Semester- III

Data Management for IoT			
Course Code	**MMCG311A**	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	3:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	3

Course Learning objectives:

- Explain the fundamental concepts, architecture, and communication protocols of IoT, including smart devices, RFID, and wireless sensor networks.
- Analyze IoT network connectivity, data exchange formats, and web integration techniques for efficient IoT communication.
- Apply data acquisition, storage, cloud computing, and analytics techniques to manage IoT data effectively.
- Evaluate IoT security challenges, privacy concerns, and identity management strategies to ensure data protection.
- Develop IoT prototypes, integrate IoT gateways, and analyze business models for real-world applications and Industry 4.0.

Module-1

Introduction to IoT and System Architecture (8 hours): Vision and Definitions of IoT**,** Smart Hyperconnected Devices and IoT Applications**,** IoT Conceptual Framework and Architectural Views**,** IoT Communication Protocols: MQTT, CoAP, XMPP**,** Sources of IoT Data: RFID, Wireless Sensor Networks**,** Wearable Technologies, Smart Homes, Smart Cities

Module-2

IoT Connectivity, Communication, and Web Integration (8 hours): IoT Network and Connectivity Principles: IPv4, IPv6, 6LoWPAN, TCP/IP, IP Addressing, MAC Addressing, IETF Six-Layer Design for IoT, Communication Protocols: HTTP, HTTPS, FTP, Telnet, Web Connectivity & Data Exchange: JSON, MIME, TLV Data Formats, REST, SOAP, Web Sockets, MQTT

Module-3

IoT Data Management and Analytics (8 hours): Data Acquisition and Storage: Data Validation, Events Assembly, Data Store Processes, SQL vs NoSQL Databases, Spatial & Time-Series Databases, Cloud Data Processing for IoT: SaaS, IaaS, PaaS, DaaS, XaaS Models, Cloud Platforms (AWS IoT, TCS Connected Universe), Cloud-Based Data Storage & Computing, IoT Data Analytics: Descriptive, Real-time, Predictive Analytics, Business Intelligence & Big Data for IoT

Module-4

IoT Security, Privacy, and Threat Management (8 hours): IoT Security Challenges: Vulnerabilities & Threat Analysis, Identity Establishment & Access Control, IoT Security Architecture: Layered Attacker Models, IoT Security Tomography, Data Privacy Considerations: Use Cases and Misuse Cases, Blockchain for IoT Security.

Module-5

IoT Prototyping, Applications, and Business Models (8 hours): Prototyping IoT Devices and Embedded Systems: Arduino, Intel Galileo, Raspberry Pi, BeagleBone, mBed**,** IoT Gateway Development & API Integration**,** IoT in Industrial Applications (Industry 4.0): Connected Vehicles (Tesla Example), Smart Cities**,** Smart Agriculture, Smart Production**,** Business Models & IoT Innovation: Value Creation using IoT**,** IoT-driven Business Strategies

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

1. Two Unit Tests each of **25 Marks**
2. Two assignments each of **25 Marks** or **one Skill Development Activity of 50 marks** to attain the COs and POs

The sum of two tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester-End Examination:

1. The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
2. The question paper will have ten full questions carrying equal marks.
3. Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from each module.
4. Each full question will have a sub-question covering all the topics under a module.
5. The students will have to answer five full questions, selecting one full question from each module

Suggested Learning Resources:

Books

1. **"Internet of Things: Principles and Paradigms"** – Rajkumar Buyya & Amir Vahid Dastjerdi *Covers IoT architecture, communication protocols, cloud integration, and security concepts.*
2. **"Internet of Things: A Hands-on Approach"** – Arshdeep Bahga & Vijay Madisetti *Practical guide with IoT prototyping using Raspberry Pi, Arduino, and cloud platforms*
3. **"Building the Internet of Things: Implement New Business Models, Disrupt Competitors, and Transform Your Industry"** – Maciej Kranz
4. **"Data Management for the Internet of Things"** – C. Müller, S. Karnouskos
5. **"IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things"** – David Hanes, Gonzalo Salgueiro, Patrick Grossetete

