).
- Building the Internet of Things, Maciej Kranz, Wiley, 1st Edition (2016).
- Internet of Things with Python, Gaston C. Hillar, Packt Publishing, 1st Edition (2016).

Certificate/Diploma Program in Internet of Things (IoT) (Semester System) Offered by Department of Electronics Technology in collaboration with Directorate of Open & Distance Learning and Online Studies, Guru Nanak Dev University, Amritsar

Subject Name: IoT Communication Protocols

Subject Code: ODIT102T

(Semester – I)

Time: 03 Hours **Max. Marks: 100 Marks**

Internal Assessment: 30 Marks

End Term: 70 Marks

Instructions for the Paper-Setter/examiner:

1. Question paper shall consist of **Four sections**.
2. Paper setter shall set **Eight questions** in all by selecting **Two questions** of equal marks from each section. However, a question may have sub-parts (not exceeding four sub-parts) and appropriate allocation of marks should be done for each sub-part.
3. Candidates shall attempt **Five questions** in all, by at least selecting **One question** from each section and the **5th question** may be attempted from any of the **Four sections**.
4. The question paper should be strictly according to the instructions mentioned above. In no case a question should be asked outside the syllabus.

Section – A

Wired Communication Protocols: Ethernet and Its Role in IoT Networking, RS-232 and RS-485 in Industrial IoT, CAN Bus and Its Applications in IoT, Advantages and Limitations of Wired Protocols, Use Cases of Wired Communication in IoT

Section – B

Wireless Communication Protocols: Bluetooth and BLE in IoT Devices, Wi-Fi for High-Speed IoT Connectivity, Zigbee and Z-Wave for Smart Home IoT, LoRaWAN for Long-Range IoT Applications 5G and Its Role in Future IoT Networks.

Section – C

Machine-to-Machine (M2M) Communication: Introduction to M2M Communication, MQTT and Its Role in IoT Data Transfer, CoAP Protocol for Lightweight IoT Communication, AMQP and Its Application in IoT Messaging, Differences Between M2M and IoT.

Section – D

Protocol Selection for IoT Applications: Criteria for Selecting an IoT Communication Protocol; Trade-offs Between Latency, Power Consumption, and Security; Use Case Scenarios for Various Protocols; Hybrid Communication Models in IoT; Security Concerns in IoT Protocols.

Reference Books

- Internet of Things: Principles and Paradigms, Rajkumar Buyya, Amir Vahid Dastjerdi, Morgan Kaufmann, 1st Edition (2016).
- Protocols and Architectures for Wireless Sensor Networks, Holger Karl, Andreas Willig, Wiley, 1st Edition (2005).
- Internet of Things (IoT): Architectures, Protocols, and Standards, Simone Cirani, Gianluigi Ferrari, Marco Picone, Wiley, 1st Edition (2018).
- Wireless Communications and Networking, Vijay Garg, Elsevier, 1st Edition (2007).
- 5G IoT: The Key to AIoT (Artificial Intelligence of Things), Olivier Hersent, Wiley, 1st Edition (2021).

Certificate/Diploma Program in Internet of Things (IoT) (Semester System) Offered by Department of Electronics Technology in collaboration with Directorate of Open & Distance Learning and Online Studies, Guru Nanak Dev University, Amritsar

Subject Name: Embedded Systems for IoT

Subject Code: ODIT103T

(Semester – I)

Time: 03 Hours **Max. Marks: 100 Marks**

Internal Assessment: 30 Marks

End Term: 70 Marks

Instructions for the Paper-Setter/examiner:

1. Question paper shall consist of **Four sections**.
2. Paper setter shall set **Eight questions** in all by selecting **Two questions** of equal marks from each section. However, a question may have sub-parts (not exceeding four sub-parts) and appropriate allocation of marks should be done for each sub-part.
3. Candidates shall attempt **Five questions** in all, by at least selecting **One question** from each section and the **5th question** may be attempted from any of the **Four sections**.
4. The question paper should be strictly according to the instructions mentioned above. In no case a question should be asked outside the syllabus.

