IoT Communication Protocols		Semester	VII
Course Code	BCO701	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:2:0	SEE Marks	50
Total Hours of Pedagogy	40 hours Theory + 8-10 Lab slots	Total Marks	100
Credits	04	Exam Hours	3hrs
Examination nature (SEE)	Theory/practical		

Course 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.

Teaching-Learning Process (General Instructions)

These are sample Strategies; that teachers can use to accelerate the attainment of the various course outcomes.

1. Lecturer method (L) need not be only a traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.
2. Use of Video/Animation to explain functioning of various concepts.
3. Encourage collaborative (Group Learning) Learning in the class.
4. Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.
5. Adopt Project Based-Learning (PBL), which fosters student's Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyze information rather than simply recall it.

MODULE-1

Fundamentals of IoT :

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 Book : **Ch1, 1.1-1.13**

MODULE-2

IoT protocols

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

Text Book : **Ch.3 3.1-3.8**

MODULE-3

IoT protocols

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 Book : Ch.3, 3.9-3.17.

MODULE-4

IIOT

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 Book : ch.4, 4.1-4.11

MODULE-5

Architecture of IIOT

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 Book: Ch.5, 5.1-5.9

PRACTICAL COMPONENT OF IPCC *(May cover all / major modules)*

Sl.NO	Experiments
1	To study various IOT protocol- 6 LowPAN, IPv4/IPv6, Wifi, Bluetooth, MQTT.
2	Controlling the Light Emitting Diode (LED) with a push button.
3	Detection of the light using photo resistor.
4	Interfacing of temperature sensor LM35 with Arduino
5	Interfacing of the Relay with Arduino.
6	To develop an application to send and receive data with Arduino using HTTP request
7	To develop an application that measures the room temperature and posts the temperature value on the cloud platform
8	To develop an application that measures the moisture of soil and post the sensed data over Google firebase cloud platform.
9	Building Intrusion Detection System with Arduino and Ultrasonic Sensor **(Can be Demo experiments for CIE)**
10	Directional Control of the DC motor using Arduino **(Can be Demo experiments for CIE)**
11	To develop an application for measuring the distance using ultrasonic sensor and post distance value on Google cloud IoT platform (**Can be Demo experiments for CIE)**
12	To develop a Simple application based on sensors.(**Can be Demo experiments for CIE)**

Course outcomes (Course Skill Set):

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

1. **Understand** fundamentals of IoT and Architecture.
2. **Illustrate** the different layers of IoT protocols.
3. **Explore** the importance of Industrial IoT.
4. **Demonstrate** Use cases of IIoT applications.

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 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

CIE for the theory component of the IPCC (maximum marks 50)

- IPCC means practical portion integrated with the theory of the course.
- CIE marks for the theory component are **25 marks** and that for the practical component is **25 marks**.
- 25 marks for the theory component are split into **15 marks** for two Internal Assessment Tests (Two Tests,

each of 15 Marks with 01-hour duration, are to be conducted) and **10 marks** for other assessment methods mentioned in 22OB4.2. The first test at the end of 40-50% coverage of the syllabus and the second test after covering 85-90% of the syllabus.

- Scaled-down marks of the sum of two tests and other assessment methods will be CIE marks for the theory component of IPCC (that is for **25 marks)**.
- The student has to secure 40% of 25 marks to qualify in the CIE of the theory component of IPCC.

CIE for the practical component of the IPCC

- **15 marks** for the conduction of the experiment and preparation of laboratory record, and **10 marks** for the test to be conducted after the completion of all the laboratory sessions.
- On completion of every experiment/program in the laboratory, the students shall be evaluated including viva-voce and marks shall be awarded on the same day.
- The CIE marks awarded in the case of the Practical component shall be based on the continuous evaluation of the laboratory report. Each experiment report can be evaluated for 10 marks. Marks of all experiments' write-ups are added and scaled down to **15 marks**.
- The laboratory test **(duration 02/03 hours)** after completion of all the experiments shall be conducted for 50 marks and scaled down to **10 marks.**
- Scaled-down marks of write-up evaluations and tests added will be CIE marks for the laboratory component of IPCC for **25 marks**.
- The student has to secure 40% of 25 marks to qualify in the CIE of the practical component of the IPCC.

SEE for IPCC

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours**)

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.
4. Marks scoredby the student shall be proportionally scaled down to 50 Marks

The theory portion of the IPCC shall be for both CIE and SEE, whereas the practical portion will have a CIE component only. Questions mentioned in the SEE paper may include questions from the practical component.

