AC –
Item No. –

University of Mumbai

Revised Syllabus for

B.E. Final Year- Computer Science and Engineering

(Internet of Things and Cyber Security including Block chain Technology)

Semester – (Sem. - VII to VIII)

(REV- 2019 'C' Scheme)

Under

FACULTY OF SCIENCE & TECHNOLOGY

(With effect from the academic year 2023-24)

University of Mumbai

Syllabus for Approval

Sr. No.	Heading	Particulars
1	Title of the Course	**Final Year Engineering Computer Science and Engineering (Internet of Things and Cyber Security including Block chain Technology)**
2	Eligibility for Admission	**After Passing Third Year Engineering as per the Ordinance 0.6243**
3	Passing Marks	**40%**
4	Ordinances / Regulations (if any)	**Ordinance 0.6243**
5	No. of Years / Semesters	**4 Years/ 8 semesters**
6	Level	**Under Graduation**
7	Pattern	**Semester**
8	Status	**Revised 2019**
9	To be implemented from Academic Year	**With effect from Academic Year: 2023-2024**

Preamble

To meet the challenge of ensuring excellence in engineering education, the issue of quality needs to be addressed, debated and taken forward in a systematic manner. Accreditation is the principal means of quality assurance in higher education. The major emphasis of accreditation process is to measure the outcomes of the program that is being accredited. In line with this Faculty of Science and Technology (in particular Engineering) of University of Mumbai has taken a lead in incorporating philosophy of outcome based education in the process of curriculum development.

Faculty resolved that course objectives and course outcomes are to be clearly defined for each course, so that all faculty members in affiliated institutes understand the depth and approach of course to be taught, which will enhance learner's learning process. Choice based Credit and grading system enables a much-required shift in focus from teacher-centric to learner-centric education since the workload estimated is based on the investment of time in learning and not in teaching. It also focuses on continuous evaluation which will enhance the quality of education. Credit assignment for courses is based on 15 weeks teaching learning process, however content of courses is to be taught in 13 weeks and remaining 2 weeks to be utilized for revision, guest lectures, coverage of content beyond syllabus etc.

There was a concern that the earlier revised curriculum more focused on providing information and knowledge across various domains of the said program, which led to heavily loading of students in terms of direct contact hours. In this regard, faculty of science and technology resolved that to minimize the burden of contact hours, total credits of entire program will be of 170, wherein focus is not only on providing knowledge but also on building skills, attitude and self learning. Therefore in the present curriculum skill based laboratories and mini projects are made mandatory across all disciplines of engineering in second and third year of programs, which will definitely facilitate self learning of students. The overall credits and approach of curriculum proposed in the present revision is in line with AICTE model curriculum.

The present curriculum will be implemented for Second Year of Engineering from the academic year 2021-22. Subsequently this will be carried forward for Third Year and Final Year Engineering in the academic years 2022-23, 2023-24, respectively.

Incorporation and Implementation of Online Contents from NPTEL/ Swayam Platform

The curriculum revision is mainly focused on knowledge component, skill based activities and project based activities. Self-learning opportunities are provided to learners. In the revision process this time in particular Revised syllabus of 'C' scheme wherever possible additional resource links of platforms such as NPTEL, Swayam are appropriately provided. In an earlier revision of curriculum in the year 2012 and 2016 in Revised scheme 'A' and 'B' respectively, efforts were made to use online contents more appropriately as additional learning materials to enhance learning of students.

In the current revision based on the recommendation of AICTE model curriculum overall credits are reduced to 171, to provide opportunity of self-learning to learner. Learners are now getting sufficient time for self-learning either through online courses or additional projects for enhancing their knowledge and skill sets.

The Principals/ HoD's/ Faculties of all the institute are required to motivate and encourage learners to use additional online resources available on platforms such as NPTEL/ Swayam. Learners can be advised to take up online courses, on successful completion they are required to submit certification for the same. This will definitely help learners to facilitate their enhanced learning based on their interest.

Preface by Board of Studies Team

It is our honor and a privilege to present the Rev-2019 'C' scheme syllabus of the Bachelor of Computer Science and Engineering in the (Internet of Thing and Cyber Security including Blockchain) (effective from the year 2021-22). AICTE has introduced Computer Science and Engineering in the (Internet of Thing and Cyber Security including Blockchain) as one of the nine emerging technology and hence many colleges affiliated with the University of Mumbai has started four years UG program for Computer Science and Engineering in the (Internet of Thing and Cyber Security including Blockchain). As part of the policy decision from the University end, the Board of IT got an opportunity to work on designing the syllabus for this new branch. As the Computer Science and Engineering in the (Internet of Thing and Cyber Security including Blockchain)is comparatively a young branch among other emerging engineering disciplines in the University of Mumbai, and hence while designing the syllabus promotion of an interdisciplinary approach has been considered.

The branch also provides multi-faceted scope like better placement and promotion of entrepreneurship culture among students and increased Industry Institute Interactions. Industries' views are considered as stakeholders while the design of the syllabus. As per Industry views only 16 % of graduates are directly employable. One of the reasons is a syllabus that is not in line with the latest emerging technologies. Our team of faculties has tried to include all the latest emerging technologies in the Computer Science and Engineering in the (Internet of Thing and Cyber Security including Blockchain) syllabus. Also the first time we are giving skill-based labs and Mini-project to students from the third semester onwards, which will help students to work on the latest Computer Science and Engineering in the (Internet of Thing and Cyber Security including Blockchain) technologies. Also the first time we are giving the choice of elective from fifth semester such that students will be mastered in one of the Internet of Thing domain. The syllabus is peer-reviewed by experts from reputed industries and as per their suggestions, it covers future emerging trends in Computer Science and Engineering in the (Internet of Thing and Cyber Security including Blockchain) technology and research opportunities available due to these trends. .

We would like to thank senior faculties of IT, Computer and Electronics Department, of all colleges affiliated to University of Mumbai for significant contribution in framing the syllabus. Also on behalf of all faculties we thank all the industry experts for their valuable feedback and suggestions. We sincerely hope that the revised syllabus will help all graduate engineers to face the future challenges in the field of Emerging Areas of Computer Science and Engineering in the (Internet of Thing and Cyber Security including Blockchain).

Program Specific Outcome for graduate Program in Computer Science and Engineering (Internet of Thing and Cyber Security including Blockchain)

1. Apply Core of IoT, Cyber Security & Blockchain knowledge to develop stable and secure Application.
2. Identify the issues of IoT, Cyber Security including Blockchain in real time application and in all three area of domain.
3. Ability to apply and develop IoT & Cyber Security including Blockchain multidisciplinary projects.

Program Structure for Fourth Year Engineering

Semester VII & VIII

UNIVERSITY OF MUMBAI

(With Effect from 2023-24)

Semester VII

Course Code	Course Name	Teaching scheme (Contact Hours)		Credits Assigned		
		Theory	**Pract**	**Theory**	**Pract**	**Total**
IoTCSBCC701	Machine Learning & Blockchain	3	--	3	--	3
IoTCSBCC702	Edge / Fog Computing	3	--	3	--	3
IoTCSBCDO701X	**Department Optional Course – 3**	**3**	**--**	**3**	**--**	**3**
IoTCSBCDO702X	**Department Optional Course –4**	**3**	**--**	**3**	**--**	**3**
IoTCSBCIO701X	**Institute Optional Course – 1**	**3**	**--**	**3**	**--**	**3**
IoTCSBCL701	ML & BC Lab	--	2	--	1	1
IoTCSBCL702	Edge / Fog Computing Lab	--	2	--	1	1
IoTCSBCL703	DevSecOps Lab	--	2	--	1	1
IoTCSBCL704	Open-Source Intelligence (OSINT) Lab	--	2	--	1	1
IoTCSBCP701	Major Project I	--	6#	--	3	3
Total		**15**	**14**	**15**	**7**	**22**

Course Code	Course Name	Examination Scheme							
		Theory					Term Work	Pract	Total
		Internal Assessment			End Sem Exam	Exam. Duration (in Hrs)			
		Test1	Test2	Avg					
IoTCSBCC701	Machine Learning & Blockchain	20	20	20	80	3	--	--	100
IoTCSBCC702	Edge / Fog Computing	20	20	20	80	3	--	--	100
IoTCSBCDO701X	**Department Optional Course – 3**	**20**	**20**	**20**	**80**	**3**	**--**	**--**	**100**
IoTCSBCDO702X	**Department Optional Course – 4**	**20**	**20**	**20**	**80**	**3**	**--**	**--**	**100**
IoTCSBCIO701X	**Institute Optional Course – 1**	**20**	**20**	**20**	**80**	**3**	**--**	**--**	**100**
IoTCSBCL701	ML & BC Lab	--	--	--	--	--	25	25	50
IoTCSBCL702	Edge / Fog Computing Lab	--	--	--	--	--	25	25	50
IoTCSBCL703	DevSecOps Lab	--	--	--	--	--	25	25	50
IoTCSBCL704	Open-Source Intelligence (OSINT) Lab	--	--	--	--	--	25	25	50
IoTCSBCP701	Major Project I	--	--	--	--	--	25	25	50
Total		**--**	**--**	**100**	**400**	--	**125**	**125**	**750**

# indicates work load of Learner (Not Faculty), for Major Project

IoTCSBCDO701X	**Department Optional Course –3**
IoTCSBCDO7011	Advance Cloud Computing Security
IoTCSBCDO7012	Software Testing & Quality Assurance (STQA)
IoTCSBCDO7013	IoT for Smart Cities

IoTCSBCDO7014	Supervisory Control and Data acquisition (SCADA) Security

IoTCSBCDO702X	**Department Optional Course –4**
IoTCSBCDO7021	DESIGN A BLOCKCHAIN APPLICATION ARCHITECTURE
IoTCSBCDO7022	Usability & Security in UID
IoTCSBCDO7023	Enterprise IoT Cyber Security
IoTCSBCDO7024	Software Engineering & Testing Methodology for IoT

 # Institute Level Optional Course (ILO)

Every student is required to take one Institute Elective Course for Semester VII, which is not closely allied to their disciplines. Different sets of courses will run in the both the semesters.

ILO701X	**Institute Optional Course – 1 (Common for all branches will be notified)**
ILO7011	Product Lifecycle Management
ILO7012	Reliability Engineering
ILO7013	Management Information System
ILO7014	Design of Experiments
ILO7015	Operation Research
ILO7016	Cyber Security and Laws
ILO7017	Disaster Management and Mitigation Measures
ILO7018	Energy Audit and Management
ILO7019	Development Engineering

Program Structure for Fourth Year Engineering Semester VII & VIII
UNIVERSITY OFMUMBAI
(With Effect from 2023-24)

Semester VIII

Course Code	Course Name	Teaching Scheme (Contact Hours)		Credits Assigned		
		Theory	Pract.	Theory	Pract.	Total
IoTCSBCC 801	NFT & DeFi (Decentralized Finance)	3	--	3	--	3
IoTCSBCD O801X	**Department Optional Course – 5**	**3**	**--**	**3**	**--**	**3**
IoTCSBCD O802X	**Department Optional Course – 6**	**3**	**--**	**3**	**--**	**3**
IoTCSBCI O801X	**Institute Optional Course – 2**	**3**	**--**	**3**	**--**	**3**
IoTCSBCL 801	Capstone Lab	--	2	--	1	1
IoTCSBCL 802	IoT Automation Lab	--	2	--	1	1
IoTCSBCP 801	Major Project II	--	12#	--	6	6
Total		**12**	**16**	**12**	**8**	**20**

Course Code	Course Name	Examination Scheme							
		Theory					Term	Prac	Total
		Internal Assessment			End Sem Exam	Exam. Duratio n (in Hrs)			
		Test1	Test2	Avg					
IoTCSBCC 801	NFT & DeFi (Decentralized Finance)	20	20	20	80	3	--	--	100
IoTCSBCD O801X	**Department Optional Course – 5**	**20**	**20**	**20**	**80**	**3**	**--**	**--**	**100**
IoTCSBCD O802X	**Department Optional Course – 6**	**20**	**20**	**20**	**80**	**3**	**--**	**--**	**100**
IoTCSBCI O801X	**Institute Optional Course – 2**	**20**	**20**	**20**	**80**	**3**	**--**	**--**	**100**
IoTCSBCL 801	Capstone Lab	--	--	--	--	--	25	25	50
IoTCSBCL 802	IoT Automation Lab	--	--	--	--	--	25	25	50
IoTCSBCP	Major Project II	--	--	--	--	--	100	50	150

801									
Total		**--**	**--**	**80**	**320**	**--**	**150**	**100**	**650**

# indicates work load of Learner (Not Faculty), for Major Project

Students group and load of faculty per week.

Mini Project 1 and 2 :
Students can form groups with minimum 2 (Two) and not more than 4 (Four)
Faculty Load : 1 hour per week per four groups

Major Project 1 and 2 :
Students can form groups with minimum 2 (Two) and not more than 4 (Four)
Faculty Load : In Semester VII – ½ hour per week per project group

In Semester VIII – 1 hour per week per project group

	Department Optional Course – 5
IoTCSBCDO8011	
IoTCSBCDO8012	
IoTCSBCDO8013	
IoTCSBCDO8014	

IoTCSBCDO802X	**Department Optional Course –6**
IoTCSBCDO8021	IoT for Smart Grids
IoTCSBCDO8022	Metaverse
IoTCSBCDO8023	Green IT
IoTCSBCDO8024	Cyber Security laws & legal accepts

 # Institute Level Optional Course (ILO)

Every student is required to take one Institute Elective Course for Semester VIII, which is not closely allied to their disciplines. Different sets of courses will run in the both the semesters.

ILO801X	**Institute Optional Course – 2 (Common for all branches will be notified)**
ILO8011	Project Management
ILO8012	Finance Management
ILO8013	Entrepreneurship Development and Management
ILO8014	Human Resource Management
ILO8015	Professional Ethics and CSR
ILO8016	Research Methodology
ILO8017	IPR and Patenting
ILO8018	Digital Business Management
ILO8019	Environmental Management

Subject Code	Subject Name	Theory	Practical	Tutorial	Theory	Practical/Oral	Tutorial	Total
IoTCSBCC701	Machine Learning & Blockchain	03	--	--	03	--	--	03

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal Assessment			End Sem. Exam				
		Test1	Test 2	Avg. of 2 Tests					
IoTCSBCC701	Machine Learning & Blockchain	20	20	20	80	--	--	--	100

Course Objectives: Six Course Objectives

Sr. No.	Course Objectives
The course aims:	
1	To learn the basic terminologies used in machine learning and preprocessing of data.
2	To learn Feature Selection and various algorithms
3	To learn concepts of Neural Network and Deep Learning
4	To learn key concepts and basics of Blockchain
5	To learn the Consensus mechanism and Smart contracts
6	To learn application areas of Blockchain

Course Outcomes: Six Course Outcomes (Based on Bloom's Taxonomy)

Sr. No.	Course Outcomes	Cognitive levels of attainment as per Bloom's Taxonomy
On successful completion, of course, learner/student will be able to:		
1	Understand Machine learning, Neural & Deep Learning Concepts.	L2
2	Evaluate mathematical parameters and regression concepts towards building efficient models.	L3
3	Discuss architectural paradigms with respect to Neural networks and deep learning.	L2
4	Understand the fundamentals of emerging blockchain technology.	L2
5	Evaluate the different consensus algorithms, and smart contracts while developing solutions.	L5
6	Delineate the New areas of applications for blockchain and machine learning.	L6

Prerequisite: Introduction to Cryptography, Basic Mathematics & Statistics

DETAILED SYLLABUS:

Sr. No.	Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	1. Mathematics: Vectors, matrices, matrix operations, eigenvalues, eigenvectors, Differentiation, integration, Probability theory 2. Statistics: Descriptive statistics, Inferential statistics, Probability distributions	2	--
I	Introduction to Machine Learning	**Introduction:-** Introduction:- What Is Learning? When Do We Need Machine Learning? Types of Learning, Relations to Other Fields **Basic Terminology & Framework:-** Machine Learning Terminology Roadmap for building machine learning -- Preprocessing, Training, and Model selection, Evaluating and Predicting Python for machine learning -- Packages for scientific computing, data science, and machine learning **Data Preprocessing:-** Dealing with missing data, Handling Categorical data, Partitioning a dataset into separate training and test datasets, Bringing features onto the same scale, Select meaningful features **Self-learning Topics:** Installation and Configuration of development environment for machine Learning.	7	CO1
II	Feature Selection & Algorithms	**Feature Selection:-** Feature Selection & Filtering, Principal Component Analysis **Algorithms: -** ***Regression:***- Ridge, Lasso, ElasticNet, Polynomial, Isotonic, Logistic. ***Naive Bayes:***- Bayes' Theorem, Naive Bayes Classifier, Bernoulli Naive Bayes, Multinomial Naive Bayes, Gaussian Naive Bayes ***Decision Tree & Ensemble Learning:***- Binary decision tree, Random Forest, AdaBoost, Gradient Tree Boost. ***Clustering:*** - K-Means Clustering **Self-learning Topics:** Compare the different algorithms for accuracy, precision, recall, F1-score, etc	9	CO2
III	Introduction to Neural Network and Deep Learning	**Introduction to Neural Network:--** Basic Architecture of Neural Networks for Perceptron and Multi-Layer Neural Network, Training Neural Network with Backpropagation, Issues in Neural Network Training **Introduction to Deep Learning:--** Artificial neural Network, Deep architecture, Brief introduction to Tensor Flow **Self-learning Topics:** Training Deep Neural Networks and	7	CO3