Web links and Video Lectures (e-Resources):

Web Links

- **IoT Fundamentals & Architecture** – Cisco Networking Academy: Introduction to IoT
- **IoT Communication Protocols** – MQTT Essentials by HiveMQ
- **IoT Security & Privacy** – NIST Guidelines for IoT Security
- **IoT Data Management & Analytics** – Google Cloud IoT Documentation
- **IoT Business Models & Applications** – IBM IoT Solutions

Video Lectures & Online Courses

- **IoT Basics & Applications** – Coursera: The Internet of Things by University of California
- **IoT Data Management & Cloud Computing** – AWS IoT Core Tutorials
- **IoT Security & Privacy** – Stanford Cybersecurity & Internet of Things`

Skill Development Activities Suggested

- **IoT Architecture & Communication** – Experiment with RFID, wireless sensor networks, and MQTT. Simulate network protocols (IPv4, IPv6, TCP/IP, CoAP) using tools like Cisco Packet Tracer.
- **IoT Data Management & Cloud Integration** – Work with SQL/NoSQL databases (MongoDB, Firebase), use cloud platforms (AWS IoT, Google Cloud IoT) for data storage, and analyze IoT data using Python and visualization tools.

Course outcome (Course Skill Set)

At the end of the course the student will be able to:

Sl. No.	Description	Blooms Level
CO1	Explain the fundamental concepts, architectures, communication protocols, and data sources of IoT, including smart devices, RFID, and wireless sensor networks.	L2
CO2	Analyse IoT network architectures, communication protocols, data exchange formats, and web integration techniques for seamless IoT connectivity.	L4
CO3	Apply data acquisition, storage, cloud computing, and analytics techniques to process and manage IoT data effectively.	L3
CO4	Evaluate IoT security challenges, privacy concerns, identity management, and emerging security frameworks for safeguarding IoT data.	L5
CO5	Develop IoT prototypes, integrate IoT gateways and APIs, and analyse real-world applications and business models for IoT innovation.	L6

Mapping of COS and Pos

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	3				2			
CO2	3							
CO3			3	3	3		2	
CO4	3	3					2	
CO5			3				3	

Semester- III

Networked Embedded Applications			
Course Code	**MMCG311B**	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	3:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03

Course Learning objectives:

- To expose the students to the fundamentals of wired embedded networking techniques.
- To introduce the concepts of embedded ethernet.
- To expose the students to the fundamentals of wireless embedded networking.
- To discuss the fundamental building blocks of digital instrumentation.
- To introduce design of Programmable measurement & control of electrical Device.

Module-1

NETWORK EMBEDDED SYSTEMS: AN INTRODUCTION

Networked Embedded Systems: Networking of Embedded Systems- Automotive Networked Embedded Systems Networks-Embedded Systems in Industrial Automation- Wireless Sensor Networks- Networked Embedded Systems in Building Automation – Middleware Design and Implementation for Networked Embedded Systems- Introduction- Middleware Solution Space ORB Middleware for Networked Embedded Systems.

Textbook 1: Ch. 1,2

Module-2

WIRELESS SENSOR NETWORKS

Introduction To WSNS- Architecture for WSNS- Localization & Synchronization for WSN- Time Sync Issues & Resource Aware Localization.

Textbook 1: Ch. 3,4,5,6

Module-3

ENERGY-EFFICIENT MAC PROTOCOLS FOR WSN

Design Issues for MAC Protocols for WSNs, Overview on Energy-Efficient MAC Protocols for WSNs, Mobility Support in WSNs, Multichannel Protocols for WSNs, Summary and Open Issues.

Textbook 1: Ch. 8

Module-4

AUTOMOTIVE NETWORKED EMBEDDED SYSTEMS

Trends in Automotive Communication Systems, Time –Triggered Communication, Flex Ray Communications, Lin Standards.

Textbook 1: Ch. 13,14,16,17

Module-5

INDUSTRIAL AUTOMATION

Introduction To Industrial Automation, Fieldbus Bus – What Is a Fieldbus, Communication Fundamental, The OSI Model Fieldbus Characteristics, Networking Networks, Interconnection in Heterogeneous Environments, Industrial Ethernet, The New Fieldbus, Real-Time Ethernet-Home Automation Home Automation-Introduction-Structure of the IEC Standardization, Real-Time Requirements, Practical Realizations.