Suggested Learning Resources:

Books

Dr. Vijendra Pratap Singh, Mr. Neeraj Kumar.., "IoT Communication Protocols", ISBN: 978-81-961690-9-1,Deccan International Academic Publishers,2023.

Reference Books:

1. 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.

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

Web links and Video Lectures (e-Resources):

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

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

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.

BLOCKCHAIN TECHNOLOGY		Semester	7
Course Code	**BIC702**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:2:0	SEE Marks	50
Total Hours of Pedagogy	40 hours Theory + 8-10 Lab slots	Total Marks	100
Credits	04	Exam Hours	03 Hrs.
Examination nature (SEE)	Theory/practical		

Course objectives:

- To understand basic concepts of blockchain.
- To provide knowledge about security mechanisms used in blockchain.
- To provide hands-on experience with the concepts.

Teaching-Learning Process (General Instructions)

1. **Interactive Learning:** Encouraging class participation through discussions, group activities, and question-answer sessions.
2. **Hands-on Experience:** Incorporating practical exercises, lab work, or coding tasks
3. **Use of Technology**: Employing e-resources, simulations, and other digital tools to enhance learning.
4. Peer Learning**:** Promoting collaborative learning through peer reviews and group assignments.

MODULE-1

Blockchain: Distributed systems, CAP theorem, Byzantine Generals problems, Consensus, Introduction to blockchain, various technical definitions of blockchains, Generic elements of a blockchain, The history of blockchain, Features of a blockchain, Applications of blockchain technology, Tiers of blockchain technology, Types of Blockchain Consensus in blockchain, CAP theorem and blockchain, Benefits and limitations of blockchain.

SLT: Textbook: Ch1, Pg. No.: 10-32

MODULE-2

Decentralization: Decentralization using blockchain, Blockchain and full ecosystem decentralization -Smart contract, organizations, autonomous organizations, autonomous corporations, autonomous societies, Platforms, Methods and Applications of decentralization.
Cryptography and Technical Foundations: Mathematics, Cryptography, Cryptographic primitives: Symmetric cryptography, DES, AES.

Textbook: Ch2: Pg. No.: 34-37, 40-48 & Ch3: Pg. No.: 51-53, 56-63

MODULE-3

Cryptographic primitives: Asymmetric cryptography, Hash functions, Secure Hash Algorithms (SHAs), Merkle trees, Patricia trees, Distributed hash tables (DHTs), Digital signatures. Public and private keys- RSA

Textbook: Ch3: Pg. No.: 65-78, 87-98

MODULE-4

Bitcoin: Bitcoin definition, Transactions -life cycle, structure, Blockchain: The structure of a block, The structure of a block header, Wallets, Types of transaction
Smart Contracts: History, Definition, Ricardian contracts

Textbook: Ch4: Pg. No.: 112- 122, 127-129, 145-148 & Ch6

MODULE-5

Module 5

Ethereum 101: Introduction - Ethereum clients and releases, Ethereum blockchain, Elements of the Ethereum blockchain, Ethereum virtual machine (EVM)- Execution Environment, Accounts, Block, Ether, Messages, Mining, The Ethereum stack

Textbook: Ch7: 210-227, 235-238, 244-254

PRACTICAL COMPONENT OF IPCC *(May cover all / major modules)*

Sl.NO	Experiments
1	Write a program to generate public and private key using OpenSSL.
2	Write a program to create a simple Blockchain using Python
3	Develop and test smart contract on local Blockchain.
4	Develop and test smart contract on Ethereum test networks.
5	Design and develop Cryptocurrency for multiple user using python.
6	Write and deploy chain code in Hyperledger Fabric.
7	Write a smart contract using a solidity program to perform the balance transfer from contract to other accounts
8	Write a program to perform token Creation and Management on Ethereum
9	Setup Metamask in the System and Create a wallet in the Metamask with Test Network
10	Develop a program to implement blockchain in Merkle Trees
11	Create multiple accounts in metamask and perform the balance transfer between the accounts and describe the transaction specification
12	Setup the Hyperledger Fabric Network with 2 Organizations 1 Peer Each in the system.

Course outcomes (Course Skill Set):

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

CO1: Understand the blockchain terminologies with its applications.

CO2: Examine and apply the decentralization, asymmetric cryptographic primitives, and Bitcoin concepts

CO3: Analyse the principles of Ethereum and its transactions in blockchain.

CO4: Apply ethical principles and demonstrate a private blockchain using Ethereum Tool.

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 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

CIE for the theory component of the IPCC (maximum marks 50)

- IPCC means practical portion integrated with the theory of the course.
- CIE marks for the theory component are **25 marks** and that for the practical component is **25**

marks.