		Issues		
IV	Introduction to Blockchain	**Introduction:--** History of Blockchain, What is Blockchain?, Centralized v/s Decentralized System, Layers of Blockchain, Advantage of Blockchain **Blockchain Foundation:-** Cryptography -- Symmetric, Asymmetric, Hash function, Game Theory -- Nash Equilibrium, Prisoner's Dilemma, Byzantine Generals' Problem, Zero-Sum Games, Trees - Merkle Trees **Self-learning Topics:** Explore the data structure used in blockchain and study Information retrieval.	8	CO4
V	Consensus Mechanism & Smart Contract	**Consensus Mechanism:-** Introduction to consensus protocols, Types of Consensus algorithm (PoW, PoS, PoET), Key privacy challenges of the blockchain **Smart Contracts:** Introduction to Smart Contracts, Working of Smart Contracts, Decentralized Applications, Challenges in Decentralized Applications. **Self-learning Topics**: Explore and Compare various blockchain platforms	6	CO5
VI	Application of Blockchain	**Blockchain Applications:-** Cryptocurrency, Blockchain in Health Care **Self-Learning Topics:** Research papers referred in Online Reference No. 6 & 7	3	CO6

Text Books:

1. Shai Shalev-Shwartz; Shai Ben-David, MACHINE LEARNING From Theory to Algorithms, Cambridge University Press, 2014
2. Sebastian Raschka; Yuxi (Hayden) Liu, Vahid Mirjalili, Machine Learning with PyTorch and Scikit-Learn, PackT, 2022
3. Giuseppe Bonaccorso, Machine Learning Algorithm, Packt, 2017
4. Charu C Aggarwal, Neural Network & Deep Learning A Textbook, Springer, 2018
5. Bikramaditya Singhal, Gautam Dhameja, Priyansu Sekhar Panda, Beginning Blockchain A Beginner's Guide to Building Blockchain Solutions, Apress, 2018
6. Kirankalyan Kulkarni, Learn Bitcoin and Blockchain, Packt, 2018
7. Sandeep Kumar Panda, Vaibhav Mishra, Sujata Priyambada Dash, Ashis Kumar Pani, Recent Advances in Blockchain Technology Real-World Applications, Springer, 2023

References:

1. Vinod Chandra S.S, Anand Hareendran S, Machine Learning A practitioner's Approach, PHI, 2021
2. Gaur, Nitin, et al. *Blockchain with hyperledger fabric: Build decentralized applications using hyperledger fabric 2*. Packt Publishing Ltd, 2020.
3. Mastering Bitcoin: Unlocking Digital Cryptocurrencies, by Andreas Antonopoulos

Online References:

1. Live Demo : https://andersbrownworth.com/blockchain/
2. Udemy Course- Machine Learning & Deep Learning in Python & R – https://www.udemy.com/course/data_science_a_to_z/
3. Public github repository with code samples:

https://github.com/HyperledgerHandsOn/trade-finance-logistics
4. Hyperledger Fabric - https://www.hyperledger.org/projects/fabric
5. NPTEL – Introduction to Machine Learning - https://nptel.ac.in/courses/106106139
6. Shah, D., Patel, D., Adesara, J. *et al.* Exploiting the Capabilities of Blockchain and Machine Learning in Education. *Augment Hum Res* **6**, 1 (2021). https://doi.org/10.1007/s41133-020-00039-7
7. M. Hassan, J. Chen, C. Zhu and U. Zukaib, "Adoption of Blockchain-based Artificial Intelligence in Healthcare," *2022 5th International Conference on Artificial Intelligence and Big Data (ICAIBD)*, Chengdu, China, 2022, pp. 140-144, doi: 10.1109/ICAIBD55127.2022.9820137.

Assessment:

Internal Assessment (IA) for 20 marks:

- IA will consist of Two Compulsory Internal Assessment Tests. Approximately 40% to 50% of syllabus content must be covered in First IA Test and remaining 40% to 50% of syllabus content must be covered in Second IA Test

Question paper format

- Question Paper will comprise of a total of **six questions each carrying 20 marks Q.1** will be **compulsory** and should **cover maximum contents of the syllabus.**
- **Remaining questions** will be **mixed in nature** (part (a) and part (b) of each question must be from different modules. For example, if Q.2 has part (a) from Module 3 then part (b) must be from any other Module randomly selected from all the modules)
- A total of **four questions** needs to be answered.

Course Code	Course Name	Theory	Practical	Tutorial	Theory	Oral	Tutorial	Total
IoTCSBC702	Edge and Fog Computing	03	--	--	03	--	--	03

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		Test1	Test 2	Avg. of 2 Tests					
IoTCSBC702	Edge and Fog Computing	20	20	20	80	--	--	--	100

Course Objectives:

Sr. No.	Course Objectives:
The course aims:	
1	Understand the fundamentals of edge computing and its role in IoT systems.
2	Analyze and compare different edge computing architectures, platforms and frameworks.
3	Analyze and evaluate data processing at the edge and Edge analytics.
4	Understand the fundamentals of fog computing and its frameworks.
5	Demonstrate effective communication and collaboration skills in developing edge computing projects.

Course Outcomes:

Sr. No.	Course Outcomes	Cognitive levels of attainment as per Bloom's Taxonomy
On successful completion, of course, learner/student will be able to:		
1	Understand the basic concepts of Edge Computing and its collaboration with Cloud Computing.	L2
2	Understand and identify edge computing architecture and various platforms and frameworks and Demonstrate knowledge of virtualization and containerization	L3
3	To apply data processing capabilities along with edge analytics and caching to process and extract insights from data at the edge	L3

4	To understand the fundamentals of Fog computing and its architecture.	L3
5	To develop programming for fog computing-based applications and frameworks.	L4
6	To develop edge computing solutions for specific IoT use cases or scenarios.	L6

Prerequisite: Linear algebra, Probability theory and Basic statistics

Sr. No.	Module	Detailed Content	Hours	CO Mapping
0	**Prerequisite**	Basic concepts of Cloud Computing and virtualization	2	--
I	**Introduction to Edge Computing and IoT**	Understanding Edge Computing: Evolution, Use cases, advantages, disadvantages, Overview of edge computing and its significance in IoT, Challenges and opportunities in edge computing. **Self-Learning Topics: Edge devices and their capabilities**	07	CO1
II	**Edge Computing Infrastructure**	Edge computing architectures and components: Requirements and views for Edge architecture, Edge Computing Reference Architecture, critical elements for Edge architecture, Challenges for Edge application Development. Setting up Edge computing environments: development tools, python libraries. Edge computing platforms and frameworks: AWS IoT Greengrass, Azure IoT Edge, Google Cloud IoT Edge, IBM Edge Application Manager, KubeEdge. Virtualization and containerization for edge computing: Introduction to Virtualization and containerization. Advantages of Virtualization and Containerization in Edge Computing. Resource Efficiency, Faster Time to Market. **Self-Learning Topics: Apache Edgent, Eclipse ioFog.**	09	CO2
III	**Data Processing at the Edge**	Data Acquisition and Processing: Data handling, python data handling, data storage and cloud connectivity, Data Aggregation, Data Timestamping and Synchronization, Data Security and Privacy. Edge analytics and machine learning at the edge: Introduction to Edge Analytics. Edge Machine Learning. Model Selection and Optimization. Collaborative Edge Learning. Resource management and task offloading strategies: Task Offloading, Edge-Cloud Collaboration, Dynamic Resource Provisioning. Edge caching and data synchronization: Introduction to Edge caching and data synchronization, Benefits of Edge Caching and Data Synchronization, Challenges in Edge	07	CO3

		Caching and Data Synchronization. **Self-Learning Topics: Task Migration, Offline Operation, Bandwidth Optimization**.		
IV	**Introduction to Fog Computing**	Definition and basic concepts, Comparison with cloud computing and IoT, Data Management in Fog Computing. Comparison with cloud computing and edge computing. Fog Computing Architecture. Fog node and infrastructure components. Hierarchical and distributed models. Programming Models and Tools for Fog Computing **Self-Learning Topics: Applications and integration of Fog Computing.**	06	CO4
V	**Fog computing programming languages and frameworks**	Middleware and software platforms. Development and deployment considerations. Industrial Internet of Things (IIoT). Performance Evaluation and Metrics in Fog Computing. Simulation and modelling techniques. Applications and Use Cases of Fog Computing **Self-Learning Topics: Development environments and Frameworks for programming in Fog Computing.**	06	CO5
VI	**Applications and Case Studies**	High-Potential Use cases, Edge computing for smart cities. Industrial IoT and edge computing. Edge computing in Healthcare.	03	CO6

Text Books:

1. "Fog and Edge Computing" by Rajkumar Buyya, Satish Narayana Srirama, Wiley Publications
2. "Edge Computing: Models, Technologies, and Applications" by Mung Chiang, Bharath Balasubramanian, and H. Vincent Poor.
3. Edge Computing with Python: End-to-end Edge Applications, Python Tools and Techniques, Edge Architectures, and AI Benefit" by Abhinandan Bhadauria, BPB publications.
4. "Edge Computing: Simply in Depth" by Ajit Singh,
5. Edge Computing: Fundamentals, Advances and Applications (Advances in Industry 4.0 and Machine Learning) by K. Anitha Kumari, G. Sudha Sadasivam, D. Dharani, M. Niranjanamurthy, CRC Press.

References:

1. "Edge Computing for IoT: Architectures and Applications" by Bharat Bhargava, Sudip Misra, Valentina E. Balas, and Raghvendra Kumar
2. "Practical Industrial Internet of Things Security: A practitioner's guide to securing connected industries" by Sravani Bhattacharjee and Rajdeep Chowdhury
3. "Edge Computing: An Introduction to the Next Generation of Networked Systems" by Kiran Chitturi, Bharadwaj Veeravalli, and Satish Narayana Srirama
4. "Building the Web of Things: With examples in Node.js and Raspberry Pi" by Dominique D. Guinard and Vlad M. Trifa

5. "Internet of Things (IoT): Technologies, Applications, Challenges, and Solutions" edited by Balamuralidhar P., Bharadwaj Veeravalli, and V. Raghu
6. "Fog and Edge Computing: Principles and Paradigms" by Rajkumar Buyya, Satish Srirama, and Pradeep Kumar S.
7. "IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things" by David Hanes and Gonzalo Salgueiro
8. "Edge Analytics in IoT" by Shivashankar B. Nair, Siddhartha Bhattacharyya, and Thomas Edward Joshua
9. "Edge Computing: The Convergence of Big Data and Internet of Things" by Samee U. Khan, Albert Y. Zomaya, and Salman A. Baset

Online References:

1. Wearables-a-new-opportunity-in-banking – Cisco
2. https://codereality.net/wearable-computing/
3. Mohd Javaid, Abid Haleem, Ravi Pratap Singh, Shanay Rab, Rajiv Suman,Internet of Behaviors (IoB) and its role in customer services, Sensors International,Volume 2, 2021, 100122, ISSN 2666-3511, https://doi.org/10.1016/j.sintl.2021.100122

MOOC Courses:

1. https://www.mooc-list.com/tags/wearable-technology

Assessment:

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- A total of **four questions** needs to be answered.

Course Code	Course Name	Theory	Practical	Tutorial	Theory	Oral	Tutorial	Total
IoTCSBCDO 7011	**Advanced Cloud Computing Security**	03	--	--	03	--	--	03

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		Test1	Test 2	Avg. of 2 Tests					
IoTCSBCDO7011	**Advanced Cloud Computing Security**	20	20	20	80	--	--	--	100

Course Objectives:

Sr. No.	Course Objectives
The course aims:	
1	To understand the concept of security and its significance in the context of cloud computing.
2	To study cloud infrastructure security and mitigation techniques
3	To understand the working of Data center and Data Protection techniques
4	To develop a comprehensive understanding of challenges and solutions in secure identity management for cloud environments
5	To study Compliance and Security Audits policies for cloud data
6	To understand the Cloud Native Security

Course Outcomes:

Sr. No.	Course Outcomes	Cognitive levels of attainment as per Bloom's Taxonomy
On successful completion, of course, learner/student will be able to:		
1	Understand the concept of security and its importance in the context of cloud computing.	L2
2	Analyze cloud infrastructure security and apply different mitigation techniques.	L3, L4
3	Apply different data protection techniques in data centers.	L3
4	Design and implement secure identity management solutions for cloud environments	L6
5	Interpret and appropriately apply the policies on Compliance and Security Audits for cloud data	L2, L3
6	Demonstrate cloud security tools for designing, implementing, and managing cloud-native security	L2, L6

Prerequisite: Knowledge of Cloud Computing and Cryptography and Network Security

DETAILED SYLLABUS

Sr. No.	Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	Basics of cloud computing, network and system security	**2**	
I	**Fundamentals Of Cloud Security Concepts**	What is security, why is it required in cloud computing, Different types of security in cloud, attacks, and vulnerabilities **Cloud Security Concepts** - CIA Triad (Confidentiality, integrity, availability), privacy, authentication, non-repudiation, access control, defence in depth, least privilege, Traditional vs Cloud Security, importance, challenges in different cloud environment (public, private, hybrid, muti-cloud) **Self-Learning Topic:** Real-world Example of CIA Triad - Bank ATM	**5**	**CO1**
II	**Cloud Infrastructure Security: Threats and Mitigation Techniques**	**Secure Infrastructure architecture** **Infrastructure Security:** Network Level, Host Level and Application Level Common attack vectors and threats **Mitigation techniques**- Isolation, Virtualization and Segmentation, Intruder Detection and prevention, Firewall, OS Hardening and minimization, Verified and measured boot. **Self-Learning Topics:** DoS, Man-in-the-Cloud, Insecure APIs, Insider Threats, Cookie Poisoning, Cloud Malware Injection,	**7**	**CO2**
III	**Cloud Data Security**	Cloud security principles Aspects of Data Security **Mitigation techniques**: Data retention, deletion and archiving procedures for tenant data, Encryption, Data Redaction, Tokenization, Obfuscation, PKI and Key **Data center Security and Data Protection:** Physical and network **data** center security, Implementation of security in Virtual Data centers, East-west Traffic Protections, Types of firewall, IDS and IPS, DMZ **Provider Data and Its Security** **Self-Learning Topics:** **Case studies:** Capital One Data Breach, Uber's AWS Data Breach, Dow Jones Data Leak, Accenture AWS S3 Data Exposure, Verizon AWS S3 Data Exposure	**6**	**CO3**
IV	**Secure Identity Management in The Cloud: Challenges And Solutions**	IAM overview, Trust Boundaries and IAM, Architecture / Lifecycle process, IAM standards and protocols, IAM Challenges **Cloud Authorization Management:** **Identity management** - User Identification, Authentication and Authorization **Roles-based Access Control** - Multi-factor authentication, Single Sign-on, Identity Federation **Cloud Service Provider IAM Practice** **Self-Learning Topic:** IAM service in AWS	**6**	**CO4**
V	**Disaster Recovery Auditing: Mitigating Risk and Ensuring Compliance**	Cloud disaster recovery, types of disasters recovery, benefits of disaster recovery, cloud disaster recovery planning **Privacy:** Data life cycle, key privacy concerns in cloud, privacy risk management and compliance, legal and regulatory implications, **Cloud Audit and Compliance:** Internal Policy Compliance, Governance, Risk, and Compliance (GRC), Benefits, GRC Program Implementation, Cloud Security Alliance, **Self-Learning Topics:** HIPAA, ISO, PCI	**7**	**CO5**

VI	**Cloud Native Security in The Modern Organization**	Overview of Cloud Native Security, where it fits in the Modern Organization, purpose of Security, Cloud Native Security Architecture, Threats to Cloud Native Applications 3 R's and 4 C's of Cloud Native Security Cloud Native Security Controls, Cloud Native Security Tools, Cloud Native security architecture principles, DevSecOps, How to Measure the Impact of Security, Cloud-Native Application Protection Platform (CNAPP) **Self Learning Topic:** Case study on Secure the Cloud	**6**	**CO6**

Textbooks:

1. Cloud Security and Privacy: An Enterprise Perspective on Risks and Compliance by Tim Mather, Subra Kumaraswamy, and Shahed Latif, O'Reilly
2. Cloud Native Security Cookbook: Recipes for a Secure Cloud 1st Edition by Josh Armitage , O'Reilly
3. Cloud Security: A Comprehensive Guide to Secure Cloud Computing by Ronald L. Krutz and Russell Dean Vines, Wiley

References:

1. "Securing the Cloud: Cloud Computer Security Techniques and Tactics" by Vic (J.R.) Winkler, SYNGRESS
2. "Identity and Access Management as a Service: Security as a Service" by Wei Meng Lee
3. Cloud Security for Dummies by Ted Coombs, O'Reilly

Online References:

1. https://www.coursera.org/learn/cloud-computing-security#about
2. https://www.coursera.org/specializations/cybersecurity-cloud
3. https://www.edx.org/course/cloud-computing-security
4. **https://www.ibm.com/topics/cloud-security**
5. **https://www.vmware.com/topics/glossary/content/east-west-security.html**
6. **https://www.vmware.com/topics/glossary/content/data-center-security.html**
7. **https://cloud.google.com/learn/what-is-disaster-recovery**
8. **https://www.splunk.com/en_us/blog/learn/cloud-native-security.html**

Assessment:

Internal Assessment (IA) for 20 marks:

- IA will consist of Two Compulsory Internal Assessment Tests. Approximately 40% to 50% of syllabus content must be covered in First IA Test and remaining 40% to 50% of syllabus content must be covered in Second IA Test

Question paper format

- Question Paper will comprise of a total of **six questions each carrying 20 marks.** Q.1 will be **compulsory** and should **cover maximum contents of the syllabus.**
- **Remaining questions** will be **mixed in nature** (part (a) and part (b) of each question must be from different modules. For example, if Q.2 has part (a) from Module 3 then part (b) must be from any other Module randomly selected from all the modules)
- A total of **four questions** needs to be answered.