Textbook 1: Ch. 20

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

1. Two Unit Tests each of **25 Marks**
2. Two assignments each of **25 Marks**or **oneSkill Development Activity of 50 marks** to attain the COs and POs

The sum of two tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester-End Examination:

1. The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
2. The question paper will have ten full questions carrying equal marks.
3. Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from each module.
4. Each full question will have a sub-question covering all the topics under a module.
5. The students will have to answer five full questions, selecting one full question from each module

Suggested Learning Resources:

Books

1. R.Zurawski, Network Embedded Systems, Crc Press, 2009.
2. G.Pottie, W.Kaiser, Principles of Embedded Networked System Design
3. Raj Kamal, Embedded Systems, Tata McGraw Hill, New Delhi, 2003
4. Francine Krief,"Communicating Embedded System" Wiley 2010.

Web links and Video Lectures (e-Resources):

1. https://youtu.be/aYfBTXXhK70?si=QwkwzAfzGt34ESP2
2. https://youtu.be/JO4AEkOVF2M?si=625mOK9NIuaP6Gn-
3. https://youtu.be/vn7aT9-cYzQ?si=eiEV3iiLAzJlIWYI
4. https://youtu.be/runrFcCsC1E?si=FGDXIXMtjNd1VykP

Skill Development Activities Suggested

1. Hands-on Simulation and Implementation.
2. IoT and Embedded Systems Prototyping.
3. Security and Optimization in Embedded Networks.

Course outcome (Course Skill Set)
At the end of the course the student will be able to :

Sl. No.	Description	Blooms Level
CO1	Understand the basics of network systems.	L1
CO2	Discuss about the sensor network components, architecture and design principles of WSN	L2, L3
CO3	Explain the need MAC protocols and energy conservation.	L2
CO4	Application of networked automotive system.	L3
CO5	Design and development of home automation	L3

Mapping of COS and Pos

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	**1**							
CO2		**2**						**2**
CO3						**2**		
CO4				**3**				
CO5			**1**					

Semester- III

Cross Platform Application Development			
Course Code	**MMCG311C**	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	3:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	3

Course Learning objectives:

- Understand Cross-Platform Development Fundamentals
- Install and configure cross-platform development environments.
- Implement responsive UI designs that adapt to different screen sizes and resolutions.
- Write code using languages like Dart (Flutter) and Implement core application functionality using reusable code components.

Module-1

Introduction to Dart - Getting started with Dart, The evolution of Dart, How Dart works, Dart VM and JavaScript compilation, Dart development tools, Understanding why Flutter uses Dart, Introducing the structure of the Dart language, Dart operators, Type checking and casting, Dart types and variables, Type inference – bringing dynamism to the show, Control flows and looping, Functions, Data structures, collections, and generics, Introduction to OOP in Dart, Dart OOP features- Objects and classes, Encapsulation, Inheritance and composition, Abstraction, Polymorphism

Text Book 1 – Chapter 1

Module-2

Intermediate Dart Programming- Dart classes and constructors, Field accessors – getters and setters, Static fields and methods, Class inheritance, Interfaces, abstract classes, and mixins, Callable classes, top-level functions, and variables, Understanding Dart libraries and packages, Creating Dart libraries, Dart packages, Package structures, Stage hand – the Dart Project Generator, The pubspec file, Pckage dependencies – pub, Introducing async programming with Futures and Isolates, Itroducing Unit testing with Dart

Text Book 1 - Chapter 2

Module-3

An Introduction to Flutter - Comparisons with other mobile app development frameworks, Flutter compilation (Dart), Flutter rendering, Widgets introduction, Hello Flutter -Running the generated project.

The Flutter User Interface – Widgets: Building Layouts in Flutter - Stateful versus stateless widgets, Built-in widgets, Understanding built-in layout widgets, Creating a UI with widgets, Creating custom widgets

Text Book 1 - Chapter 3 and Chapter 4

Module-4

Handling User Input and Gestures- Handling user gestures, Input Widgets, , Validating Inputs (Forms), Custom input and Form Field.