- 25 marks for the theory component are split into **15 marks** for two Internal Assessment Tests (Two Tests, each of 15 Marks with 01-hour duration, are to be conducted) and **10 marks** for other assessment methods mentioned in 22OB4.2. The first test at the end of 40-50% coverage of the syllabus and the second test after covering 85-90% of the syllabus.
- Scaled-down marks of the sum of two tests and other assessment methods will be CIE marks for the theory component of IPCC (that is for **25 marks)**.
- The student has to secure 40% of 25 marks to qualify in the CIE of the theory component of IPCC.

CIE for the practical component of the IPCC

- **15 marks** for the conduction of the experiment and preparation of laboratory record, and **10 marks** for the test to be conducted after the completion of all the laboratory sessions.
- On completion of every experiment/program in the laboratory, the students shall be evaluated including viva-voce and marks shall be awarded on the same day.
- The CIE marks awarded in the case of the Practical component shall be based on the continuous evaluation of the laboratory report. Each experiment report can be evaluated for 10 marks. Marks of all experiments' write-ups are added and scaled down to **15 marks**.
- The laboratory test **(duration 02/03 hours)** after completion of all the experiments shall be conducted for 50 marks and scaled down to **10 marks.**
- Scaled-down marks of write-up evaluations and tests added will be CIE marks for the laboratory component of IPCC for **25 marks**.
- The student has to secure 40% of 25 marks to qualify in the CIE of the practical component of the IPCC.

SEE for IPCC

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours**)

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.
4. Marks scoredby the student shall be proportionally scaled down to 50 Marks

The theory portion of the IPCC shall be for both CIE and SEE, whereas the practical portion will have a CIE component only. Questions mentioned in the SEE paper may include questions from the practical component.

Textbook

1. Imran Bashir, "Mastering Blockchain", Packt, 2017

Reference Books

1. Mastering Bitcoin: Programing the Open Blockchain Paperback-2017 by Andreas M. O'rielly
2. Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller and Steven Goldfeder. Bitcoin and cryptocurrency technologies: a comprehensive introduction. Princeton University Press, 2016.

Web links and Video Lectures (e-Resources):

1. **https://www.youtube.com/watch?v=6WG7D47tGb0**
2. **https://www.youtube.com/watch?v=3681ZYbDSSk**
3. **https://www.youtube.com/watch?v=3xGLc-zz9cA**
4. **https://www.youtube.com/watch?v=aTDGJ4FSF8I**
5. **https://www.youtube.com/watch?v=FEfLNYedUXc**

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

1. Develop a blockchain application for real-world use cases. - 5 marks
2. Write a code to create a genesis block. - 5 marks

	MACHINE LEARNING		Semester	7
	Course Code	**BIC703**	CIE Marks	50
	Teaching Hours/Week (L: T:P: S)	4:0:0:0	SEE Marks	50
	Total Hours of Pedagogy	50	Total Marks	100
	Credits	04	Exam Hours	03
	Examination type (SEE)	Theory		

Course objectives:

- To introduce the fundamental concepts and techniques of machine learning.
- To understanding of various types of machine learning and the challenges faced in real-world applications.
- To familiarize the machine learning algorithms such as regression, decision trees, Bayesian models, clustering, and neural networks.
- To explore advanced concept like reinforcement learning and provide practical insight into its applications.
- To enable students to model and evaluate machine learning solutions for different types of problems.

Teaching-Learning Process (General Instructions)
These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

1. Lecturer method (L) needs not to be only a traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.
2. Use of Video/Animation/Demonstration to explain functioning of various concepts.
3. Encourage collaborative (Group Learning) Learning in the class.
4. Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.
5. Adopt Problem/Practical Based Learning (PBL), which fosters students' Analytical skills, develop design thinking skills, and practical skill such as the ability to design, evaluate, generalize, and analyze information rather than simply recall it.
6. Use animations/videos to help the students to understand the concepts.
7. Demonstrate the concepts using PYTHON and its libraries wherever possible

Module-1

Introduction: Need for Machine Learning, Machine Learning Explained, Machine Learning in Relation to other Fields, Types of Machine Learning, Challenges of Machine Learning, Machine Learning Process, Machine Learning Applications

Understanding Data – 1: Introduction, Big Data Analysis Framework, Descriptive Statistics, Univariate Data Analysis and Visualization.