Course Code	Course Name	Theory	Practical	Tutorial	Theory	Pract/Oral	Tutorial	Total
IoTCSBCDO7012	**Software Testing & Quality Assurance (STQA)**	03	--	--	03	--	--	03

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		Test1	Test 2	Avg. of 2 Tests					
IoTCSBCDO 7012	**Software Testing & Quality Assurance (STQA)**	20	20	20	80	--	--	--	100

Course Objectives:

Sr. No.	Course Objectives
The course aims:	
1	To provide students with knowledge in Software Testing techniques.
2	To provide knowledge of Black Box and White Box testing techniques.
3	To provide skills to design test case plans for testing software.
4	To prepare test plans and schedules for testing projects.
5	To understand how testing methods can be used in a specialized environment.
6	To understand how testing methods can be used as an effective tool in providing quality assurance concerning software.

Course Outcomes:

Sr. No.	Course Outcomes	Cognitive levels of attainment as per Bloom's Taxonomy
On successful completion, of course, learner/student will be able to:		
1	Investigate the reason for bugs and analyze the principles in software testing to prevent and remove bugs.	L1, L2, L3, L4
2	Understand various software testing methods and strategies.	L1, L2
3	Manage the testing process and testing metrics.	L1, L2, L3, L4
4	Understand fundamental concepts of software automation and use automation tools.	L1, L2
5	Apply the software testing techniques in the real time environment.	L1, L2. L3
6	Use practical knowledge of a variety of ways to test software and quality attributes.	L1, L2. L3

Prerequisite: Programming Language (C++, Java), Software Engineering

DETAILED SYLLABUS:

Sr. No.	Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	Software Engineering Concepts, Basics of programming Language	**02**	
I	Testing Methodology	Introduction, Goals of Software Testing, Software Testing Definitions, Model for Software Testing, Effective Software Testing vs Exhaustive Software Testing, Software Failure Case Studies, Software Testing Terminology, Software Testing Life Cycle (STLC), Software Testing methodology, Verification and Validation, Verification requirements, Verification of high-level design, Verification of low-level design, validation. **Self-learning Topics:** Study any system/application, find requirement specifications and design the system. Select software testing methodology suitable to the application.	**07**	CO1
II	Testing Techniques	Dynamic Testing: Black Box Testing: Boundary Value Analysis, Equivalence Class Testing, State Table Based testing, Cause-Effect Graphing Based Testing, Error Guessing. White Box Testing Techniques: need, Logic Coverage Criteria, Basis Path Testing, Graph Matrices, Loop Testing, Data Flow testing, Mutation testing. Static Testing. Validation Activities: Unit validation, Integration, Function, System, Acceptance Testing. Regression Testing: Progressive vs. Regressive, Regression Testing, Regression Testability, Objectives of Regression Testing, Regression Testing Types, Define Problem, Regression Testing Techniques. **Self-learning Topics:** Select the test cases (positive and negative scenarios) for the selected system and Design Test cases for the system using any two studied testing techniques.	**09**	CO2
III	Managing the Test Process	Test Management: test organization, structure and of testing group, test planning, detailed test design and test Specification. Software Metrics: need, definition and Classification of software matrices. Testing Metrics for Monitoring and Controlling the Testing Process: attributes and corresponding metrics, estimation model for testing effort, architectural design, information flow matrix used for testing, function point and test point analysis. Efficient Test Suite Management: minimizing the test suite and its benefits, test suite minimization problem, test suite prioritization of its type, techniques and measuring effectiveness. **Self-learning Topics:** Design quality matrix for your selected system	**08**	CO3
IV	Test Automation	Automation and Testing Tools: need, categorization, selection and cost in testing tool, guidelines for testing tools. Study of testing tools: JIRA, Bugzilla, TestDirector and IBM Rational Functional Tester, Selenium etc. **Self-learning Topics:** Write down test cases, execute and manage using studied tools	**05**	CO4

V	Testing for specialized environment	Agile Testing, Agile Testing Life Cycle, Testing in Scrum phases, Challenges in Agile Testing Testing Web based Systems: Web based system, web technology evaluation, traditional software and web-based software, challenges in testing for web-based software, testing web-based testing. **Self-learning Topics:** Study the recent technical papers on software testing for upcoming technologies (Mobile, Cloud, Blockchain, IoT)	**04**	CO5
VI	Quality Management	Software Quality Management, McCall's quality factors and Criteria, ISO 9000:2000, SIX sigma, Software quality management **Self-learning Topics:** Case Studies to Identify Quality Attributed Relationships for different types of Applications (Web based, Mobile based etc.)	**04**	CO6

Textbooks:

1. Software Testing Principles and Practices Naresh Chauhan Oxford Higher Education
2. Software Testing and quality assurance theory and practice by Kshirasagar Naik, Priyadarshi Tripathy, Wiley Publication

References Books:

1. Effective Methods for Software Testing, third edition by Willam E. Perry, Wiley Publication
2. Software Testing Concepts and Tools by Nageswara Rao Pustular , Dreamtech press

Online References:

1. www.swayam.gov.in
2. www.coursera.org
3. http://onlinelibrary.wiley.com/journal/10.1002/(ISSN)1099 -1689
4. https://onlinecourses.nptel.ac.in/noc17_cs32/preview
5. https://www.youtube.com/channel/UC8w8_H_1uDfi2ftQx7a64uQ

Assessment:

Internal Assessment (IA) for 20 marks:

- IA will consist of Two Compulsory Internal Assessment Tests. Approximately 40% to 50% of syllabus content must be covered in First IA Test and remaining 40% to 50% of syllabus content must be covered in Second IA Test

Question paper format

- Question Paper will comprise of a total of **six questions each carrying 20 marks.** Q.1 will be **compulsory** and should **cover maximum contents of the syllabus.**
- **Remaining questions** will be **mixed in nature** (part (a) and part (b) of each question must be from different modules. For example, if Q.2 has part (a) from Module 3 then part (b) must be from any other Module randomly selected from all the modules)
- A total of **four questions** needs to be answered.

Subject Code	Subject Name	Theory	Practical	Tutorial	Theory	Practical /Oral	Tutorial	Total
IoTCSBCDO 7013	**IoT for Smart Cities**	03	--	--	03	--	--	03

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test 2	Avg. of 2 Tests					
IoTCSBCDO 7013	**IoT for Smart Cities**	20	20	20	80	--	--	--	100

Course Objectives:

Sr. No.	Course Objectives
The course aims:	
1.	Understand the concept and significance of smart cities and the various components and characteristics that define them.
2.	Explore the transformation of conventional cities into smart cities and the parameters used to measure their level of "smartness".
3.	Understand the collaboration between drones and the Internet of Things (IoT) in smart cities and the implications for privacy security energy efficiency and public safety.
4.	Develop an understanding of the system architecture design principles for IoT-based smart cities including domain analysis reference architecture design and deployment view.
5.	Examine the development of Smart Seoul including its infrastructure government/municipal-developed services citizen-developed services and smart city standardization.
6.	Analyze real-world case studies of smart city applications in the areas of parking weather monitoring forest fire detection and air pollution monitoring.

Course Outcomes:

After the course students will be able to

Sr. No.	Course Outcomes	Cognitive levels of attainment as per Bloom's Taxonomy
On successful completion, of course, learner/student will be able to:		
1	Define the concept of smart cities and explain their importance in the modern world.	L1, L2
2.	Identify and describe the parameters used to measure the smartness of cities.	L2,L3
3.	Propose energy-efficient solutions using drones and IoT in smart cities.	L3,L4
4.	Evaluate the effectiveness of different architectural approaches for IoT-based smart cities.	L2,L3
5.	Generate ideas for innovative applications and solutions to improve smart city infrastructure and services based on the case study of Smart Seoul.	L1,L2
6.	Critically assess the impact and potential risks associated with the implementation of smart city solutions in various domains.	L2,L3

Prerequisites:

IoT Architecture and Protocols, RFID and Microcontrollers, Wireless Sensor Technologies

DETAILED SYLLABUS:

Sr. No.	Module	Detailed Content	Hours	CO Mapping
0	**Prerequisite**	IoT architecture, protocols, design stages, applications.		
I	**Introduction to smart cities**	Introduction, Characteristics of Smart Cities, Smart Economy, Smart People Smart Governance Smart Mobility, Smart Environment, Smart Living. IoT-Based Solutions for Smart Cities , Smart Grid,Smart Home, Transport and Traffic Management,Smart Healthcare Challenges Ahead,Planning , Costs and Quality,Security and Privacy, Risks.	**3**	**CO1**
II	**Journey from Conventional Cities to Smart Cities**	Types of cities, Background of smart cities, Artificial intelligence for smart cities, Smart cities indexed parameters, Economy, Human capital, International outreach, Mobility and transport, Environment, Technology, Urban planning,Governance, Social cohesion, Infrastructure.	**5**	**CO2**
III	**Collaborative drone and IoT for improving**	Overview of the collaboration between drones and the IoT, privacy and security issues, energy efficiency, data collection in smart cities, improving life quality, public	**5**	**CO3**

	the smartness of smart cities.	safety in smart cities, disaster management.		
IV	**System Architecture Design of IoT-Based Smart Cities**	Domain Analysis, Reference Architecture Design, Architecture Framework and Viewpoint Selection, Decomposition View, Layered View, Deployment View. Case Study of Smart EV Charging.	**8**	**CO4**
V	**Case study: Smart Cities Seoul**	Smart Seoul, Smart Seoul Infrastructure, Government/Municipal-developed Services, Citizen-developed Services, NFC-based Mobile Payment, Virtual Store,Smart City Standardization. Artificial Intelligence Techniques for Smart City Applications : Machine Learning Algorithms for Smart Monitoring, Supervised Machine Learning Algorithms for Smart Monitoring, Unsupervised and Hybrid Machine Learning Algorithms for Smart Monitoring	**7**	**CO5**
VI	**Case study on smart city applications**	Smart Parking,Weather monitoring, Forest fire detection, Air pollution monitoring.	**8**	**CO6**

Text Books:

1. Internet of Things for Smart Cities: Technologies, Big Data and Security, WaleedEjaz, AlaganAnpalagan, Springer briefs in electrical and computer engineering
2. Smart Cities and Construction Technologies, Edited by Sara Shirowzhan and Kefeng Zhang, Intech open, Published in London, United Kingdom
3. Bahga, A. and Madisetti, V. (2015) Internet of Things: A Hands-On Approach., Universities Press.

References:

1. Green Internet of Things for Smart Cities, Concepts, Implications, and Challenges, Edited By Surjeet Dalal, Vivek Jaglan, Dac-Nhuong Le, CRC Press, 2021
2. Smart Cities: The Internet of Things, People and Systems, Schahram Dustdar , Stefan Nastić , Ognjen Šćekić, Springer, 2017.
3. IoT for Sustainable Smart Cities and Society, Edited By Joel J. P. C. Rodrigues, Parul Agarwal, Kavita Khanna, Springer, 2022.

Online References:

1. Survey on Collaborative Smart Drones and Internet of Things for Improving Smartness of Smart Cities, IEEE, https://ieeexplore.ieee.org/document/8795473

2. System Architecture Design of IoT-Based Smart Cities, MDPI, https://www.mdpi.com/2076-3417/13/7/4173
3. Smart Cities Seoul, International Telecommunication Union, https://www.itu.int/dms_pub/itu-t/oth/23/01/T23010000190001PDFE.pdf
4. Internet of Things for Smart Cities, IEEE INTERNET OF THINGS JOURNAL, VOL. 1, NO. 1, FEBRUARY 2014, https://ieeexplore.ieee.org/stamp/stamp.jsp?arnumber=6740844
5. Artificial Intelligence Techniques for Smart City Applications, Proceedings of the 18th International Conference on Computing in Civil and Building Engineering, 2021, Volume 98, ISBN : 978-3-030-51294-1

Assessment:

Internal Assessment (IA) for 20 marks:

- IA will consist of Two Compulsory Internal Assessment Tests. Approximately 40% to 50% of syllabus content must be covered in First IA Test and remaining 40% to 50% of syllabus content must be covered in Second IA Test.

➢ **Question paper format:**

- Question Paper will comprise of a total of **six questions each carrying 20 marks Q.1** will be **compulsory** and should **cover maximum contents of the syllabus.**
- **Remaining questions** will be **mixed in nature** (part (a) and part (b) of each question must be from different modules. For example, if Q.2 has part (a) from Module 3 then part (b) must be from any other Module randomly selected from all the modules).
- A total of **four questions** need to be answered.

Course Code	Course Name	Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
IoTCSBCDO7014	**Supervisory Control and Data acquisition (SCADA) Security**	03	--	--	03	--	--	03

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		Test1	Test 2	Avg. of 2 Tests					
IoTCSBCDO7014	**Supervisory Control and Data acquisition (SCADA) Security**	20	20	20	80	--	--	--	100

Course Objectives:

The course aims:

Sr. No.	Course Objectives
1	To understand SCADA systems operations and measuring the effectiveness of viable security controls.
2	To identify the challenges in securing current SCADA systems.
3	To interpret incident response, prioritization and notification in SCADA systems.
4	To plan SCADA contingency processes for Disaster Recovery and Business Continuity.
5	To assimilate Project Management for SCADA Systems.
6	Study new age SCADA systems utilities.

Course Outcomes:

On successful completion, of course, learner/student will be able to:

Sr. No.	Course Outcomes	Cognitive levels of attainment as per Bloom's Taxonomy
1	Understand SCADA systems operations and measuring the effectiveness of viable security controls.	L1, L2
2	Identify and analyze the challenges in securing current SCADA systems.	L1, L2, L4
3	Interpret incident response, prioritization, and notification in SCADA systems.	L1, L2, L3
4	Plan SCADA contingency processes for Disaster Recovery and Business Continuity.	L1, L2. L3
5	Assimilate Project Management for SCADA Systems.	L1, L2, L3
6	Demonstrate new age SCADA systems utilities.	L1, L2

Prerequisite: Computer Network and Security

DETAILED SYLLABUS:

Sr. No.	Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	Computer Network and Security	**02**	
I	Industrial Control Systems and Metrics Framework	Evolution of Industrial Control Systems, ICS Industrial Sectors and their Interdependencies, ICS Operation and Components, ICS versus IT Systems Security, Metrics: Security group knowledge, Attack group knowledge, Access, Vulnerabilities, Damage potential, Detection and Recovery, Defining cybersecurity metrics. **Self-Study:** Other Types of Control Systems	**05**	CO1
II	The Cyberthreat to SCADA systems and Commercial product vulnerabilities	Directed attacks, Thwarted attacks, Successful attacks, Identified incidents, Microsoft: the leading supplier of software with vulnerabilities, Other major vendors: Oracle, IBM Google, Adobe, Apple, and Cisco. **Self-Study:** Improvement of SCADA Security	**07**	CO2
III	Incident Response and SCADA	Difficulties with SCADA and incident response, Incident analysis, Incident prioritization, Incident notification, choosing a containment strategy, Evidence gathering and handling, Basic forensics for standard computers, Identifying the attacker, Eradication and recovery, Evidence retention. **Self-Study:** Case study: DHS (Department of Homeland Security)	**07**	CO3
IV	Disaster recovery and business continuity of SCADA	Business continuity process, Types of plans, Examples of SCADA systems at risk, SCADA contingency planning process, SCADA system contingency plan development, Recovery phase, Sequence of recovery activities, Recovery procedures, Recovery escalation and notification, Reconstitution phase, Plan appendices, Maintenance of data security, integrity, and backup, Protection of resources, Identification of alternate storage and processing facilities. **Self-Study:** Client/server systems and Telecommunications systems	**07**	CO4
V	Project management for SCADA systems	Introduction, Areas of knowledge needed, Similarities and differences with the SCADA community, managing stakeholders and projects, how to be successful with SCADA implementations. **Self-Study:** Case study: SCADA implementations	**05**	CO5
VI	Supervisory control applications & Operator interface	Operating System Utilities, SCADA System Utilities, Program Development Tools, Access-Control Mechanisms, Standard System Displays, Logs and Reports. **Self-Study:** Standardized APIs, Site/Industry–Specific Displays, Historical Trending	**06**	CO6

Textbooks:

1. Guide to Industrial Control Systems (ICS) Security, Revision 2 by Keith Stouffer, Victoria Pillitteri, Suzanne Lightman, Marshall Abrams, Adam Hahn
2. Handbook of SCADA/Control Systems, Second Edition by Robert Radvanovsky, Jacob Brodsky
3. Cybersecurity for SCADA Systems, Second Edition by Willam Shaw
4. Cyber-security of SCADA and Other Industrial Control Systems By Edward J. M. Colbert, Alexander Kott

References Books:

1. "Industrial Automation and Control System Security Principles" by Ronald L. Krutz and Russell Dean Vines
2. "SCADA Security: What's Broken and How to Fix It" by Robert Radvanovsky and Jacob Brodsky
3. "SCADA Security: Protecting Critical Infrastructure Systems" by Jack Whitsitt
4. "SCADA and Me: A Book for Children and Management" by Robert M. Lee

Online References:

1. https://www.inductiveautomation.com/resources/article/what-is-scada
2. https://www.dpstele.com/scada/introduction-fundamentals-implementation.php
3. https://www.parasyn.com.au/scada-services-rtu-solutions/#whataretheapplicationsusedinscada?
4. https://www.parasyn.com.au/scada-services-rtu-solutions/#whatarethegreatestproblemswithscadasystems?
5. https://www.forcepoint.com/cyber-edu/scada-security

Assessment:

Internal Assessment (IA) for 20 marks:

- IA will consist of Two Compulsory Internal Assessment Tests. Approximately 40% to 50% of syllabus content must be covered in First IA Test and remaining 40% to 50% of syllabus content must be covered in Second IA Test

Question paper format

- Question Paper will comprise of a total of **six questions each carrying 20 marks.** Q.1 will be **compulsory** and should **cover maximum contents of the syllabus.**
- **Remaining questions** will be **mixed in nature** (part (a) and part (b) of each question must be from different modules. For example, if Q.2 has part (a) from Module 3 then part (b) must be from any other Module randomly selected from all the modules)
- A total of **four questions** needs to be answered.