Theming and Styling - Theme widgets, Material Design, Using Custom Fonts, Dynamic styling with MediaQuery and LayoutBuilder

Text Book 1 - Chapter 5 and Chapter 6

Module-5

Routing: Navigating between Screens- Understanding the Navigator widget, Named routes, Screen transitions, Hero animations

Developing Fully Featured Apps – Firebase Plug-in - Firebase Overview, Firebase authentication, NoSql Database with Cloud Fire store

Text Book 1 - Chapter 7 and Chapter 7

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

1. Two Unit Tests each of **25 Marks**
2. Two assignments each of **25 Marks** or **one Skill Development Activity of 50 marks** to attain the COs and POs

The sum of two tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester-End Examination:

1. The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
2. The question paper will have ten full questions carrying equal marks.
3. Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from each module.
4. Each full question will have a sub-question covering all the topics under a module.
5. The students will have to answer five full questions, selecting one full question from each module

Suggested Learning Resources:

Books

1. **Flutter for Beginners - Alessandro Biessek, Published by Packt Publishing Ltd.**

   ISBN 978-1-78899-608-2

Web links and Video Lectures (e-Resources):

Web Links

- Official Docs: https://flutter.dev/docs
- Flutter YouTube Channel: https://www.youtube.com/c/FlutterDev
- Dart Programming: https://dart.dev

Skill Development Activities Suggested

1. Basic Hands-on Activities

Setup & Environment Configuration

- Install and configure cross-platform development tools (Flutter, React Native, Xamarin).
- Set up IDEs like VS Code, Android Studio, and Xcode.

Hello World App

- Create a simple cross-platform application displaying a text message

2. Responsive UI Development

Design and implement adaptive layouts

Course outcome (Course Skill Set)

At the end of the course the student will be able to:

Sl. No.	Description	Blooms Level
CO1	Explain the fundamental concepts, benefits, and challenges of cross-platform application development.	L2
CO2	Compare different cross-platform frameworks (Flutter, React Native, Xamarin) and select the appropriate one for a given application.	L4
CO3	Design and implement responsive and adaptive user interfaces for cross-platform applications.	L3
CO4	Design and develop basic user interfaces that are responsive across multiple platforms and screen sizes.	L3

Mapping of COS and POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	**2**	**2**			**2**			
CO2	**2**		**2**		**2**			
CO3			**3**		**3**			**3**
CO4								
CO5			**2**		**2**			

Semester- III

IoT Technology and Applications			
Course Code	**MMCG311D**	CIE Marks	50
Teaching Hours/Week (L:P: SDA)	3:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	3

Course Learning objectives:

- To understand the concepts of Internet of Things and the application of IoT.
- To Explore IoT Architectures and Technologies.
- Examine IoT Communication and Networking.
- Apply IoT Solutions in Real-World Scenarios.

Module-1

What is The Internet of Things? Overview and Motivations, Examples of Applications, IPV6 Role, Areas of Development and Standardization, Scope of the Present Investigation. Internet of Things Definitions and frameworks-IoT Definitions, IoT Frameworks, Basic Nodal Capabilities. Internet of Things Application Examples-Overview, Smart Metering/Advanced Metering Infrastructure Health/Body Area Networks, City Automation, Automotive Applications, Home Automation, Smart Cards, Tracking, Over-The-Air-Passive Surveillance/Ring of Steel, Control Application Examples, Myriad Other Applications.

Textbook1: Ch1: 1.1 – 1.5, Ch2: 2.1 – 2.3, Ch3: 3.1 – 3.11

Module-2

Fundamental IoT Mechanism and Key Technologies-Identification of IoT Object and Services, Structural Aspects of the IoT, Key IoT Technologies. Evolving IoT Standards-Overview and Approaches, IETF IPV6 Routing Protocol for RPL Roll, Constrained Application Protocol, Representational State Transfer, ETSI M2M, Third Generation Partnership Project Service Requirements for Machine-Type Communications, CENELEC, IETF IPv6 Over Low power WPAN, Zigbee IP(ZIP), IPSO.