Section – A

Microcontrollers for IoT: Introduction to Microcontrollers – Arduino, Raspberry Pi, ESP32; Key Features of IoT-Specific Microcontrollers, Development Boards for IoT Prototyping, Power Consumption and Efficiency in Microcontrollers, Case Studies on IoT Microcontroller Applications.

Section – B

IoT Programming Languages: Embedded C for IoT Applications, Python for IoT Development, Basics of MicroPython and Its IoT Applications, IoT Development Environments – Arduino IDE, Thonny, PlatformIO; Best Practices in Embedded Programming.

Section – C

Sensor and Actuator Interfacing: Connecting Analog and Digital Sensors to Microcontrollers**,** Interfacing Actuators (Motors, Relays) with IoT Devices**,** Data Acquisition and Processing Techniques, Communication Between Sensors and Cloud Platforms, Debugging and Troubleshooting Sensor Issues

Section – D

Real-Time Operating Systems (RTOS) for IoT: Introduction to RTOS and Its Need in IoT, Comparison Between RTOS and Non-RTOS Systems, Popular RTOS for IoT (FreeRTOS, Zephyr, Contiki), Task Scheduling and Memory Management in RTOS, RTOS-Based IoT Application Development.

Reference Books

- Embedded Systems: Real-Time Interfacing to ARM Cortex-M Microcontrollers, Jonathan W. Valvano, CreateSpace Independent Publishing, 4th Edition (2017).
- Mastering Arduino: Building Advanced IoT Projects, Jon Hoffman, Packt Publishing, 2nd Edition (2022).
- Raspberry Pi IoT in C, Harry Fairhead, I/O Press, 1st Edition (2016).
- Exploring Arduino: Tools and Techniques for Engineering Wizardry, Jeremy Blum, Wiley, 2nd Edition (2019).
- Programming the Internet of Things: An Introduction to Embedded Systems, Andy King, O'Reilly Media, 1st Edition (2021).

Certificate/Diploma Program in Internet of Things (IoT) (Semester System) Offered by Department of Electronics Technology in collaboration with Directorate of Open & Distance Learning and Online Studies, Guru Nanak Dev University, Amritsar

Subject Name: Seminar-I
Subject Code: ODIT104S
(Semester – I)

Time: 03 Hours **Max. Marks: 100 Marks**
End Term: 100 Marks

Seminar on Emerging Trends in IoT

This seminar is designed to familiarize students with the latest advancements, challenges, and opportunities in the Internet of Things (IoT). It will encourage students to explore key aspects of IoT, including technological innovations, communication methods, and embedded solutions that enable real-world applications such as smart cities, industrial automation, healthcare, and edge computing.

Students will investigate various components of IoT, such as device integration, network communication strategies, and embedded system design for efficient and secure operation. Emphasis will be placed on understanding different connectivity protocols, optimizing hardware and software for IoT devices, and addressing challenges related to scalability, security, and energy efficiency.

Each student will select a relevant topic, conduct comprehensive research, and deliver a structured presentation. The seminar aims to enhance technical communication, critical analysis, and presentation skills. As part of the assessment, students will be required to submit a detailed seminar report and present their findings before a panel of examiners. Evaluation will be based on research depth, clarity of presentation, and active engagement in discussions.

Certificate/Diploma Program in Internet of Things (IoT) (Semester System) Offered by Department of Electronics Technology in collaboration with Directorate of Open & Distance Learning and Online Studies, Guru Nanak Dev University, Amritsar

Subject Name: Project-I

Subject Code: ODIT105P

(Semester – I)

Time: 03 Hours **Max. Marks: 100 Marks**

End Term: 100 Marks

This project focuses on designing, implementing, and analyzing an end-to-end system that leverages IoT concepts to address real-world challenges. It involves defining the problem, analyzing requirements, and developing a structured solution that integrates hardware, communication, and software components. Key aspects include selecting appropriate devices, designing system architecture, ensuring seamless data exchange, and managing cloud connectivity. Practical considerations such as efficiency, scalability, and security will be emphasized throughout the development process. The project will also involve testing, optimization, and addressing implementation challenges to create a reliable and functional system. Finally, students will present their findings and demonstrate the project, showcasing their ability to apply IoT principles effectively. Students need to submit a detailed project report as well.