Subject Code	Subject Name	Theory	Practical	Tutorial	Theory	Practical/ Oral	Tutorial	Total
IoTCSBCDO7021	Design a Blockchain Application Architecture	03	--	--	03	--	--	03

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal Assessment			End Sem. Exam				
		Test1	Test 2	Avg. of 2 Tests					
IoTCSBCDO7021	Design A Blockchain Application Architecture	20	20	20	80	--	--	--	100

Course Objectives:

Sr. No.	Course Objectives
1.	To get acquainted with the concepts of Blockchain and the concepts of consensus in Permissioned Blockchain.
2.	To get familiar with the concepts of Ethereum Blockchain
3.	To get familiar with the concepts of Hyperledger Fabric as an Enterprise Blockchain.
4.	To understand scalability and interoperability concepts in blockchain.
5.	To understand and compare various Blockchain Ecosystems and platforms
6.	To analyze the applications and use cases of Blockchain

Course Outcomes:

Sr. No.	Course Outcomes	Cognitive levels of attainment as per Bloom's Taxonomy
1	Describe the basic concepts of Blockchain and the knowledge of consensus in Permissioned Blockchain.	L2
2	Apply the fundamentals of Ethereum Blockchain towards developing industrial solutions.	L2
3	Understand and apply Enterprise based Blockchain with respect to Hyperledger Fabric.	L3
4	Interpret the scalability and interoperability concepts in blockchain.	L3
5	Illustrate different blockchain platforms and their applications.	L5
6	Apply the concepts of Blockchain towards different use-cases and applications.	L2

Prerequisite: Introduction to Cryptography and Distributed Systems.

DETAILED SYLLABUS:

Sr. No.	Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	**Introduction to Cryptography -** Hash Functions, Public Key Cryptography, Digital Signature. **Introduction to Distributed System**s - Distributed Systems, Benefits of Distributed Systems, Decentralized Vs Distributed, CAP Theorem, BASE Properties	2	--
I	Introduction to Blockchain and Consensus Mechanism	Fundamental concepts of blockchain, key characteristics, history, generations blockchain vs traditional databases. **Consensus:** Definition, requirements, characteristics, algorithms: PoW, PoA, PoS, RAFT, Byzantine General Problem, Practical Byzantine Fault Tolerance **Self-learning Topics:** DAG, other consensus algorithms.	5	CO1
II	Ethereum Blockchain	**Introduction to Ethereum**: Ethereum 1.0 and 2.0, Turing completeness EVM and compare with bitcoin, Basics of Ether Units, Ethereum Wallets: Structure of Transaction, Transaction Nonce, Transaction GAS, Recipient, Values and Data, Transmitting Values to EOA and Contracts. **Smart Contracts and Solidity:** Development environment and client, Basic of Solidity, Life cycle of Smart contract, Smart Contract programming using solidity, Metamask (Ethereum Wallet), Setting up a development environment, Use cases of Smart Contract, Smart Contracts: Opportunities and Risk. **Smart Contract Deployment**: Introduction to Truffle, Use of Remix and test networks for deployment **Self-learning Topics:** Smart contract development using Java or Python.	10	CO2
III	Hyperledger	Basic definition, tools and frameworks, Hyperledger Fabric – Components, Transaction Flow, Membership and Identity Management, Network Setup, Certificate Authority, Nodes, Chain codes, Channels, Consensus: Solo and Kafka, Challenges: Interoperability and Scalability of blockchain **Self-learning Topics:** Deploy from scratch, Hyperledger Composer- Application Development and Network Administration.	6	CO3
IV	Security, Scalability and Interoperability	**Introduction to scalability and Interoperability:** understanding concepts of blockchain scalability and interoperability, benefits, key challenges, potential solutions, cross-chain technology, applications. Security and Privacy challenges of blockchain. **Self-learning Topics:** white-papers addressing challenges and solutions for scalability and interoperability.	6	CO3
V	Blockchain Platforms and Polkadot	Introduction, basic working, advantages and disadvantages, with respect to EOS, Corda, Multichain, Quorum, Polkadot, COSMOS. Introduction to Polkadot, evolution and working of Polkadot, the Network and governance on polkadot network. **Self-learning Topics**: Other blockchain platforms	6	CO5
VI	Blockchain Use Cases	Blockchain in Financial Service - Payments and Secure Trading, Blockchain in Supply Chain and Other Industries Blockchain in Government - Advantages, Use Cases, Digital Identity, Tax Payments and Land Registry Records	4	CO6

Text Books:

1. Antonopoulos, Andreas M. *Mastering Bitcoin: Programming the open blockchain*. " O'Reilly Media, Inc.", 2017.
2. Blockchain Scalability & Interoperability Bane-To-Boon: By Harish Jaggi & Raj Jha.
3. Blockchain Technology Kindle Edition by Chandramouli Subramanian, Asha A George, Abhilash K A, Meena Karthikeyan.
4. Mastering Ethereum - Building Smart Contracts and DApps, Andreas M. Antonopoulos and Dr. Gavin Wood, O'Reilly Media, Inc.", 2019.
5. Mastering Blockchain, Third Edition, 2020 Packt Publishing, Imran Bashir
6. Blockchain with Hyperledger Fabric, Second Edition, 2020 Packt Publishing, Nitin Gaur et.al.
7. POLKADOT FOR BEGINNERS A non-technical guide to decentralization, blockchains, and Polkadot, Gbaci.

References:

1. Kube, Nicolas. "Daniel Drescher: Blockchain basics: a non-technical introduction in 25 steps: Apress, 2017, 255 pp, ISBN: 978-1-4842-2603-2." (2018): 329-331.
2. Blockchain by Melanie Swan, O'Reilly
3. Zero to Blockchain - An IBM Redbooks course, by Bob Dill, David Smits
4. Baset, Salman A., et al. *Hands-on blockchain with Hyperledger: building decentralized applications with Hyperledger Fabric and composer*. Packt Publishing Ltd, 2018.
5. Gaur, Nitin, et al. *Blockchain with hyperledger fabric: Build decentralized applications using hyperledger fabric 2*. Packt Publishing Ltd, 2020.
6. Mastering Bitcoin: Unlocking Digital Cryptocurrencies, by Andreas Antonopoulos

Online References:

1. Live Demo : https://andersbrownworth.com/blockchain/
2. Udemy Course - Blockchain A-Z™: Learn How To Build Your First Blockchain https://www.udemy.com/course/build-your-blockchain-az/
3. Chakraborty, Sandip, and Praveen Jayachandran. "Blockchain-Architecture, Design and Use cases." *NPTEL Course Lecture* (2018). https://www.youtube.com/watch?v=mzPoUjQC4WU&list=PLHRLZtgrF2jl8yqucJsMFqh5XpRLTgCI4
4. https://101blockchains.com/blockchain-scalability-solutions/
5. https://crypto.com/university/blockchain-scalability
6. https://cointelegraph.com/learn/what-is-blockchain-interoperability-a-beginners-guide-to-cross-chain-technology
7. https://www.geeksforgeeks.org/blockchain-interoperability/
8. https://www.eublockchainforum.eu/sites/default/files/reports/report_scalaibility_06_03_2019.pdf

Assessment:

Internal Assessment (IA) for 20 marks:

- IA will consist of Two Compulsory Internal Assessment Tests. Approximately 40% to 50% of syllabus content must be covered in First IA Test and remaining 40% to 50% of syllabus content must be covered in Second IA Test

Question paper format

- Question Paper will comprise of a total of **six questions each carrying 20 marks Q.1** will be **compulsory** and should **cover maximum contents of the syllabus.**

- **Remaining questions** will be **mixed in nature** (part (a) and part (b) of each question must be from different modules. For example, if Q.2 has part (a) from Module 3 then part (b) must be from any other Module randomly selected from all the modules)

- A total of **four questions** needs to be answered.

Course Code	Course Name	Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
IoTCSBCDO7022	**User Interface Design with Security**	03	--	--	03	--	--	03

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		Test1	Test 2	Avg. of 2 Tests					
IoTCSBCDO7022	**User Interface Design with Security**	20	20	20	80	--	--	--	100

Course Objectives:

Sr. No.	Course Objectives
1	To stress the importance of good interface design.
2	To understand the importance of human psychology as well as social and emotional aspect in designing good interfaces.
3	To learn the techniques of data gathering, establishing requirements, analysis and data interpretation.
4	To learn the techniques for prototyping and evaluating user experiences.
5	To understand interaction design process and bring out the creativity in each student – build innovative applications that are usable, effective and efficient for intended users.
6	To understand the role of security in User interaction design.

Course Outcomes:

Sr. No.	Course Outcomes	Cognitive levels of attainment as per Bloom's Taxonomy
On successful completion, of course, learner/student will be able to:		
1	Identify and criticize bad features of interface designs.	L4
2	Predict good features of interface designs.	L5
3	Illustrate and analyze user needs and formulate user design specifications.	L4
4	Interpret and evaluate the data collected during the process.	L2, L5
5	Evaluate designs based on theoretical frameworks and methodological approaches and will be able to produce/show better techniques to improve the user interaction design interfaces.	L5
6	Evaluate designs based on cyber security aspects.	L5

Prerequisite: Basics of Cyber Security, Software Engineering concepts and any programming Language

DETAILED SYLLABUS:

Sr. No.	Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	Basics of Cyber Security, Software Engineering concepts and any programming Language **Self-learning Topics:** Web design languages	**1**	--
I	Introduction To Interaction Design	Good And Poor Design, Interaction Design, The User Experience, The Process of Interaction Design, interaction Design and The User Experience **Self-learning Topics:** Study of Various interactive day to day application	**5**	CO1
II	Understanding And Conceptualizing Interaction	Understanding The Problem Space and Conceptualizing Design, Conceptual Model, Interface Types, Cognitive Aspects, Social Interaction and The Emerging Social Phenomena, Emotions and The User Experience, Expressive And Frustrating Interfaces, Persuasive Technologies **Self-learning Topics:** Study of Various interactive Interface Types	**5**	CO2
III	Data Processing	Establishing Requirements, Five Key Issues, Techniques for Data Gathering, Data Analysis Interpretation and Presentation, Task Description and Task Analysis **Self-learning Topics:** Any case study of how to gather requirements. (eq.BE Project)	**6**	CO3
IV	Process Of Interaction Design and Design Rules and Industry Standards	Interaction Design Process, Prototyping and Conceptual Design, Interface Metaphors and Analogies, Design Principles, Principles to Support Usability, Standards And Guidelines, Golden Rules and Heuristics, ISO/IEC Standards **Self-learning Topics:** Study of two websites with usability concepts. Study experiments on industry standards and design principles. principles.https://xd.adobe.com/ideas/career-tips/15-rules-every-ux-designer-know/	**7**	CO4
V	Evaluation Techniques and Framework	The Why, what, Where and When of Evaluation, Types Of Evaluation, Case Studies DECIDE Framework, Usability Testing, Conducting Experiments, Field Studies, Heuristic Evaluation and Walkthroughs, Predictive Models. **Self-learning Topics:** Evaluation of any GUI with usability principles.	**7**	CO5
VI	Usability Design and Evaluation for Privacy and Security Solutions and Secure Systems	Usability in the Software and Hardware Life Cycle: Unique Aspects of HCI and Usability in the Privacy and Security Domain, Usability in Requirements, Usability in Design and Development, Usability in Post release, Guidelines and Strategies for Secure Interaction Design, Design Guidelines, Authorization, Communication, Design Strategies, Security by Admonition and Security by Designation, Applying the Strategies to Everyday Security Problems, Fighting Phishing at the User Interface **Self-learning Topics:** Any case study of how to check Cyber Security Guidelines (eg. BE Project)	**8**	CO6

Textbooks:

1. Interaction Design, by J. Preece, Y. Rogers and H. Sharp. ISBN 0-471-49278-7.
2. Security and Usability by Lorrie Faith Cranor, Simson Garfinkel, Publisher(s): O'Reilly Media, Inc. ISBN: 9780596553852 (Chapter 4 , 13 & 14)
3. Jeff Johnson, "Designing with the mind in mind", Morgan Kaufmann Publication.
4. Wilbert O. Galitz, "The Essential Guide to User Interface Design", John Wiley & Sons, Second Edition 2002.
5. Human Computer Interaction, by Alan Dix, Janet Finlay, Gregory D Abowd, Russell Beale
6. Alan Cooper, Robert Reimann, David Cronin, "About Face3: Essentials of Interaction design", Wiley publication.
7. Wilbert O. Galitz, "The Essential Guide to User Interface Design", Wiley publication.

References:

1. Nilakshi Jain, Dhanajay R kalbande UI DESIGN: Key to Captivate User Understanding, STBGEN Learning
2. The UX Book, by Rex Hartson and Pardha S Pyla.
3. Donald A. Norman, "The design of everyday things", Basic books.

Online References:

1. https://onlinecourses.nptel.ac.in/noc21_ar05/preview
2. https://nptel.ac.in/courses/124/107/124107008/
3. https://nptel.ac.in/noc/courses/noc19/SEM1/noc19-ar10/
4. https://nptel.ac.in/courses/107/103/107103083/
5. https://www.youtube.com/watch?v=6C2Ye1makdY&list=PLW-zSkCnZ-gD5TDfs1eL5EnH2mQ0f9g6B
6. https://xd.adobe.com/ideas/process/

Assessment:

Internal Assessment (IA) for 20 marks:

● IA will consist of Two Compulsory Internal Assessment Tests. Approximately 40% to 50% of syllabus content must be covered in First IA Test and remaining 40% to 50% of syllabus content must be covered in Second IA Test

Question paper format

● Question Paper will comprise of a total of **six questions each carrying 20 marks.** Q.1 will be **compulsory** and should **cover maximum contents of the syllabus.**

● **Remaining questions** will be **mixed in nature** (part (a) and part (b) of each question must be from different modules. For example, if Q.2 has part (a) from Module 3 then part (b) must be from any other Module randomly selected from all the modules)

● A total of **four questions** needs to be answered.

Subject Code	Subject Name	Theory	Practical	Tutorial	Theory	Oral	Tutorial	Total
IoTCSBCDO7023	**Enterprise IoT Cyber Security**	03	--	--	03	--	--	03

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		Test1	Test 2	Avg. of 2 Tests					
IoTCSBCDO7023	**Enterprise IoT Cyber Security**	20	20	20	80	--	--	--	100

Course Objectives: The course aims:

1. To learn fundamentals of Enterprise IoT, vulnerabilities, attacks and countermeasures for IoT systems.
2. To gain knowledge in security engineering for IoT development and lifecycle.
3. To understand the cryptographic fundamentals for IoT security engineering.
4. To develop a comprehensive understanding of challenges and solutions in secured identity management.
5. To gain knowledge of the different privacy regulations and compliance requirements.
6. To analyze various case studies and applications for Enterprise IoT.