Textbook1: Ch4: 4.1 – 4.3, Ch5: 5.1 – 5.10

Module-3

Layer ½ Connectivity: Wireless Technologies for the IoT-WPAN Technologies for IoT/M2M, Cellular and Mobile Network Technologies for IoT/M2M, Layer 3 Connectivity: IPv6 Technologies for the IoT: Overview and Motivations. Address Capabilities, IPv6 Protocol Overview, IPv6 Tunneling, IPsec in IPv6, Header Compression Schemes, Quality of Service in IPv6, Migration Strategies to IPv6.

Textbook1: Ch6: 6.1 - 6.2, Ch7: 7.1 - 7.8

Module-4

Case Studies illustrating IoT Design-Introduction, Home Automation, Cities, Environment, Agriculture, Productivity Applications.

Textbook2: Ch9: 9.1 - 9.6

Module-5

Data Analytics for IoT: Introduction, Apache Hadoop, Using Hadoop MapReduce for Batch Data Analysis, Apache Oozie, Apache Spark, Apache Storm, Using Apache Storm for Real-time Data Analysis, Structural Health Monitoring Case Study.

Textbook2: Ch: 10.1 - 10.8

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

1. Two Unit Tests each of **25 Marks**
2. Two assignments each of **25 Marks** or **one Skill Development Activity of 50 marks** to attain the COs and POs

The sum of two tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester-End Examination:

1. The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
2. The question paper will have ten full questions carrying equal marks.
3. Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from each module.
4. Each full question will have a sub-question covering all the topics under a module.
5. The students will have to answer five full questions, selecting one full question from each module

Suggested Learning Resources:

Textbooks

1. Daniel Minoli: Building the Internet of Things with IPv6 and MIPv6: The Evolving World of M2M Communications, Wiley, 2013.
2. ArshdeepBahga, Vijay Madisetti: Internet of Things: A Hands-on Approach, Universities Press, 2015.

Reference Books

1. Michael Miller: The Internet of Things, Pearson, First Edition, 2015.
2. Claire Rowland, Elizabeth Goodman et.al: Designing Connected Products, O'Reilly, First Edition, 2015.

Web links and Video Lectures (e-Resources):

- http://download.e-bookshelf.de/download/0000/8067/18/L-G-0000806718-0002366365.pdf
- https://jcer.in/jcer-docs/E-Learning/Digital%20Library%20/E-Books/Internet-of-things-a-hands-on-approach-%20Arshadeep.pdf

Skill Development Activities Suggested

- Students focus on developing IoT-based solutions for smart cities, healthcare, home automation, agriculture, and environmental monitoring. Students will design systems for traffic management, remote health monitoring, smart security, precision farming, and real-time pollution tracking. These hands-on projects will enhance their skills in IoT hardware, cloud integration, AI-driven analytics, and real-time system development for real-world applications.

Course outcome (Course Skill Set)
At the end of the course the student will be able to:

Sl. No.	Description	Blooms Level
CO1	Use of Devices, Gateways and Data Management in IoT.	L2
CO2	Design IoT applications in different domain and be able to analyze their performance	L3
CO3	Implement basic IoT applications on embedded platform.	L4
C04	Implement basic IoT applications for Data Analytics	L4

Mapping of COS and POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1		**1**				**2**		
CO2			**1**					
CO3						**2**		**3**
CO4		**3**						

Semester- III

Communication and Networking Technologies in IOT			
Course Code	**MMCG311E**	CIE Marks	50
Teaching Hours/Week (L:P: SDA)	3:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	3

Course Learning objectives:

- Understand fundamentals of IoT architecture outline and standards.
- Understand and analyze different architectural views.
- Understand the importance of IoT Layer Protocols.
- Understand the importance of architecture and Industrial Internet of Things.