Chapter-1, 2 (2.1-2.5)

Module-2

	Understanding Data – 2: Bivariate Data and Multivariate Data, Multivariate Statistics, Essential Mathematics for Multivariate Data, Feature Engineering and Dimensionality Reduction Techniques. **Basic Learning Theory:** Design of Learning System, Introduction to Concept of Learning, Modelling in Machine Learning. **Chapter-2 (2.6-2.8, 2.10), Chapter-3 (3.3, 3.4, 3.6)**
	Module-3
	Similarity-based Learning: Nearest-Neighbor Learning, Weighted K-Nearest-Neighbor Algorithm, Nearest Centroid Classifier, Locally Weighted Regression (LWR). **Regression Analysis:** Introduction to Regression, Introduction to Linear Regression, Multiple Linear Regression, Polynomial Regression, Logistic Regression. **Decision Tree Learning:** Introduction to Decision Tree Learning Model, Decision Tree Induction Algorithms. **Chapter-4 (4.2-4.5), Chapter-5 (5.1-5.3, 5.5-5.7), Chapter-6 (6.1, 6.2)**
	Module-4
	Bayesian Learning: Introduction to Probability-based Learning, Fundamentals of Bayes Theorem, Classification Using Bayes Model, Naïve Bayes Algorithm for Continuous Attributes. **Artificial Neural Networks:** Introduction, Biological Neurons, Artificial Neurons, Perceptron and Learning Theory, Types of Artificial Neural Networks, Popular Applications of Artificial Neural Networks, Advantages and Disadvantages of ANN, Challenges of ANN. **Chapter-8 (8.1-8.4), Chapter-10 (10.1-10.5, 10.9-10.11)**
	Module-5
	Clustering Algorithms: Introduction to Clustering Approaches, Proximity Measures, Hierarchical Clustering Algorithms, Partitional Clustering Algorithm, Density-based Methods, Grid-based Approach. **Reinforcement Learning:** Overview of Reinforcement Learning, Scope of Reinforcement Learning, Reinforcement Learning as Machine Learning, Components of Reinforcement Learning, Markov Decision Process, Multi-Arm Bandit Problem and Reinforcement Problem Types, Model-based Learning, Model Free Methods, Q-Learning, SARSA Learning. **Chapter -13 (13.1-13.6), Chapter-14 (14-1-14.10)**

Course outcome (Course Skill Set)

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

1. Describe the machine learning techniques, their types and data analysis framework.
2. Apply mathematical concepts for feature engineering and perform dimensionality reduction to enhance model performance.
3. Develop similarity-based learning models and regression models for solving classification and prediction tasks.
4. Build probabilistic learning models and design neural network models using perceptrons and multilayer architectures
5. Utilize clustering algorithms to identify patterns in data and implement reinforcement learning techniques

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 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

- For the Assignment component of the CIE, there are 25 marks and for the Internal Assessment Test component, there are 25 marks.
- The first test will be administered after 40-50% of the syllabus has been covered, and the second test will be administered after 85-90% of the syllabus has been covered
- Any two assignment methods mentioned in the 22OB2.4, if an assignment is project-based then only one assignment for the course shall be planned. The teacher should not conduct two assignments at the end of the semester if two assignments are planned.
- For the course, CIE marks will be based on a scaled-down sum of two tests and other methods of assessment.

Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester-End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours).**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.
4. Marks scored shall be proportionally reduced to 50 marks

Suggested Learning Resources:

Books

1. S Sridhar, M Vijayalakshmi, "Machine Learning", OXFORD University Press 2021, First Edition.

Reference Books

1. Murty, M. N., and V. S. Ananthanarayana. Machine Learning: Theory and Practice, Universities Press, 2024.
2. T. M. Mitchell, "Machine Learning", McGraw Hill, 1997.
3. Burkov, Andriy. *The hundred-page machine learning book*. Vol. 1. Quebec City, QC, Canada: Andriy Burkov, 2019.

Web links and Video Lectures (e-Resources):

- Machine Learning Tutorials: https://www.geeksforgeeks.org/machine-learning/
- Machine Learning Tutorials: https://www.tutorialspoint.com/machine_learning/index.htm
- Python for Machine Learning: https://www.w3schools.com/python/python_ml_getting_started.asp
- Introduction to Machine Learning: https://onlinecourses.nptel.ac.in/noc22_cs29/preview

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- Programming Assignment-1: Implementation of important concepts of Feature Engineering, Data Representation, Regression models, Nearest Neighbor-Based Models, and Decision Tree Models - 10 Marks.
- Programming Assignment-2: Implementation of simple Machine Learning models using various supervised and unsupervised ML algorithms - 15 Marks.

Note: Refer the ***Reference book 1*** for programming assignments
https://www.universitiespress.com/resources?id=9789393330697