Course Outcomes: On successful completion of course, learner/student will be able to:

Sr. No.	Course Outcomes	Cognitive levels of attainment as per Bloom's Taxonomy
On successful completion, of course, learner/student will be able to:		
1	Discuss fundamentals of Enterprise IoT, vulnerabilities, attacks and threats in IoT systems	L2
2.	Illustrate IoT security life cycle	L4
3.	Examine various cryptographic controls for IoT protocols.	L4
4.	Evaluate the identity and access management solution for IoT security.	L5
5.	Identify applicable privacy regulations and compliance requirements for data in IoT environments	L2
6.	Evaluate various case studies and applications for Enterprise IoT	L5

Prerequisite: Knowledge of IoT and Cryptography

DETAILED SYLLABUS

Sr. No.	Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	Basics of IoT and cryptography	**2**	
I	**INTRODUCTION TO ENTERPRISE IOT CYBER SECURITY**	Fundamentals of IOT in Enterprise, IoT device lifecycle. Security Requirements in IoT Architecture, Security in Enabling Technologies. Primer on threats, vulnerability and risks (TVR), Primer on attacks and countermeasures. Today's IoT attacks. **Self Learning Topics**: Threat modeling an IoT System.	**5**	**CO1**
II	**IOT SECURITY ENGINEERING AND DEVELOPMENT**	**Building security into design and development**- Security in Agile developments **Secure design**- Safety and security design, Process and agreements, Technology selection – security products and services **IoT security lifecycle** – Implementation and integration, operations and maintenance, Dispose. **Self Learning Topics:** Cyber attack on Industrial control system, ransomware attack on healthcare enterprise "Wannacry" case study	**7**	**CO2**
III	**CRYPTOGRAPHIC FUNDAMENTALS FOR IOT SECURITY**	Cryptographic primitives and its role in securing the IoT. Cryptographic module principles, key management fundamentals. Cryptographic controls built into IoT communication and messaging protocols IoT Node Authentication **Self Learning Topics:** Future directions of IoT and Cryptography (Including blockchain for IoT security)	**6**	**CO3**
IV	**IDENTITY & ACCESS MANAGEMENT SOLUTIONS FOR SECURE IOT**	**Identity lifecycle** **Authentication credentials** – Passwords, Symmetric keys, Certificates, Biometrics **IoT IAM infrastructure** –802.1X, PKI for IoT **Authorization and access control** – OAuth 2.0, publish/ subscribe protocols and communication protocols **Self Learning Topics:** Authentication and authorization framework of IIoT	**6**	**CO4**
V	**MITIGATING IOT PRIVACY CONCERNS AND COMPLIANCE MONITORING**	Privacy challenges introduced by the IoT, Performing an IoT Privacy Impact Assessment **(PIA)**, Privacy by Design **(PbD)** principles, Privacy engineering recommendations IoT Compliance, challenges associated with IoT compliance, examining compliance standard support for IoT **Self Learning Topics:** Differential privacy in Industrial IoT	**7**	**CO5**
VI	**ENTERPRISE IOT: CASE STUDIES AND APPLICATION**	Cleaning Service Industry and Technology, Global Cold Chain Management, Intelligent Lot Tracking, Industrial Internet Consortium Testbeds	**6**	**CO6**

Text Books:

1. "Enterprise IoT: Strategies and Best Practices for Connected Products and Services" by Dirk Slama, Frank Puhlmann, Jim Morrish, and Rishi M. Bhatnagar, O′Reilly

2. “Practical Internet of Things Security” by Brian Russell, Drew Van Duren, and John Sammons, PACKT Publishing

3. "Securing the Internet of Things" by Shancang Li, Li Da Xu, and Liming Chen, SYNGRESS

References:

1. Security and Privacy in Internet of Things (IoTs) Models, Algorithms, and Implementations by FEI HU, CRC Press

2. Security, Privacy and Trust in the IoT Environment by Zaigham Mahmood, Springer, ISBN: 9783030180744, 2019.

3. Ollie Whitehouse, “Security of Things: An Implementers’ Guide to Cyber-Security forInternet of Things Devices and Beyond”, NCC Group, 2014

4. “Practical Industrial Internet of Things Security”, By Sravani Bhattacharjee, PACKT Publishing.

Online References:

1. https://www.coursera.org/learn/iot-cyber-security
2. https://www.edx.org/course/cybersecurity-and-privacy-in-the-iot

Assessment:

Internal Assessment (IA) for 20 marks:

- IA will consist of Two Compulsory Internal Assessment Tests. Approximately 40% to 50% of syllabus content must be covered in First IA Test and remaining 40% to 50% of syllabus content must be covered in Second IA Test.

➢ **Question paper format:**

- Question Paper will comprise of a total of **six questions each carrying 20 marks Q.1** will be **compulsory** and should **cover maximum contents of the syllabus.**
- **Remaining questions** will be **mixed in nature** (part (a) and part (b) of each question must be from different modules. For example, if Q.2 has part (a) from Module 3 then part (b) must be from any other Module randomly selected from all the modules).
- A total of **four questions** need to be answered.

Course Code	Subject Name	Theory	Practical	Tutorial	Theory	Practical /Oral	Tutorial	Total
IoTCSBCDO 7024	**Software Engineering & Testing Methodology for IoT**	03	--	--	03	--	--	03

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		Test1	Test 2	Avg. of 2 Tests					
IoTCSBCDO 7024	**Software Engineering & Testing Methodology for IoT**	20	20	20	80	--	--	--	100

Course Objectives:

1. To provide the knowledge of the new process models and trends for IoT based software engineering practices.
2. To acquire skills on web based IoT application development
3. To gain the ability to identify the challenges in IoT to automate the real-time problems.
4. To acquire knowledge about various software test planning and techniques for IoT.

Course Outcomes: On successful completion of course, learners will be able to:

Sr. No.	Course Outcomes	Cognitive levels of attainment as per Bloom's Taxonomy
On successful completion, of course, learner/student will be able to:		
1	Apprehend new process models and trends for IoT based software engineering practices.	L1
2.	Design and model an IoT system using UML diagrams.	L3,L4
3.	Understand the challenges in IoT to automate the real-time problems.	L1, L2
4.	Understand IoT based testing concepts and challenges.	L1,L2
5.	Identify different IoT testing planning and strategies.	L1,L2
6.	Explore various IoT testing techniques.	L3,L4

Prerequisite:

Software Engineering , IoT Architecture and Protocols

DETAILED SYLLABUS

Sr. No.	Module	Detailed Content	Hours	CO Mapping
0	**Prerequisite**	**Process models in Software Engineering:** Prescriptive, evolutionary, and agile process models, UML Diagrams, IoT devices and protocols.	2	
I	**IoT Based Software Engineering**	**New process model for IoT based Software Engineering:** Introduction, Layers of IoT, IoT based SDLC, Identifying Business needs through IoT, IoT in various domains. **Introduction to trends in integrating IoT into Software Engineering practices**: DevOps in IoT, DevSecOps in IoT, Integrating security into IoT, Machine Learning and AI in IoT of Software Engineering practices.	6	CO1
II	**Modelling & Design of IoT System**	**Modeling of IoT system using UML diagrams:** IoT Software Engineering, **UML representations of IoT Systems:** Use case diagram, class diagram, interaction diagrams, and physical diagrams, Architecture design of IoT system, Cryptographic approaches, Machine Learning approaches.	8	CO2
III	**Web Based IoT Application Development**	**Introduction to web based IoT application development**, IoT layered architecture for web application development, challenges of IoT application development, End-to-end complete IoT Solution.	5	CO3
IV	**Introduction to IoT Testing**	**Challenges in IoT Testing**, advanced IoT device challenges, IoT development-test-security-operation lifecycle, **Verification & Validation** testing concepts, factors and keys for IoT testing.	4	CO4
V	**IoT Test Planning & Strategy**	**Basics of IoT Test Planning**, IoT test planning & strategy for hardware & software, Agile/DevOps test lifecycle, Product and Development Lifecycle Impacts on Test Planning – DevOps and Agile, V & V activities, **IoT test planning:** Regression test cases, OTS hardware and software, Security and critical quality factors, IoT strategy.	8	CO5
VI	**IoT Testing Techniques and Practices**	**Techniques, practices, levels and types of testing to apply to IoT**, Functional test design techniques, Exploratory testing, structural testing, **industrial test practices,** IoT levels of testing related to lifecycle phases, test planning for Agile Team.	6	CO6

Text Books:

1. Jon Duncan Hagar, *IoT System Testing: An IoT Journey from Devices to Analytics and the Edge,* Apress 2022.
2. D. Jeya Mala, *Integrating the Internet of Things into Software Engineering Practices*, IGI Global 2019.

References:

1. Sudham Sudhakar, *Testing IoT: Build and Implement Test Automation and Performance Testing for IoT Systems*.
2. Aaron Guzman, Aditya Gupta, *IoT Penetration Testing Cookbook: Identify vulnerabilities and secure your smart devices* Paperback – Import, 29 November 2017.

3. Yogesh Singh, Software Testing, Cambridge University Press, 2012.
4. Mauro Pezze, Michal Young: *Software Testing and Analysis – Process, Principles and Techniques*, Wiley India, 2009.
5. Haengkon Kim, Roger Lee, Software Engineering in IoT, Big Data, Cloud and Mobile Computing, Springer Nature, 2020.

Online References:

1. https://bytebeam.io/blog/iot-software-testing-guide/
2. www.omg.org/spec/UML/2.5.1/About-UML/
3. https://www.softwaretestinghelp.com/internet-of-things-iot-testing/
4. https://www.techarcis.com/whitepapers/security-testing-in-iot/
5. https://dl.acm.org/doi/abs/10.1145/3356317.3356326
6. https://yalantis.com/blog/iot-testing-guide/

Assessment:

Internal Assessment (IA) for 20 marks:

- IA will consist of Two Compulsory Internal Assessment Tests. Approximately 40% to 50% of syllabus content must be covered in First IA Test and remaining 40% to 50% of syllabus content must be covered in Second IA Test.

➢ **Question paper format:**

- Question Paper will comprise of a total of **six questions each carrying 20 marks Q.1** will be **compulsory** and should **cover maximum contents of the syllabus.**
- **Remaining questions** will be **mixed in nature** (part (a) and part (b) of each question must be from different modules. For example, if Q.2 has part (a) from Module 3 then part (b) must be from any other Module randomly selected from all the modules).
- A total of **four questions** need to be answered.

Course Code	Course Name	Theory	Practical	Tutorial	Theory	Oral	Tutorial	Total
ILO7011	**Product Life Cycle Management**	03	--	--	03	--	--	03

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		Test1	Test 2	Avg. of 2 Tests					
ILO7011	**Product Life Cycle Management**	20	20	20	80	--	--	--	100

Course Objectives:

Sr. No.	Course Objectives:
The course aims:	
1	To familiarize the students with the need, benefits and components of PLM
2	To acquaint students with Product Data Management & PLM strategies
3	To give insights into new product development program and guidelines for designing and developing a product
4	To familiarize the students with Virtual Product Development

Course Outcomes:

Sr. No.	Course Outcomes	Cognitive levels of attainment as per Bloom's Taxonomy
On successful completion, of course, learner/student will be able to:		
1	Gain knowledge about phases of PLM, PLM strategies and methodology for PLM feasibility study and PDM implementation	L1
2	Illustrate various approaches and techniques for designing and developing products	L3, L4
3	Apply product engineering guidelines / thumb rules in designing products for moulding, machining, sheet metal working etc.	L3
4	Acquire knowledge in applying virtual product development tools for components, machining and manufacturing plant.	L3

Module	Detailed Contents	Hrs
01	**Introduction to Product Lifecycle Management (PLM):** Product Lifecycle Management (PLM), Need for PLM, Product Lifecycle Phases, Opportunities of Globalization, Pre-PLM Environment, PLM Paradigm, Importance & Benefits of PLM, Widespread Impact of PLM, Focus and Application, A PLM Project, Starting the PLM Initiative, PLM Applications **PLM Strategies:** Industrial strategies, Strategy elements, its identification, selection and implementation, Developing PLM Vision and PLM Strategy, Change management for PLM	10
02	**Product Design:** Product Design and Development Process, Engineering Design, Organization and Decomposition in Product Design, Typologies of Design Process Models, Reference Model, Product Design in the Context of the Product Development Process, Relation with the Development Process Planning Phase, Relation with the Post design Planning Phase, Methodological Evolution in Product Design, Concurrent Engineering, Characteristic Features of Concurrent Engineering, Concurrent Engineering and Life Cycle Approach, New Product Development (NPD) and Strategies, Product Configuration and Variant Management, The Design for X System, Objective Properties and Design for X Tools, Choice of Design for X Tools and Their Use in the Design Process	09
03	**Product Data Management (PDM):** Product and Product Data, PDM systems and importance, Components of PDM, Reason for implementing a PDM system, financial justification of PDM, barriers to PDM implementation	05
04	**Virtual Product Development Tools:** For components, machines, and manufacturing plants, 3D CAD systems and realistic rendering techniques, Digital mock-up, Model building, Model analysis, Modeling and simulations in Product Design, Examples/Case studies	05
05	**Integration of Environmental Aspects in Product Design:** Sustainable Development, Design for Environment, Need for Life Cycle Environmental Strategies, Useful Life Extension Strategies, End-of-Life Strategies, Introduction of Environmental Strategies into the Design Process, Life Cycle Environmental Strategies and Considerations for Product Design	05
06	**Life Cycle Assessment and Life Cycle Cost Analysis:** Properties, and Framework of Life Cycle Assessment, Phases of LCA in ISO Standards, Fields of Application and Limitations of Life Cycle Assessment, Cost Analysis and the Life Cycle Approach, General Framework for LCCA, Evolution of Models for Product Life Cycle Cost Analysis	05

Assessment:

Internal:
Assessment consists of two tests out of which; one should be compulsory class test and the other is either a class test or assignment on live problems or course project.

End Semester Theory Examination:
Some guidelines for setting up the question paper. Minimum 80% syllabus should be covered in question papers of end semester examination. **In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.**

1. Question paper will comprise of total six question
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four question need to be solved.

REFERENCES:

1. John Stark, "Product Lifecycle Management: Paradigm for 21st Century Product Realisation", Springer-Verlag, 2004. ISBN: 1852338105
2. Fabio Giudice, Guido La Rosa, AntoninoRisitano, "Product Design for the environment-A life cycle approach", Taylor & Francis 2006, ISBN: 0849327229
3. SaaksvuoriAntti, Immonen Anselmie, "Product Life Cycle Management", Springer, Dreamtech, ISBN: 3540257314
4. Michael Grieve, "Product Lifecycle Management: Driving the next generation of lean thinking", Tata McGraw Hill, 2006, ISBN: 0070636265

Course Code	Course Name	Theory	Practical	Tutorial	Theory	Oral	Tutorial	Total
ILO7012	**Reliability Engineering**	03	--	--	03	--	--	03

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		Test1	Test 2	Avg. of 2 Tests					
ILO7012	**Reliability Engineering**	20	20	20	80	--	--	--	100

Sr. No.	Course Objectives:
The course aims:	
1	To familiarize the students with various aspects of probability theory
2	To acquaint the students with reliability and its concepts
3	To introduce the students to methods of estimating the system reliability of simple and complex systems
4	To understand the various aspects of Maintainability, Availability and FMEA procedure

Course Outcomes:

Sr. No.	Course Outcomes	Cognitive levels of attainment as per Bloom's Taxonomy
On successful completion, of course, learner/student will be able to:		
1	Understand and apply the concept of Probability to engineering problems	L1, L3
2	Apply various reliability concepts to calculate different reliability parameters	L3
3	Estimate the system reliability of simple and complex systems	L5
4	Carry out a Failure Mode Effect and Criticality Analysis	L4

Module	Detailed Contents	Hrs
01	**Probability theory:** Probability: Standard definitions and concepts; Conditional Probability, Baye's Theorem. **Probability Distributions:** Central tendency and Dispersion; Binomial, Normal, Poisson, Weibull, Exponential, relations between them and their significance. **Measures of Dispersion:** Mean, Median, Mode, Range, Mean Deviation, Standard Deviation, Variance, Skewness and Kurtosis.	08
02	**Reliability Concepts:** Reliability definitions, Importance of Reliability, Quality Assurance and Reliability, Bath Tub Curve. **Failure Data Analysis:** Hazard rate, failure density, Failure Rate, Mean Time to Failure (MTTF), MTBF, Reliability Functions. **Reliability Hazard Models:** Constant Failure Rate, linearly increasing, Time Dependent Failure Rate, Weibull Model. Distribution functions and reliability analysis.	08
03	**System Reliability:** System Configurations: Series, parallel, mixed configuration, k out of n structure, Complex systems.	05
04	**Reliability Improvement:** Redundancy Techniques: Element redundancy, Unit redundancy, Standby redundancies. Markov analysis. System Reliability Analysis – Enumeration method, Cut-set method, Success Path method, Decomposition method.	08
05	**Maintainability and Availability:** System downtime, Design for Maintainability: Maintenance requirements, Design methods: Fault Isolation and self-diagnostics, Parts standardization and Interchangeability, Modularization and Accessibility, Repair Vs Replacement. Availability – qualitative aspects.	05
06	**Failure Mode, Effects and Criticality Analysis:** Failure mode effects analysis, severity/criticality analysis, FMECA examples. Fault tree construction, basic symbols, development of functional reliability block diagram, Fau1t tree analysis and Event tree Analysis	05

Assessment

Internal:

Assessment consists of two tests out of which; one should be compulsory class test and the other is either a class test or assignment on live problems or course project.

End Semester Theory Examination:

Some guidelines for setting up the question paper. Minimum 80% syllabus should be covered in question papers of end semester examination. **In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.**

1. Question paper will comprise of total six question
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four question need to be solved.

REFERENCES:

1. L.S. Srinath, "Reliability Engineering", Affiliated East-Wast Press (P) Ltd., 1985.
2. Charles E. Ebeling, "Reliability and Maintainability Engineering", Tata McGraw Hill.
3. B.S. Dhillion, C. Singh, "Engineering Reliability", John Wiley & Sons, 1980.
4. P.D.T. Conor, "Practical Reliability Engg.", John Wiley & Sons, 1985.
5. K.C. Kapur, L.R. Lamberson, "Reliability in Engineering Design", John Wiley & Sons.
6. Murray R. Spiegel, "Probability and Statistics", Tata McGraw-Hill Publishing Co. Ltd.