Module-1

Introduction: IoT Technology trends and future opportunities, IoT and Business scope Evolution, Business perspectives, Embedded systems Relationships, Challenges of IoT, Characteristics of IoT, Sensors and Actuators in IoT enabling Industrial Automation, Wireless sensor Networks in IoT, connecting all the things in Internet of things, IoT M2M, Software Define Networking. IoT System Management is Essential.

Text Book1: Ch1, 1.1-1.13

Module-2

Introduction IOT life cycle, Physical Design, IOT Conceptual architecture, IOT protocols, Levels of IOT, IOT networking Protocols, Networking standards and technologies in IOT.

Text Book1: Ch 3, 3.1-3.8

Module-3

Introduction of 5G networks in IoT, IoT Networking consideration and Challenges, Business case for the IoT, Network optimization for IoT devices, Transport Layer protocols, Network Layer Protocols, IoT communication Challenges, Application Protocols for IoT.

Text Book1: Ch 3, 3.9-3.17.

Module-4

Introduction, Evolution of IIOT, Advantages of IIOT, Drivers, Risk associated with IIOT, Businesses and Industries approach IIOT security, Applications of IIOT, Work flow of IIOT, Security considerations and challenges, IIOT: Use Cases.

Text Book1: Ch 4, 4.1-4.11

Module-5

Introduction, IIOT layered Architecture, three tier IIOT, Security in IIOT, Service based Frameworks, Solutions against Intrusions in IIOT, Machine learning based solutions, Deep Learning based solutions.

Text Book1: Ch 5, 5.1-5.9

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

1. Two Unit Tests each of **25 Marks**
2. Two assignments each of **25 Marks** or **one Skill Development Activity of 50 marks** to attain the COs and POs

The sum of two tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester-End Examination:

1. The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
2. The question paper will have ten full questions carrying equal marks.
3. Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from each module.
4. Each full question will have a sub-question covering all the topics under a module.
5. The students will have to answer five full questions, selecting one full question from each module

Suggested Learning Resources:

Textbooks

1. Dr. Vijendra Pratap Singh, Mr. Neeraj Kumar., "IoT Communication Protocols", ISBN: 978-81961690-9-1, Deccan International Academic Publishers,2023.

Reference Books

2. Bernd Scholz-Reiter, Florian Michahelles, "Architecting the Internet of Things", ISBN 978-3- 642-19156-5 e-ISBN 978-3-642-19157-2, Springer, 2016.

3. N. Ida, Sensors, Actuators and Their Interfaces, Scitech Publishers, 2014.

Weblinks and Video Lectures (e-Resources):

- https://books.google.co.in/books?id=PSe0EAAAQBAJ&printsec=frontcover&source=gbs_ge_summaryr&cad=0#v=onepage&q&f=false
- https://link.springer.com/book/10.1007/978-3-642-19157-2
- https://onlinecourses.nptel.ac.in/noc19_cs65/preview
- https://archive.nptel.ac.in/courses/106/105/106105166/
- https://onlinecourses.nptel.ac.in/noc21_ee85/preview

Skill Development Activities Suggested

- Demonstration of IoT protocols using any simulation tools.
- The students' team may of the size of 2 or 4. Students are expected to use any simulation tools to demonstrate some IoT protocols and then they have to prepare a report and then to be submitted to the concerned staff.

Course outcome (Course Skill Set)

At the end of the course the student will be able to:

Sl. No.	Description	Blooms Level
CO1	Understand fundamentals of IoT and Architecture.	L2
CO2	Illustrate the different layers of IoT protocols.	L3
CO3	Explore the importance of Industrial IoT.	L4
C04	Demonstrate Use cases of IIoT applications.	L4

Mapping of COS and POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1		**1**						**2**
CO2			**2**					
CO3				**3**				
CO4			**2**	**3**				

Semester- III

Software and Programming in IOT			
Course Code	**MMCG311F**	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	3:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03

Course Learning objectives:

- Understand the Fundamentals of IoT Programming with Python
- Develop RESTful API and Web Socket-based IoT Applications
- Implement MQTT-based IoT Communication
- Integrate IoT with Visualization and Automation Platforms
- Explore the Synergies of IoT with Emerging Technologies

Module-1

Programming with Python - Setting Up your Development Environment, Understanding your Python installation, Getting Started with Python and IoT, Creating a breadboard prototype circuit, Reading an electronic schematic diagram, Exploring two ways to flash an LED in Python, Exploring two ways to integrate a push button in Python, Creating your first IoT program.