Certificate/Diploma Program in Internet of Things (IoT) (Semester System) Offered by Department of Electronics Technology in collaboration with Directorate of Open & Distance Learning and Online Studies, Guru Nanak Dev University, Amritsar

Subject Name: Cloud Computing for IoT

Subject Code: ODIT201T

(Semester – II)

Time: 03 Hours **Max. Marks: 100 Marks**

Internal Assessment: 30 Marks

End Term: 70 Marks

Instructions for the Paper-Setter/examiner:

1. Question paper shall consist of **Four sections**.
2. Paper setter shall set **Eight questions** in all by selecting **Two questions** of equal marks from each section. However, a question may have sub-parts (not exceeding four sub-parts) and appropriate allocation of marks should be done for each sub-part.
3. Candidates shall attempt **Five questions** in all, by at least selecting **One question** from each section and the **5th question** may be attempted from any of the **Four sections**.
4. The question paper should be strictly according to the instructions mentioned above. In no case a question should be asked outside the syllabus.

Section – A

Introduction to Cloud Computing: Fundamentals of Cloud Computing, Cloud Service Models (IaaS, PaaS, SaaS), Benefits and Challenges of Cloud Computing for IoT, Virtualization and Containerization in Cloud Computing, Security and Privacy in Cloud-Based IoT Systems.

Section – B

Cloud Platforms for IoT: Overview of AWS IoT, Azure IoT, and Google Cloud IoT, Cloud Deployment Models (Public, Private, Hybrid), IoT Platform-as-a-Service (PaaS) Solutions, Device Connectivity and Cloud Integration, Case Studies on Cloud-Based IoT Applications.

Section – C

Data Storage and Management on the Cloud: Cloud Storage Solutions for IoT Data, Database Management in Cloud Computing, Data Retention, Backup, and Compliance, Streaming and Batch Processing of IoT Data, Challenges in Managing Large-Scale IoT Data

Section – D

Cloud-Based IoT Data Analytics and Device Management: Cloud-Based Data Processing and Analytics, IoT Device Lifecycle Management in the Cloud, Monitoring and Troubleshooting IoT Devices on Cloud, Edge vs. Cloud Data Processing in IoT, Future Trends in Cloud Computing for IoT.

Reference Books

- Cloud Computing: Concepts, Technology & Architecture, Thomas Erl, Ricardo Puttini, Zaigham Mahmood, Pearson, 1st Edition (2013).
- Cloud Computing for IoT, Pradeep Tomar, Gurjit Kaur, CRC Press, 1st Edition (2021).
- Cloud Computing: A Practical Approach, Anthony T. Velte, Toby J. Velte, Robert Elsenpeter, McGraw-Hill, 1st Edition (2009).
- Architecting the Cloud: Design Decisions for Cloud Computing Service Models (SaaS, PaaS, and IaaS), Michael J. Kavis, Wiley, 1st Edition (2014).
- IoT and Cloud Computing for Societal Good, Nazir Ahmad, Mozaher Ali, Springer, 1st Edition (2021).

Certificate/Diploma Program in Internet of Things (IoT) (Semester System) Offered by Department of Electronics Technology in collaboration with Directorate of Open & Distance Learning and Online Studies, Guru Nanak Dev University, Amritsar

Subject Name: Data Analytics in IoT
Subject Code: ODIT202T
(Semester – II)

Time: 03 Hours **Max. Marks: 100 Marks**
Internal Assessment: 30 Marks
End Term: 70 Marks

Instructions for the Paper-Setter/examiner:

1. Question paper shall consist of **Four sections**.
2. Paper setter shall set **Eight questions** in all by selecting **Two questions** of equal marks from each section. However, a question may have sub-parts (not exceeding four sub-parts) and appropriate allocation of marks should be done for each sub-part.
3. Candidates shall attempt **Five questions** in all, by at least selecting **One question** from each section and the **5th question** may be attempted from any of the **Four sections**.
4. The question paper should be strictly according to the instructions mentioned above. In no case a question should be asked outside the syllabus.