Course Code	Course Name	Theory	Practical	Tutorial	Theory	Oral	Tutorial	Total
ILO7013	**Management Information System**	03	--	--	03	--	--	03

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		Test1	Test 2	Avg. of 2 Tests					
ILO7013	**Management Information System**	20	20	20	80	--	--	--	100

Course Objectives:

Sr. No.	Course Objectives:
The course aims:	
1	The course is blend of Management and Technical field.
2	Discuss the roles played by information technology in today's business and define various technology architectures on which information systems are built
3	Define and analyze typical functional information systems and identify how they meet the needs of the firm to deliver efficiency and competitive advantage
4	Identify the basic steps in systems development

Course Outcomes:

Sr. No.	Course Outcomes	Cognitive levels of attainment as per Bloom's Taxonomy
On successful completion, of course, learner/student will be able to:		
1	Explain how information systems Transform Business	L2, L4, L5
2	Identify the impact information systems have on an organization	L1
3	Describe IT infrastructure and its components and its current trends	L1, L2
4	Understand the principal tools and technologies for accessing information from databases to improve business performance and decision making	L1
5	Identify the types of systems used for enterprise-wide knowledge management and how they provide value for businesses.	L1

Module	Detailed Contents	Hrs
01	Introduction To Information Systems (IS): Computer Based Information Systems, Impact of IT on organizations, Imporance of IS to Society. Organizational Strategy, Competitive Advantages and IS.	4
02	Data and Knowledge Management: Database Approach, Big Data, Data warehouse and Data Marts, Knowledge Management. Business intelligence (BI): Managers and Decision Making, BI for Data analysis. and Presenting Results	7
03	Ethical issues and Privacy: Information Security. Threat to IS, and Security Controls	7
04	Social Computing (SC): Web 2.0 and 3.0, SC in business-shopping, Marketing, Operational and Analytic CRM, E-business and E-commerce – B2B B2C. Mobile commerce.	7
05	Computer Networks Wired and Wireless technology, Pervasive computing, Cloud computing model.	6
06	Information System within Organization: Transaction Processing Systems, Functional Area Information System, ERP and ERP support of Business Process. Acquiring Information Systems and Applications: Various System development life cycle models.	8

Assessment:

Internal:
Assessment consists of two tests out of which; one should be compulsory class test and the other is either a class test or assignment on live problems or course project.

End Semester Theory Examination:
Some guidelines for setting up the question paper. Minimum 80% syllabus should be covered in question papers of end semester examination. **In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.**

1. Question paper will comprise of total six question
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four question need to be solved.

REFERENCES:

1. Kelly Rainer, Brad Prince,Management Information Systems, Wiley
2. K.C. Laudon and J.P. Laudon, Management Information Systems: Managing the DigitalFirm, 10th Ed., Prentice Hall, 2007.
3. D. Boddy, A. Boonstra, Managing Information Systems: Strategy and Organization, Prentice Hall, 2008

Course Code	Course Name	Theory	Practical	Tutorial	Theory	Oral	Tutorial	Total
ILO7014	**Design of Experiments**	03	--	--	03	--	--	03

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		Test1	Test 2	Avg. of 2 Tests					
ILO7014	**Design of Experiments**	20	20	20	80	--	--	--	100

Course Objectives:

Sr. No.	Course Objectives:
The course aims:	
1	To understand the issues and principles of Design of Experiments (DOE)
2	To list the guidelines for designing experiments
3	To become familiar with methodologies that can be used in conjunction with experimental designs for robustness and optimization.

Course Outcomes:

Sr. No.	Course Outcomes	Cognitive levels of attainment as per Bloom's Taxonomy
On successful completion, of course, learner/student will be able to:		
1	Plan data collection, to turn data into information and to make decisions that lead to appropriate action.	L6
2	Apply the methods taught to real life situations.	L3
3	Plan, analyze, and interpret the results of experiments.	L4, L6

Module	Detailed Contents	Hrs
01	**Introduction** Strategy of Experimentation, Typical Applications of Experimental Design Guidelines for Designing Experiments, Response Surface Methodology	06

02	**Fitting Regression Models** Linear Regression Models, Estimation of the Parameters in Linear Regression Models Hypothesis Testing in Multiple Regression, Confidence Intervals in Multiple Regression Prediction of new response observation, Regression model diagnostics, Testing for lack of fit	08
03	**Two-Level Factorial Designs** The 2^2 Design, The 2^3 Design, The General2^k Design, A Single Replicate of the 2^k Design The Addition of Center Points to the 2^k Design, Blocking in the 2^k Factorial Design, Split-Plot Designs	07
04	**Two-Level Fractional Factorial Designs** The One-Half Fraction of the 2^k Design, The One-Quarter Fraction of the 2^k Design The General 2^{k-p} Fractional Factorial Design, Resolution III Designs, Resolution IV and V Designs, Fractional Factorial Split-Plot Designs	07
05	**Response Surface Methods and Designs** Introduction to Response Surface Methodology, The Method of Steepest Ascent Analysis of a Second-Order Response Surface, Experimental Designs for Fitting Response Surfaces	07
06	**Taguchi Approach** Crossed Array Designs and Signal-to-Noise Ratios, Analysis Methods, Robust design examples	04

Assessment:

Internal:
Assessment consists of two tests out of which; one should be compulsory class test and the other is either a class test or assignment on live problems or course project.

End Semester Theory Examination:
Some guidelines for setting up the question paper. Minimum 80% syllabus should be covered in question papers of end semester examination. **In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.**

1. Question paper will comprise of total six question
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four question need to be solved.

REFERENCES:

1. Raymond H. Mayers, Douglas C. Montgomery, Christine M. Anderson-Cook, Response Surface Methodology: Process and Product Optimization using Designed Experiment, 3rd edition,John Wiley & Sons, New York, 2001
2. D.C. Montgomery, Design and Analysis of Experiments, 5th edition, John Wiley &Sons, New York, 2001
3. George E P Box, J Stuart Hunter, William G Hunter, Statics for Experimenters: Design, Innovation and Discovery, 2nd Ed. Wiley
4. W J Dimond, Peactical Experiment Designs for Engineers and Scintists, John Wiley and Sons Inc. ISBN: 0-471-39054-2
5. Design and Analysis of Experiments (Springer text in Statistics), Springer by A.M. Dean, and D. T.Voss.

Course Code	Course Name	Theory	Practical	Tutorial	Theory	Oral	Tutorial	Total
ILO7015	**Operations Research**	03	--	--	03	--	--	03

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		Test1	Test 2	Avg. of 2 Tests					
ILO7015	**Operations Research**	20	20	20	80	--	--	--	100

Course Objectives:

Sr. No.	Course Objectives:
The course aims:	
1	Formulate a real-world problem as a mathematical programming model.
2	Understand the mathematical tools that are needed to solve optimization problems
3	Use mathematical software to solve the proposed models.

Course Outcomes:

Sr. No.	Course Outcomes	Cognitive levels of attainment as per Bloom's Taxonomy
On successful completion, of course, learner/student will be able to:		
1	Understand the theoretical workings of the simplex method, the relationship between a linear program and its dual, including strong duality and complementary slackness.	L1
2	Perform sensitivity analysis to determine the direction and magnitude of change of a model's optimal solution as the data change.	L5
3	Solve specialized linear programming problems like the transportation and assignment problems, solve network models like the shortest path, minimum spanning tree, and maximum flow problems.	L3
4	Understand the applications of integer programming and a queuing model and compute important performance measures	L1,L2

Module	Detailed Contents	Hrs
01	**Introduction to Operations Research**: Introduction, , Structure of the Mathematical Model, Limitations of Operations Research **Linear Programming**: Introduction, Linear Programming Problem, Requirements of LPP, Mathematical Formulation of LPP, Graphical method, Simplex Method Penalty Cost Method or Big M-method, Two Phase Method, Revised simplex method, **Duality**, Primal – Dual construction, Symmetric and Asymmetric Dual, Weak Duality Theorem, Complimentary Slackness Theorem, Main Duality Theorem, Dual Simplex Method, Sensitivity Analysis **Transportation Problem**: Formulation, solution, unbalanced Transportation problem. Finding basic feasible solutions – Northwest corner rule, least cost method and Vogel's approximation method. Optimality test: the stepping stone method and MODI method. **Assignment Problem**: Introduction, Mathematical Formulation of the Problem, Hungarian Method Algorithm, Processing of n Jobs Through Two Machines and m Machines, Graphical Method of Two Jobs m Machines Problem Routing Problem, Travelling Salesman Problem **Integer Programming Problem**: Introduction, Types of Integer Programming Problems, Gomory's cutting plane Algorithm, Branch and Bound Technique. Introduction to Decomposition algorithms.	14
02	**Queuing models**: queuing systems and structures, single server and multi-server models, Poisson input, exponential service, constant rate service, finite and infinite population	05
03	**Simulation**: Introduction, Methodology of Simulation, Basic Concepts, Simulation Procedure, Application of Simulation Monte-Carlo Method: Introduction, Monte-Carlo Simulation, Applications of Simulation, Advantages of Simulation, Limitations of Simulation	05
04	**Dynamic programming**. Characteristics of dynamic programming. Dynamic programming approach for Priority Management employment smoothening, capital budgeting, Stagecoach/Shortest Path, cargo loading and Reliability problems.	05
05	**Game Theory**. Competitive games, rectangular game, saddle point, minimax (maximin) method of optimal strategies, value of the game. Solution of games with saddle points, dominance principle. Rectangular games without saddle point – mixed strategy for 2 X 2 games.	05
06	**Inventory Models**: Classical EOQ Models, EOQ Model with Price Breaks, EOQ with Shortage, Probabilistic EOQ Model,	05

Assessment:

Internal:
Assessment consists of two tests out of which; one should be compulsory class test and the other is either a class test or assignment on live problems or course project.

End Semester Theory Examination:
Some guidelines for setting up the question paper. Minimum 80% syllabus should be covered in question papers of end semester examination. **In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.**

1. Question paper will comprise of total six question
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four question need to be solved.

REFERENCES:

1. Taha, H.A. "Operations Research - An Introduction", Prentice Hall, (7th Edition), 2002.
2. Ravindran, A, Phillips, D. T and Solberg, J. J. "Operations Research: Principles and Practice", John Willey and Sons, 2nd Edition, 2009.
3. Hiller, F. S. and Liebermann, G. J. "Introduction to Operations Research", Tata McGraw Hill, 2002.
4. Operations Research, S. D. Sharma, KedarNath Ram Nath-Meerut.
5. Operations Research, KantiSwarup, P. K. Gupta and Man Mohan, Sultan Chand & Sons.

Course Code	Course Name	Theory	Practical	Tutorial	Theory	Oral	Tutorial	Total
ILO7016	**Cyber Security and Laws**	03	--	--	03	--	--	03

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		Test1	Test 2	Avg. of 2 Tests					
ILO7016	**Cyber Security and Laws**	20	20	20	80	--	--	--	100

Course Objectives:

Sr. No.	Course Objectives:
The course aims:	
1	To understand and identify different types of cybercrime and cyber law
2	To recognized Indian IT Act 2008 and its latest amendments
3	To learn various types of security standards compliances

Course Outcomes:

Sr. No.	Course Outcomes	Cognitive levels of attainment as per Bloom's Taxonomy
On successful completion, of course, learner/student will be able to:		
1	Understand the concept of cybercrime and its effect on the outside world.	L1
2	Interpret and apply IT law in various legal issues.	L5, L3
3	Distinguish different aspects of cyber law.	L2, L4
4	Apply Information Security Standards compliance during software design and development.	L3, L6

Module	Detailed Contents	Hrs
01	**Introduction to Cybercrime:** Cybercrime definition and origins of the world, Cybercrime and information security, Classifications of cybercrime, Cybercrime and the Indian ITA 2000, A global Perspective on cybercrimes.	4
02	**Cyber offenses & Cybercrime:** How criminal plan the attacks, Social Engg, Cyber stalking, Cybercafé and Cybercrimes, Bot nets, Attack vector, Cloud computing, Proliferation of Mobile and Wireless Devices, Trends in Mobility, Credit Card Frauds in Mobile and Wireless Computing Era, Security Challenges Posed by Mobile Devices, Registry Settings for Mobile Devices, Authentication Service Security, Attacks on Mobile/Cell Phones, Mobile Devices: Security Implications for Organizations, Organizational Measures for Handling Mobile, Devices-Related Security Issues, Organizational Security Policies and Measures in Mobile Computing Era, Laptops	9
03	**Tools and Methods Used in Cyber line.** Phishing, Password Cracking, Key loggers and Spywares, Virus and Worms, Steganography, DoS and DDoS Attacks, SQL Injection, Buffer Overflow, Attacks on Wireless Networks, Phishing, Identity Theft (ID Theft)	6
04	**The Concept of Cyberspace** E-Commerce, The Contract Aspects in Cyber Law, The Security Aspect of Cyber Law, The Intellectual Property Aspect in Cyber Law, The Evidence Aspect in Cyber Law, The Criminal Aspect in Cyber Law, Global Trends in Cyber Law, Legal Framework for Electronic Data Interchange Law Relating to Electronic Banking, The Need for an Indian Cyber Law	8
05	**Indian IT Act.** Cyber Crime and Criminal Justice: Penalties, Adjudication and Appeals Under the IT Act, 2000, IT Act. 2008 and its Amendments	6
06	**Information Security Standard compliances** SOX, GLBA, HIPAA, ISO, FISMA, NERC, PCI.	6

Assessment:

Internal:
Assessment consists of two tests out of which; one should be compulsory class test and the other is either a class test or assignment on live problems or course project.

End Semester Theory Examination:
Some guidelines for setting up the question paper. Minimum 80% syllabus should be covered in question papers of end semester examination.

In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.

1. Question paper will comprise of total six question.
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four question need to be solved.

Textbooks:

1. "Cyber Security & Cyber Laws" by Nilakshi Jain & Ramesh Menon.

REFERENCES:

1. Nina Godbole, Sunit Belapure, *Cyber Security*, Wiley India, New Delhi
2. The Indian Cyber Law by Suresh T. Vishwanathan; Bharat Law House New Delhi
3. The Information technology Act, 2000; Bare Act- Professional Book Publishers, New Delhi.
4. Cyber Law & Cyber Crimes By Advocate Prashant Mali; Snow White Publications, Mumbai
5. Nina Godbole, *Information Systems Security,* Wiley India, New Delhi
6. Kennetch J. Knapp, *Cyber Security &Global Information Assurance* Information Science Publishing.
7. William Stallings, *Cryptography and Network Security,* Pearson Publication
8. Websites for more information is available on : The Information Technology ACT, 2008- TIFR : https://www.tifrh.res.in
9. Website for more information , A Compliance Primer for IT professional : https://www.sans.org/reading-room/whitepapers/compliance/compliance-primer-professionals- 33538

Course Code	Course Name	Theory	Practical	Tutorial	Theory	Oral	Tutorial	Total
ILO7017	**Disaster Management and Mitigation Measures**	03	--	--	03	--	--	03

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		Test1	Test 2	Avg. of 2 Tests					
ILO7017	**Disaster Management and Mitigation Measures**	20	20	20	80	--	--	--	100

Course Objectives:

Sr. No.	Course Objectives:
The course aims:	
1	To understand physics and various types of disaster occurring around the world
2	To identify extent and damaging capacity of a disaster
3	To study and understand the means of losses and methods to overcome /minimize it.
4	To understand role of individual and various organization during and after disaster
5	To understand application of GIS in the field of disaster management
6	To understand the emergency government response structures before, during and after disaster

Course Outcomes:

Sr. No.	Course Outcomes	Cognitive levels of attainment as per Bloom's Taxonomy
On successful completion, of course, learner/student will be able to:		
1	Get to know natural as well as manmade disaster and their extent and possible effects on the economy	L1
2	Plan of national importance structures based upon the previous history.	L6
3	Get acquainted with government policies, acts and various organizational structure associated with an emergency.	L1
4	Get to know the simple do's and don'ts in such extreme events and act accordingly.	L1

Module	Detailed Contents	Hrs
01	**Introduction** Definition of Disaster, hazard, global and Indian scenario, general perspective, importance of study in human life, Direct and indirect effects of disasters, long term effects of disasters. Introduction to global warming and climate change.	03
02	**Natural Disaster and Manmade disasters:** Natural Disaster: Meaning and nature of natural disaster, Flood, Flash flood, drought, cloud burst, Earthquake, Landslides, Avalanches, Volcanic eruptions, Mudflow, Cyclone, Storm, Storm Surge, climate change, global warming, sea level rise, ozone depletion. Manmade Disasters: Chemical, Industrial, Nuclear and Fire Hazards. Role of growing population and subsequent industrialization, urbanization and changing lifestyle of human beings in frequent occurrences of manmade disasters.	09
03	**Disaster Management, Policy and Administration** Disaster management: meaning, concept, importance, objective of disaster management policy, disaster risks in India, Paradigm shift in disaster management. Policy and administration: Importance and principles of disaster management policies, command and co-ordination of in disaster management, rescue operations-how to start with and how to proceed in due course of time, study of flowchart showing the entire process.	06
04	**Institutional Framework for Disaster Management in India:** Importance of public awareness, Preparation and execution of emergency management programme. Scope and responsibilities of National Institute of Disaster Management (NIDM) and National disaster management authority (NDMA) in India. Methods and measures to avoid disasters, Management of casualties, set up of emergency facilities, importance of effective communication amongst different agencies in such situations. Use of Internet and softwares for effective disaster management. Applications of GIS, Remote sensing and GPS in this regard.	06
05	**Financing Relief Measures:** Ways to raise finance for relief expenditure, role of government agencies and NGO's in this process, Legal aspects related to finance raising as well as overall management of disasters. Various NGO's and the works they have carried out in the past on the occurrence of various disasters, Ways to approach these teams. International relief aid agencies and their role in extreme events.	09
06	**Preventive and Mitigation Measures:** Pre-disaster, during disaster and post-disaster measures in some events in general Structural mapping: Risk mapping, assessment and analysis, sea walls and embankments, Bio shield, shelters, early warning and communication Non-Structural Mitigation: Community based disaster preparedness, risk transfer and risk financing, capacity development and training, awareness and education, contingency plans. Do's and don'ts in case of disasters and effective implementation of relief aids.	06

Assessment:

Internal:
Assessment consists of two tests out of which; one should be compulsory class test and the other is either a class test or assignment on live problems or course project.

End Semester Theory Examination:
Some guidelines for setting up the question paper. Minimum 80% syllabus should be covered in question papers of end semester examination. **In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.**

1. Question paper will comprise of total six question
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four question need to be solved.