Module-2

Networking with RESTful APIs and Web Sockets Using Flask, Introducing the Flask microservices framework, Creating a RESTful API service with Flask-RESTful, Creating a Web Socket service with Flask-SocketIO, Adding a Web Socket client web page, Comparing the RESTful API and Web Socket servers.

Module-3

Networking with MQTT, Python, and the Mosquitto MQTT Broker, Installing the Mosquitto MQTT broker, Learning MQTT by example, Introducing the Python Paho-MQTT client library, Controlling an LED with Python and MQTT, Building a web-based MQTT client.

Module-4

IoT Visualization and Automation Platforms-Triggering an IFTTT Applet from your Raspberry Pi, Actioning your Raspberry Pi from an IFTTT Applet, Visualizing data with the ThingSpeak platform, Other IoT and automation platforms for further exploration.

Module-5

Exploring Synergies with Emerging Technologies, Benefits of combining IoT and blockchain, Benefits of combining IoT and generative AI, Benefits of combining IoT and LLM, Benefits of combining IoT and AI/ML, Benefits of combining IoT with immersive Technologies, Benefits of combining IoT with 3D and 4D printing, Benefits of combining IoT with 5G and 6G, Benefits of combining IoT and cloud.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

1. Two Unit Tests each of **25 Marks**
2. Two assignments each of **25 Marks** or **one Skill Development Activity of 50 marks** to attain the COs and POs

The sum of two tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester-End Examination:

1. The SEE question paper will be set for 100 marks and the marks scored will be proportionately

Suggested Learning Resources: Textbooks:

1. Practical Python Programming for IoT: Build advanced IoT projects using a Raspberry Pi 4, MQTT, RESTful APIs, WebSockets, and Python 3, Gary Smart, Publisher(s): Packt Publishing.
2. Architectural Patterns and Techniques for Developing IoT Solutions, Jasbir Singh Dhaliwal, Packt Publishing
3. Raspberry Pi Cookbook, Simon Monk, Publisher(s): O'Reilly Media, Inc.

Reference Books:

4. Programming the Internet of Things, by Andy King, Publisher O'Reilly Media, Inc.
5. Internet of Things: Architecture and Design Principles, Raj Kamal, McGraw Hill Education (India) Private Limited

Web links and Video Lectures (e-Resources):

Web links:

- Flask Basics – https://flask.palletsprojects.com/en/latest/
- Building RESTful APIs with Flask-RESTful – https://flask-restful.readthedocs.io/en/latest/
- Flask-SocketIO for Real-time WebSockets – https://flask-socketio.readthedocs.io/en/latest/
- Triggering IFTTT with Raspberry Pi – https://ifttt.com/
- Learning MQTT Protocol – https://www.hivemq.com/mqtt-essentials

Video Lectures:

https://youtu.be/E2ZBZb_WKMw
https://youtu.be/t7vQF0ynF9g
https://youtu.be/38PkhZBaEE4
https://youtu.be/dPhr1YCQTU4
https://youtu.be/gRRcFdmtjOM
https://youtu.be/z3YMz-Gocmw

Skill Development Activities Suggested

- The students with the help of the course teacher can take up technical activities which will enhance their skill or the students should interact with industry (small, medium and large), understand their problems or foresee what can be undertaken for study in the form of research/testing/projects, and for creative and innovative methods to solve the identified problem. The prepared report shall be evaluated for CIE marks.

Course outcome (Course Skill Set)

At the end of the course the student will be able to :

Sl. No.	Description	Blooms Level
CO1	Demonstrate basic IOT programming in Python.	L1,L2
CO2	Develop practical applications with RESTful API, Web Sockets, MQTT, IFTTT etc.	L3,L2
CO3	Apply IoT techniques to solve real world problems.	L3,L5

Mapping of COS and Pos

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	**1**							
CO2			**2**					
CO3		**2**			**3**			