Section – A

Data Analytics in IoT: Data Collection from IoT Devices, Handling Missing and Noisy IoT Data, Data Normalization and Feature Engineering, Data Transformation and Encoding Techniques, Case Studies on IoT Data Preprocessing.

Section – B

Time Series Analysis for IoT: Introduction to Time Series Data in IoT, Time Series Forecasting Techniques, Anomaly Detection in IoT Time Series Data, Predictive Maintenance Using Time Series Analysis, Tools and Libraries for Time Series Analysis.

Section – C

Machine Learning for IoT Data: Supervised and Unsupervised Learning Algorithms for IoT, Classification and Clustering of IoT Data, Anomaly Detection and Fault Prediction in IoT, Deep Learning for IoT Applications, Implementing ML Models in IoT Devices.

Section – D

Data Visualization in IoT: Introduction to IoT Data Visualization, Visualization Tools (Tableau, Power BI, Matplotlib), Real-Time Data Dashboarding for IoT, Visualizing Sensor Data for Decision Making, Best Practices for IoT Data Representation.

Reference Books:

- Data Science for IoT, Jesus Rogel-Salazar, Packt Publishing, 1st Edition (2020).
- Big Data Analytics for IoT, Tausifa Jan Saleem, N. Shanmuganantham, Amir Alavi, Springer, 1st Edition (2021).
- Machine Learning for IoT Applications, Tanishka Pandey, Prasenjit Choudhury, Wiley-Scrivener, 1st Edition (2022).
- Time Series Analysis and Its Applications, Robert H. Shumway, David S. Stoffer, Springer, 4th Edition (2017).
- Hands-On Machine Learning for Smart IoT Devices, Amita Kapoor, Packt Publishing, 1st Edition (2021).

Certificate/Diploma Program in Internet of Things (IoT) (Semester System) Offered by Department of Electronics Technology in collaboration with Directorate of Open & Distance Learning and Online Studies, Guru Nanak Dev University, Amritsar

Subject Name: IoT Security
Subject Code: ODIT203T
(Semester – II)

Time: 03 Hours **Max. Marks: 100 Marks**
Internal Assessment: 30 Marks
End Term: 70 Marks

Instructions for the Paper-Setter/examiner:

1. Question paper shall consist of **Four sections**.
2. Paper setter shall set **Eight questions** in all by selecting **Two questions** of equal marks from each section. However, a question may have sub-parts (not exceeding four sub-parts) and appropriate allocation of marks should be done for each sub-part.
3. Candidates shall attempt **Five questions** in all, by at least selecting **One question** from each section and the **5th question** may be attempted from any of the **Four sections**.
4. The question paper should be strictly according to the instructions mentioned above. In no case a question should be asked outside the syllabus.

Section – A

Security Challenges in IoT: Common Security Threats in IoT Networks, Case Studies on IoT Security Breaches, Risk Assessment in IoT Deployments, Impact of Cyberattacks on IoT Ecosystems, Future Trends in IoT Security.