REFERENCES:

1. 'Disaster Management' by Harsh K.Gupta, Universities Press Publications.
2. 'Disaster Management: An Appraisal of Institutional Mechanisms in India' by O.S.Dagur, published by Centre for land warfare studies, New Delhi, 2011.
3. 'Introduction to International Disaster Management' by Damon Copolla, Butterworth Heinemann Elseveir Publications.
4. 'Disaster Management Handbook' by Jack Pinkowski, CRC Press Taylor and Francis group.
5. 'Disaster management & rehabilitation' by Rajdeep Dasgupta, Mittal Publications, New Delhi.
6. 'Natural Hazards and Disaster Management, Vulnerability and Mitigation – R B Singh, Rawat Publications
7. Concepts and Techniques of GIS –C.P.Lo Albert, K.W. Yonng – Prentice Hall (India) Publications. (Learners are expected to refer reports published at national and International level and updated information available on authentic web sites)

Course Code	Course Name	Theory	Practical	Tutorial	Theory	Oral	Tutorial	Total
ILO7018	**Energy Audit and Management**	03	--	--	03	--	--	03

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		Test1	Test 2	Avg. of 2 Tests					
ILO7018	**Energy Audit and Management**	20	20	20	80	--	--	--	100

Course Objectives:

Sr. No.	Course Objectives:
The course aims:	
1	To understand the importance of energy security for sustainable development and the fundamentals of energy conservation
2	To introduce performance evaluation criteria of various electrical and thermal installations to facilitate energy management.
3	To relate the data collected during performance evaluation of systems for identification of energy saving opportunities.

Course Outcomes:

Sr. No.	Course Outcomes	Cognitive levels of attainment as per Bloom's Taxonomy
On successful completion, of course, learner/student will be able to:		
1	To identify and describe present state of energy security and its importance	L1, L2, L4
2	To identify and describe the basic principles and methodologies adopted in energy audit of a utility.	L1, L2, L4
3	To describe the energy performance evaluation of some common electrical installations and identify the energy saving opportunities.	L1, L2, L4
4	To describe the energy performance evaluation of some common thermal installations and identify the energy saving opportunities.	L1, L2, L4
5	To analyze the data collected during performance evaluation and recommend energy saving measures	L4

Module	Detailed Contents	Hrs
01	**Energy Scenario:** Present Energy Scenario, Energy Pricing, Energy Sector Reforms, Energy Security, Energy Conservation and its Importance, Energy Conservation Act- 2001 and its Features. Basics of Energy and its various forms, Material and Energy balance	04
02	**Energy Audit Principles:** Definition, Energy audit- need, Types of energy audit, Energy management (audit) approach-understanding energy costs, Bench marking, Energy performance, Matching energy use to requirement, maximizing system efficiencies, Optimizing the input energy requirements, Fuel and energy substitution. Elements of monitoring& targeting; Energy audit Instruments; Data and information-analysis. Financial analysis techniques: Simple payback period, NPV, Return on investment (ROI), Internal rate of return (IRR)	08
03	**Energy Management and Energy Conservation in Electrical System:** Electricity billing, Electrical load management and maximum demand Control; Power factor improvement, Energy efficient equipment and appliances, star ratings. **Energy efficiency measures in lighting system, Lighting control:** Occupancy sensors, daylight integration, and use of intelligent controllers. Energy conservation opportunities in: water pumps, industrial drives, induction motors, motor retrofitting, soft starters, variable speed drives.	10
04	**Energy Management and Energy Conservation in Thermal Systems:** Review of different thermal loads; Energy conservation opportunities in: Steam distribution system, Assessment of steam distribution losses, Steam leakages, Steam trapping, Condensate and flash steam recovery system. General fuel economy measures in Boilers and furnaces, Waste heat recovery, use of insulation- types and application. HVAC system: Coefficient of performance, Capacity, factors affecting Refrigeration and Air Conditioning system performance and savings opportunities.	10
05	**Energy Performance Assessment:** On site Performance evaluation techniques, Case studies based on: Motors and variable speed drive, pumps, HVAC system calculations; Lighting System: Installed Load Efficacy Ratio (ILER) method, Financial Analysis.	04
06	**Energy conservation in Buildings:** Energy Conservation Building Codes (ECBC): Green Building, LEED rating, Application of Non-Conventional and Renewable Energy Sources	03

Assessment:

Internal:
Assessment consists of two tests out of which; one should be compulsory class test and the other is either a class test or assignment on live problems or course project.

End Semester Theory Examination:
Some guidelines for setting up the question paper. Minimum 80% syllabus should be covered in question papers of end semester examination. **In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.**

1. Question paper will comprise of total six question
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four question need to be solved.

REFERENCES:

1. Handbook of Electrical Installation Practice, Geofry Stokes, Blackwell Science
2. Designing with light: Lighting Handbook, By Anil Valia, Lighting System
3. Energy Management Handbook, By W.C. Turner, John Wiley and Sons
4. Handbook on Energy Audits and Management, edited by A. K. Tyagi, Tata Energy Research Institute (TERI).
5. Energy Management Principles, C.B.Smith, Pergamon Press
6. Energy Conservation Guidebook, Dale R. Patrick, S. Fardo, Ray E. Richardson, Fairmont Press
7. Handbook of Energy Audits, Albert Thumann, W. J. Younger, T. Niehus, CRC Press
8. www.energymanagertraining.com
9. www.bee-india.nic.in.

Course Code	Course Name	Theory	Practical	Tutorial	Theory	Oral	Tutorial	Total
ILO7019	**Development Engineering**	03	--	--	03	--	--	03

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		Test1	Test 2	Avg. of 2 Tests					
ILO7019	**Development Engineering**	20	20	20	80	--	--	--	100

Course Objectives:

Sr. No.	Course Objectives:
The course aims:	
1	To familiarise the characteristics of rural Society and the Scope, Nature and Constraints of rural Development
2	To provide an exposure to implications of 73rdCAA on Planning, Development and Governance of Rural Areas
3	An exploration of human values, which go into making a 'good' human being, a 'good' professional, a 'good' society and a 'good life' in the context of work life and the personal life of modern Indian professionals
4	To familiarise the Nature and Type of Human Values relevant to Planning Institutions

Course Outcomes:

Sr. No.	Course Outcomes	Cognitive levels of attainment as per Bloom's Taxonomy
On successful completion, of course, learner/student will be able to:		
1	Demonstrate understanding of knowledge for Rural Development.	L3
2	Prepare solutions for Management Issues.	L3
3	Take up Initiatives and design Strategies to complete the task	L6
4	Develop acumen for higher education and research.	L6
5	Demonstrate the art of working in group of different nature	L3
6	Develop confidence to take up rural project activities independently.	L6

Module	Contents	Hrs
1	Introduction to Rural Development Meaning, nature and scope of development; Nature of rural society in India; Hierarchy of settlements; Social, economic and ecological constraints for rural development Roots of Rural Development in India Rural reconstruction and Sarvodaya program before independence; Impact of voluntary effort and Sarvodaya Movement on rural development; Constitutional direction, directive principles; Panchayati Raj - beginning of planning and community development; National extension services.	**08**
2	Post-Independence rural Development Balwant Rai Mehta Committee - three tier system of rural local Government; Need and scope for people's participation and Panchayati Raj; Ashok Mehta Committee - linkage between Panchayati Raj, participation and rural development.	**06**
3	Rural Development Initiatives in Five Year Plans Five Year Plans and Rural Development; Planning process at National, State, Regional and District levels; Planning, development, implementing and monitoring organizations and agencies; Urban and rural interface - integrated approach and local plans; Development initiatives and their convergence; Special component plan and sub-plan for the weaker section; Micro-eco zones; Data base for local planning; Need for decentralized planning; Sustainable rural development	**07**
4	Post 73rd Amendment Scenario 73rd Constitution Amendment Act, including - XI schedule, devolution of powers, functions and finance; Panchayati Raj institutions - organizational linkages; Recent changes in rural local planning; Gram Sabha - revitalized Panchayati Raj; Institutionalization; resource mapping, resource mobilization including social mobilization; Information Technology and rural planning; Need for further amendments.	**04**
5	Values and Science and Technology Material development and its values; the challenge of science and technology; Values in planning profession, research and education Types of Values Psychological values — integrated personality; mental health; Societal values — the modern search for a good society; justice, democracy, rule of law, values in the Indian constitution; Aesthetic values — perception and enjoyment of beauty; Moral and ethical values; nature of moral judgment; Spiritual values; different concepts; secular spirituality; Relative and absolute values; Human values— humanism and human values; human rights; human values as freedom, creativity, love and wisdom	**10**
6	Ethics Canons of ethics; ethics of virtue; ethics of duty; ethics of responsibility. Work ethics; Professional ethics; Ethics in planning profession, research and education	**04**

Assessment:

Internal Assessment for 20 marks:
Consisting of **Two Compulsory Class Tests**
First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I)

End Semester Examination:
The weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of total six question
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four question need to be solved.

Reference

1. ITPI, Village Planning and Rural Development, ITPI, New Delhi
2. Thooyavan, K.R. Human Settlements: A 2005 MA Publication, Chennai
3. GoI, Constitution (73rdGoI, New Delhi Amendment) Act, GoI, New Delhi
4. Planning Commission, Five Year Plans, Planning Commission
5. Planning Commission, Manual of Integrated District Planning, 2006, Planning Commission New Delhi
6. Planning Guide to Beginners
7. Weaver, R.C., The Urban Complex, Doubleday
8. Farmer, W.P. et al, Ethics in Planning, American Planning Association, Washington.
9. How, E., Normative Ethics in Planning, Journal of Planning Literature, Vol.5, No.2, pp. 123-150
10. Watson, V. Conflicting Rationalities: -- Implications for Planning Theory and Ethics, Planning Theory and Practice, Vol. 4, No.4, pp.395 – 407

Subject Code	Subject Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Oral	Tutorial	Total
IoTCSBCL 701	ML & Blockchain Lab	--	2	--	--	2	--	2

Subject Code	Subject Name	Examination Scheme						
		Theory Marks				Term Work	Oral	Total
		Internal assessment			End Sem. Exam			
		Test1	Test 2	Avg. of 2 Tests				
IoTCSBCL 701	ML & Blockchain Lab	--	--	--	--	25	25	50

Lab Objectives:

Sr. No.	Lab Objectives
The course aims:	
1	To introduce the basic concepts of tools and techniques of Machine Learning.
2	To acquire in-depth understanding of various supervised and unsupervised machine learning algorithms.
3	To be able to apply various ensemble techniques for combining Machine Learning models and also demonstrate dimensionality reduction techniques.
4	To be able to understand fundamental of blockchain technology.
5	To be able to apply understanding of consensus algorithms and smart contract programming.
6	To be able to collate blockchain based solutions towards various industry-based application.

Lab Outcomes:

Sr. No.	Lab Outcomes	Cognitive levels of attainment as per Bloom's Taxonomy
On successful completion, of course, learner/student will be able to:		
1	To interpret and conceptualize the basic concepts of tools and techniques of Machine Learning.	L2
2	To demonstrate machine learning algorithms with complex datasets	L3
3	To understand fundamental neural network architecture and concepts.	L2
4	To examine fundamental concepts of block chain technology and consensus algorithm	L4
5	To develop smart contracts	L6
6	To collate blockchain based solutions towards various industry-based application.	L6

Prerequisite: Must have completed the course on Introduction to Linear Algebra and have basic familiarity with probability theory and basics of programming language.

Sr. No.	Suggested list of Assignments	LO
1	To implement Supervised Learning using Linear regression algorithm	LO1
2	To implement Supervised Learning using Logistic regression algorithm	LO1
3	To implement PCA / SVD / LDA	LO2
4	To implement Decision Tree Algorithms	LO2
5	To implement Graph based clustering and CART algorithm	LO2
6	To implement a Simple Neural Network using backpropogation.	LO3
7	To study installation tools and basic blockchain concepts.	LO4
8	To implement Smart contracts using Solidity/Python/ Java language.	LO5
9	To implement Smart contracts using Solidity/Python/ Java language.	LO5
10	To design and implement Mini-project on Machine Learning / Blockchain topics	LO6

Text Books:

1. Shai Shalev-Shwartz; Shai Ben-David, MACHINE LEARNING From Theory to Algorithms, Cambridge University Press, 2014
2. Sebastian Raschka; Yuxi (Hayden) Liu, Vahid Mirjalili, Machine Learning with PyTorch and Scikit-Learn, PackT, 2022
3. Bikramaditya Singhal, Gautam Dhameja, Priyansu Sekhar Panda, Beginning Blockchain A Beginner's Guide to Building Blockchain Solutions, Apress, 2018
4. Sandeep Kumar Panda, Vaibhav Mishra, Sujata Priyambada Dash, Ashis Kumar Pani, Recent Advances in Blockchain Technology Real-World Applications, Springer, 2023
5. Artificial Intelligence and Data Mining Approaches in Security Frameworks Editor(s):Neeraj Bhargava, Ritu Bhargava, Pramod Singh Rathore, Rashmi Agrawal, 2021.

References:

1. Sebastian Raschka, Vahid Mirjalili Python Machine Learning, 3rd Edition, 2019, Packt
2. Machine Learning: A Probabilistic Perspective, Kevin P Murphy, MIT Press.
3. Christopher M. Bishop. Pattern Recognition and Machine Learning. Springer 2006.
4. Tom Mitchell. Machine Learning. McGraw Hill, 1997.
5. Arjuna Sky Kok, Hands-on Blockchain for Python Developers, 2019, Packt

Online References and MOOC Courses:

1. https://www.toptal.com/ethereum/one-click-login-flows-a-metamask-tutorial
2. What Is Machine Learning in Security? - Cisco
3. https://www.mdsny.com/5-top-machine-learning-use-cases-for-security/
4. https://trufflesuite.com/docs/truffle/how-to/truffle-with-metamask/
5. https://remix-ide.readthedocs.io/en/latest/index.html
6. https://nptel.ac.in/courses/106/106/106106139/
7. https://nptel.ac.in/courses/106/106/106106202/
8. https://www.classcentral.com/course/independent-machine-learning-security-12651

Assessment:

Term Work: Term Work shall consist of at least 10 practicals based on the above list. Also Term work Journal must include at least 2 assignments.

Term Work Marks: 25 Marks (Total marks) = 15 Marks (Experiment) + 5 Marks (Assignments) + 5 Marks (Attendance)

Oral Exam: An Oral exam will be held based on the above syllabus.

Subject Code	Subject Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Oral	Tutorial	Total
IoTCSBCL702	Edge and Fog Computing Lab	--	2	--	--	1	--	1

Subject Code	Subject Name	Examination Scheme						
		Theory Marks				Term Work	Oral	Total
		Internal assessment			End Sem. Exam			
		Test1	Test 2	Avg. of 2 Tests				
IoTCSBCL702	Edge and Fog Computing Lab	--	--	--	--	25	25	50

Lab Objectives:

Sr. No.	Lab Objectives
1	To study the concepts of virtual servers and AWS Edge platforms
2	To get acquainted with different Aws IoT Core Services.
3	To learn message passing between AWS IoT Core devices
4	To study different simulators and development of Edge Computing networks
5	To study different simulators and development of FogComputing networks

Lab Outcomes:

Sr. No.	Lab Outcomes	Cognitive Levels of Attainment as per Bloom's Taxonomy
On successful completion of the course students will be able to,		
1	Understand the concept of virtual servers deployed on AWS Edge platform	L1
2	Analyze the use of AWS IoT Core and related services.	L3
3	To examine the message passing techniques in AWS IoT Core devices and assess the security using VPC on AWS.	L3
4	Deploy Edge computing networks using Edge computing simulators	L4
5	Deploy Fog computing networks using Fog computing simulators	L5

Prerequisite: Cloud Computing and IoT concepts

Sr. No.	Suggested list of Assignments	LO
1	Create and deploy virtual servers on AWS / Azure.	LO1
2	To deploy Raspberry Pi on AWS IoT Core	LO2
3	To implement MQTT messaging between Raspberry Pi and AWS IoT Core	LO2
4	To implement virtual private cloud (VPC) on AWS for IoT services.	LO3
5	Study assignment on Edge and Fog Simulators	LO4
6	Design and deploy an edge computing architecture using edge simulators such as Mobius / EdgeCloudSim.	LO4
7	Develop and evaluate edge-based data analytics algorithms in an edge simulator.	LO5
8	Design and deploy a fog computing architecture using simulators such as iFogSim / CloudSim.	LO4
9	Explore collaboration between edge and fog nodes for IoT applications.	LO5

Text Books:

1. “Fog and Edge Computing” by Rajkumar Buyya, Satish Narayana Srirama, Wiley Publications
2. "Edge Computing: Models, Technologies, and Applications" by Mung Chiang, Bharath Balasubramanian, and H. Vincent Poor.
3. Edge Computing with Python: End-to-end Edge Applications, Python Tools and Techniques, Edge Architectures, and AI Benefit” by Abhinandan Bhadauria, BPB publications.
4. “Edge Computing: Simply in Depth” by Ajit Singh,
5. Edge Computing: Fundamentals, Advances and Applications (Advances in Industry 4.0 and Machine Learning) by K. Anitha Kumari, G. Sudha Sadasivam, D. Dharani, M. Niranjanamurthy, CRC Press.