Section – B

Authentication and Authorization Mechanisms: User and Device Authentication in IoT, Multi-Factor Authentication (MFA) for IoT Security, Role-Based Access Control (RBAC) in IoT Systems, OAuth and Other Identity Management Frameworks, Best Practices for Secure IoT Authentication

Section – C

Encryption Techniques for IoT: Symmetric vs. Asymmetric Encryption in IoT, Lightweight Cryptography for Resource-Constrained IoT Devices, End-to-End Data Encryption in IoT Networks, Key Management and Secure Key Exchange Protocols, Implementing AES, RSA, and ECC for IoT Security

Section – D

Secure Communication Protocols for IoT: Secure MQTT, CoAP, and HTTPS in IoT, Blockchain for IoT Security, Secure Firmware Updates and Patch Management, Secure Boot and Trusted Platform Module (TPM), Best Practices for Secure IoT Deployments

Reference Books:

- IoT Security Issues, Sanjoy Das, Alex Joseph, Springer, 1st Edition (2021).
- Security and Privacy in Internet of Things (IoTs): Models, Algorithms, and Implementations, Fei Hu, CRC Press, 1st Edition (2016).
- Cybersecurity and Privacy in IoT, Souvik Pal, Vijay Bhaskar Semwal, CRC Press, 1st Edition (2020).
- Practical IoT Security: Securing the Internet of Things for Developers, Brian Russell, Drew Van Duren, Packt Publishing, 1st Edition (2016).
- Blockchain for IoT Security and Privacy, Sandeep Saxena, Springer, 1st Edition (2023).

Certificate/Diploma Program in Internet of Things (IoT) (Semester System) Offered by Department of Electronics Technology in collaboration with Directorate of Open & Distance Learning and Online Studies, Guru Nanak Dev University, Amritsar

Subject Name: Seminar-II
Subject Code: ODIT204S
(Semester – II)

Time: 03 Hours **Max. Marks: 100 Marks**
End Term: 100 Marks

This major seminar will provide the students with an in-depth understanding of advanced concepts, challenges, and innovations in the Internet of Things (IoT). It will enable students to explore key areas such as IoT system architecture, communication protocols, embedded system design, cloud integration, data analytics, and security mechanisms that drive real-world applications in smart cities, industrial automation, healthcare, and edge computing.

The seminar will cover critical aspects of IoT implementation, including device integration, efficient communication strategies, cloud-based data management, intelligent analytics for decision-making, and security frameworks to protect IoT ecosystems. Emphasis will be placed on overcoming practical challenges such as scalability, reliability, interoperability, and energy efficiency to develop robust and secure IoT solutions.

Each student will undertake a comprehensive research study, selecting a topic aligned with recent advancements in IoT. They will be required to analyze existing solutions, identify research gaps, and propose innovative approaches. The seminar will enhance technical communication, analytical thinking, and presentation skills, preparing students for future academic and professional endeavors.

As part of the evaluation process, students must submit a detailed seminar report, deliver an in-depth presentation, and actively engage in discussions. The assessment will be based on research depth, originality, clarity of presentation, and the ability to critically analyze and discuss complex IoT concepts. Successful completion of this seminar is a mandatory requirement for the conferment of the degree.

Certificate/Diploma Program in Internet of Things (IoT) (Semester System) Offered by Department of Electronics Technology in collaboration with Directorate of Open & Distance Learning and Online Studies, Guru Nanak Dev University, Amritsar

Subject Name: Project-II

Subject Code: ODIT205P

(Semester – II)

Time: 03 Hours **Max. Marks: 100 Marks**

End Term: 100 Marks

This major project focuses on designing, implementing, and analyzing an end-to-end IoT system while incorporating cloud computing, data analytics, and security considerations. The project will begin with problem identification and requirement analysis, followed by the development of a structured solution that integrates hardware, communication protocols, and software components. Cloud computing will be utilized for data storage, processing, and remote access, ensuring scalability and real-time responsiveness. Data analytics will play a key role in extracting meaningful insights, optimizing system performance, and enabling intelligent decision-making. Security measures will be implemented at various levels, including device authentication, encrypted communication, and threat mitigation strategies to safeguard IoT infrastructure. The project will also emphasize testing, optimization, and addressing real-world implementation challenges to ensure reliability and efficiency. Finally, students will present their findings and demonstrate their working prototype, showcasing a well-rounded IoT solution with practical applications. Students also need to submit a detailed project report.