References:

1. "Edge Computing for IoT: Architectures and Applications" by Bharat Bhargava, Sudip Misra, Valentina E. Balas, and Raghvendra Kumar
2. "Practical Industrial Internet of Things Security: A practitioner's guide to securing connected industries" by Sravani Bhattacharjee and Rajdeep Chowdhury
3. "Edge Computing: An Introduction to the Next Generation of Networked Systems" by Kiran Chitturi, Bharadwaj Veeravalli, and Satish Narayana Srirama
4. "Building the Web of Things: With examples in Node.js and Raspberry Pi" by Dominique D. Guinard and Vlad M. Trifa
5. "Internet of Things (IoT): Technologies, Applications, Challenges, and Solutions" edited by Balamuralidhar P., Bharadwaj Veeravalli, and V. Raghu
6. "Fog and Edge Computing: Principles and Paradigms" by Rajkumar Buyya, Satish Srirama, and Pradeep Kumar S.

7. "IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things" by David Hanes and Gonzalo Salgueiro
8. "Edge Analytics in IoT" by Shivashankar B. Nair, Siddhartha Bhattacharyya, and Thomas Edward Joshua
9. "Edge Computing: The Convergence of Big Data and Internet of Things" by Samee U. Khan, Albert Y. Zomaya, and Salman A. Baset

Online References:

1. http://www.steves-internet-guide.com/mqtt-protocol-messages-overview/
2. https://aws.amazon.com/iot-core/
3. https://github.com/CagataySonmez/EdgeCloudSim/wiki
4. https://www.cloudsimtutorials.online/ifogsim-project-structure-a-beginners-guide/
5. https://www.udemy.com/course/essential-ifogsim-tutorials/
6. https://slogix.in/source-code/ifog-computing-samples/how-to-create-fog-topology-in-ifogsim/

Assessment:

Term Work: Term Work shall consist of at least 10 to 12 practicals based on the above list. Also, Term work Journal must include at least 2 assignments.

Term Work Marks: 25 Marks (Total marks) = 15 Marks (Experiment) + 5 Marks (Assignments) + 5 Marks (Attendance)

Oral Exam: An Oral exam will be held based on the above syllabus / suggested list of Assignment.

Subject Code	Subject Name	Theory	Practical	Tutorial	Theory	Practical & Oral	Tutorial	Total
IoTCSBC L703	**DevSecOps Lab**	**--**	**2**	**--**	**--**	**--**	**--**	**01**

Subject Code	Subject Name	Examination Scheme						
		Theory Marks				Term Work	Practical & Oral	Total
		Internal assessment			End Sem. Exam			
		Test1	Test 2	Avg. of 2 Tests				
IoTCSBC L703	**DevSecOps Lab**	**--**	**--**	**--**	**--**	**25**	**25**	**50**

Lab Objectives:

Sr. No.	**Lab Objectives**
1	To understand the concept of distributed version control.
2	To familiarize with Jenkins build & test software Applications & Continuous integration.
3	To understand Docker to build, ship and run containerized images.
4	To familiarize with the concept of Software Configuration Management with Continuous Monitoring.
5	To understand the basics of Application/code security testing and threat modeling.
6	To familiarize with the concept of Cloud and Infrastructure as a Code.

Lab Outcomes:

Sr. No.	**Lab Outcomes**	**Cognitive Levels of Attainment as per Bloom's Taxonomy**
On successful completion of the course students will be able to,		
1	Understand the concepts of distributed version control using GIT and GITHUB	L1

2	Apply Jenkins to Build, Deploy and Test the Software Applications	L3
3	Analyze & Illustrate the Containerization of OS images and deployment of applications over Docker	L3,L4
4	Deploy and Examine the Software Configuration management using Ansible and Continuous monitoring and alerting using Prometheus and Nagios	L4
5	Use Sonarqube and snyk to perform code quality checks and Threat Dragon to create threat models to identify threats in the system.	L3
6	Implement Terraform scripts to manage VMs on a cloud.	L3

Sr. No.	Module	Detailed Content	Hours	LO
	Prerequisite	Concept of DevOps with related technologies which are used to Code, Build, Test, Configure & Monitor the Software Applications.	**02**	**-**
I	Version Control using GIT	To Perform Version Control on documents/files websites/ Softwares using GIT & GITHUB that covers all GIT commands given in GIT cheat sheet ● To implement Version control for different files/directories using GIT ● To implement version control using GITHUB to sync local GIT repositories and perform various related operations.	**04**	**LO 1**
II	Working with Jenkins	● To deploy and test Java/web/Python application on jenkins server ● To implement Jenkins pipeline using scripted/declarative pipeline ● To use jenkins to deploy and run test cases for Java/Web application using Selenium/JUnit	**04**	**LO 2**
III	Containerization	● To use docker to run containers of different applications and operating Systems ● To create a custom docker image using Dockerfile and upload it to the docker hub.	**04**	**LO 3**
IV	Software Configuration Management and Continuous Monitoring	● To implement continuous deployment using Ansible ● To Implement automated monitoring and alerting using Prometheus ● To implement continuous monitoring using Splunk/NagiOS	**04**	**LO 4**

V	Application/Code Security	● To implement Application and code security testing using snyk ● To implement Static Application Security Testing using SonarQube ● To implement threat models to identify threats in the system using Threat Dragon	**04**	**LO 5**
VI	Cloud and Infrastructure as a code	● To create and work with virtual machine on cloud (GCP / AWS / Azure) ● To implement terraform script for deploying compute/Storage/network infrastructure on the public cloud platform (GCP / AWS / Azure)	**04**	**LO 6**

Text Books:

1. Prem Kumar Ponuthorai, Jon Loeliger, Version Control with Git, 3rd Edition,O'Reilly Media.
2. John Ferguson Smart,"Jenkins, The Definitive Guide", O'Reilly Publication.
3. Karl Matthias & Sean P. Kane, Docker: Up and Running, O'Reilly Publication.
4. Russ McKendrick, Learn Ansible, Pakt Publication.
5. Yevgeniy Brikman, Terraform: Up and Running, 3rd Edition,O'Reilly Publication.
6. G. Ann Campbell,SonarQube in Action,First Edition, Manning publication.

References:

1. Sanjeev Sharma and Bernie Coyne,"DevOps for Dummies", Wiley Publication
2. Httermann, Michael, "DevOps for Developers",Apress Publication.
3. Joakim Verona, "Practical DevOps",Pack publication

Online references:

Sr. No.	Topic	Link
1	GIT Cheat sheet	https://www.atlassian.com/git/tutorials/atlassian-git-cheatsheet
2	Jenkins	1) https://www.javacodegeeks.com/2021/04/how-to-create-run-a-job-in-jenkins-using-jenkins-freestyle-project.html 2) https://k21academy.com/devops-foundation/ci-cd-pipeline-using-jenkins/
3	Docker	https://docs.docker.com/get-started/docker_cheatsheet.pdf
4	Ansible	https://docs.ansible.com/ansible/latest/index.html
5	Prometheus	https://prometheus.io/docs/introduction/overview/
6	Snyk	https://snyk.io/learn/application-security/static-application-security-testing/

7	Threatdragon	https://www.threatdragon.com/#/
8	SonarQube	https://docs.sonarqube.org/latest/
9	Terraform	https://developer.hashicorp.com/terraform/intro

Assessment

Term Work: Term Work shall consist of at least 10 to 12 practicals based on the above list. Also Term work Journal must include at least 2 assignments.

Term Work Marks: 25 Marks (Total marks) = 15 Marks (Experiment) + 5 Marks (Assignments) + 5 Marks (Attendance)

Oral Exam: An Oral exam will be held based on the above syllabus

Course Code	Course Name	Theory	Practical	Tutorial	Theory	Practical /Oral	Tutorial	Total
IoTCSBCL704	Open-Source Intelligence (OSINT) Lab	--	02	--	--	1	--	01

Course Code	Course Name	Theory Marks				Term Work	Practical/Oral	Total
		Internal assessment			End Sem. Exam			
		Test1	Test 2	Avg. of 2 Tests				
IoTCSBCL704	Open-Source Intelligence (OSINT) Lab	--	--	--	--	25	25	50

Lab Objectives:

Sr. No.	Lab Objectives
The course aims:	
1	To provide hands-on experiences for students to develop critical thinking, research skills
2	To incorporate ethical usage of OSINT tools.
3	To get familiar with OSINT framework and its usage on publicly available data.
4	To learn to use the OSINT tools for Social Media, Email, Image, or network analysis, websites and understand the usage for Digital Forensics .
5	To performs background/profile/corporate profile checks, corporate Open-Source Intelligence (OSINT) Assessment etc.
6	Identify intelligence needs and leverage a broad range of tools and sources to improve data collection, analysis, and decision making.

Lab Outcomes:

Sr. No.	Lab Outcomes	Cognitive levels of attainment as per Bloom's Taxonomy
On successful completion, of course, learner/student will be able to:		
1	Gain knowledge about Open-Source Intelligence understand the threats and think critically about countermeasures.	L1, L2, L3
2	Conduct advanced searches to gather intelligence and apply advance OSINT search techniques and tools.	L1, L2, L4
3	Use OSINT tools for analysis fake news, image, video data	L1, L2, L3
4	Conduct advanced searches to gather intelligence from social media sites and understand the use of Public Records for corporate and business intelligence etc.	L1, L2
5	Gather information/metadata about Maps to performance detailed map profiling	L1, L2, L3
6	Get familiar with Technical Foot printing websites for mitigating various threats	L1, L2

Prerequisite:

1. Kali Linux Installation and VM deployment.
2. Networking and security fundamentals

DETAILED SYLLABUS:

Sr. No.	Module	Detailed Content	Hours	LO Mapping
0	The Evolution of Open-Source Intelligence,	Open-Source Information Categories OSINT Types, Digital Data Volume, OSINT Organizations, Parties Interested in OSINT Information, International Organizations, Information Gathering Types, Benefits of OSINT, Challenges of Open-Source Intelligence Legal and Ethical Constraints	**1**	LO1
I	Introduction To Online Threats and Countermeasures	Online Threats-. Securing the Operating System: Hardening the Windows OS, Staying Private in Windows, Destroying Digital Traces General Privacy Settings- Avoiding Pirated Software, Handling Digital Files Metadata, Physically Securing Computing Devices	**1**	LO1
II	Using Search Engines to Locate Information	Search Engine Technique - Keywords Discovery and Research, - Google, Privacy-Oriented Search Engines, Other Search Engines, Business Search Sites, Metadata Search Engines, Code Search FTP Search Engines Automated Search Tools, Dorks	**2**	LO2
III	Searching for Digital Files	News Search - Customize Google News, News Websites, Fake News Detection - Document Search, Image, Video, File Extension and File Signature List, Productivity Tools	**2**	LO4
IV	People Search Engines and Public Records	Social Media Intelligence: What Is Social Media Intelligence? Social Media Content Types, General Resources for Locating Information on Social Media Sites Pastebin Sites People Search Engine, Public Records and example of Public Records, Searching for Personal Details, General People Search , Online Registries, Vital Records, Criminal and Court Search, Property Records, Tax and Financial Records, Social Security Number Search Username Check, E-mail Search and Investigation Data Compromised Repository Websites, Phone Number Search	**6**	LO4
V	Online Maps:	The Basics of Geolocation Tracking, How to Find the GPS Coordinates of Any Location on a Map How to Find the Geocode Coordinates from a Mailing Address, General Geospatial Research Tools Commercial Satellites, Date/Time Around the World, Location-Based social media, Conducting Location Searches on social media Using Automated Tools, Country Profile Information Transport Tracking	**6**	LO5
VI	Technical Foot printing:	Website History and Website Capture Website Monitoring Services - RSS Feed Investigate the Target Website, Investigate the Robots.txt File, Mirror the Target Website Extract the Links Check the Target	**6**	LO6

		Website's Backlinks Monitor Website Updates Check the Website's Archived Contents Identify the Technologies Used, Web Scraping Tools Investigate the Target Website's File Metadata, Website Certification Search, Website Statistics and Analytics Tools, Website Reputation Checker Tools, Passive Technical Reconnaissance Activities, WHOIS Lookup, Subdomain Discovery, DNS Reconnaissance, IP Address Tracking		

Textbooks:

1. Open Source Intelligence Methods and Tools: A Practical Guide to Online Intelligence by Nihad A. Hassan (Author), Rami Hijazi (Author)

2. OSINT Techniques - Resources for Uncovering Online Information - 10th Edition (2023) by Michael Bazzell

3. Operator Handbook: Red Team + OSINT + Blue Team Reference by Joshua Picolet

References:

1. We Are Bellingcat: Global Crime, Online Sleuths, and the Bold Future of Newsby Eliot Higgins
2. Extreme Privacy: What It Takes to Disappear in America by Michael Bazzell

Tools:

- https://cheatsheet.haax.fr/open-source-intelligence-osint/
- https://inteltechniques.com/tools/
- https://hunter.io/
- https://www.shodan.io/

https://github.com/laramies/theHarvester

- https://www.osintcombine.com/osint-bookmarks
- https://osintframework.com/
- https://learn.baselgovernance.org/enrol/index.php?id=79
- https://inteltechniques.com/
- https://www.bellingcat.com//
- https://www.tracelabs.org/

List of Experiments/Mini-Project.

Sr. No.	Detailed Content
1.	. Perform Email Header Analysis for extracting valuable information like sender IP address, email servers, and routing information. . Conduct email address enumeration by attempting to verify the existence of email addresses within a target domain. Use tools like the Harvester or thehunter.io to search for email addresses associated with a specific domain. This can help identify valid email addresses within an organization. . Analyze the metadata of an email, including date and time stamps, email clients used, or the originating IP address, email's origin, potential geographic location of the sender, or possible email routing
2	Using OSINT tool such as (Harverster) you can gather information like emails, subdomains, hosts, employee names, open ports and banners from different public sources like search engines, PGP key server.
3	Use OSINT DORKS (create and execute search queries) to verify the accuracy of the information by cross-referencing various sources and critically evaluating the reliability and credibility of the New article.

4	To perform the reverse Image analysis for finding physical location where the content was captured. Use OSINT tool to use image metadata, landmarks, street signs, or other visual cues to identify the geolocation accurately.
5	Using OSINT tools gather Tactical information using WHOIS lookup tools or websites like DomainTools (domain, registration details, owner's contact information, registration date, and expiration date.) Archives, Text, Reverse Image Search, Images and EXIF data, Source code, Others TLD, Mentions of target, Check info such as via RSS,SSL certificates, Robots/Sitemap, Port scans, Reverse IP lookup
6	Utilize website crawling OSINT tools to gather a comprehensive list of URLs, internal links, and structure of the website
7	Use OSINT Tools to identify the technologies and frameworks used by the website, such as content management systems (CMS), server software, programming languages, or analytics tools and create vulnerability reports.
8	Determine the geolocation (country, city, or approximate location) of each IP address (at least 10) One can use online IP geolocation tools, databases, and various techniques to gather information and accurately identify the physical location associated with each IP
9	Conduct a comprehensive OSINT investigation about well-known company and gather information about the company's history, key executives, financial data, partnerships, news mentions, and any other relevant details using online databases, news articles, corporate websites, and industry reports
10	Analyze the company's competitors to understand their market positioning, strengths, and weaknesses. Tools like SEMrush, Similar Web, or Alexa or any other OSINT tool can provide website traffic, keyword analysis, and competitor comparisons
11	Fake News detection - Analyze at least 5 OSINT tools to detect, verify, authenticate, fake news and report.
12.	Example Mini Project suggestion - Digital Footprint Analysis using OSINT Tools: Assess and analyze your own digital footprints wrt, Personal Information, data (full name, age, date of birth, address, phone number, and email address), images, videos (online directories, social media profiles (at least 3 social media accounts), personal websites, Online Professional Presence and analyze 1.Posts, comments, photos, and other content that they have shared publicly or with specific privacy settings 2.Analyze their online interactions, connections, interests, and activities. 3. Analyze the nature of the content, locations, events, or people, as it can provide insights into activities, hobbies, or relationships. 4. Analyze work experience, educational background, skills, recommendations, and any professional associations or achievements.

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Oral	Tutorial	Total
IoTCSBCP 701	**Major Project I**	**--**	**6#**	**--**	**--**	**3**	**--**	**3**

Subject Code	Subject Name	Examination Scheme						
		Theory Marks				Term Work	Practical & Oral	Total
		Internal assessment			End Sem. Exam			
		Test1	Test 2	Avg. of 2 Tests				
IoTCSBCP 701	**Major Project 1**	**--**	**--**	**--**	**--**	**25**	**25**	**50**

Course Objectives:	
The project work facilitates the students to develop and prove Technical, Professional and Ethical skills and knowledge gained during graduation program by applying them from problem identification, analyzing the problem and designing solutions.	
Course Outcomes: Learner will able	
1	To develop the understanding of the problem domain through extensive review of literature.
2	To Identify and analyze the problem in detail to define its scope with problem specific data.
3	To know various techniques to be implemented for the selected problem and related technical skills through feasibility analysis.
4	To design solutions for real-time problems that will positively impact society and environment.
5	To develop clarity of presentation based on communication, teamwork and leadership skills.
6	To inculcate professional and ethical behavior.

Guidelines:

- **Project Topic Selection and Allocation:**

1. Project topic selection Process to be defined and followed:
2. Project orientation can be given at the end of sixth semester.
3. Students should be informed about the domain and domain experts whose guidance can be taken before selecting projects.
4. Students should be recommended to refer papers from reputed conferences/ journals like IEEE, Elsevier,

ACM etc. which are not more than 3 years old for review of literature.

5. Students can certainly take ideas from anywhere but be sure that they should evolve them in a unique way to suit their project requirements. Students can be informed to refer Digital India portal, SIH portal or any other hackathon portal for problem selection.

- Topics can be finalized with respect to following criterion:

  Topic Selection: The topics selected should be novel in nature (Product based, Application based, or Research based) or should work towards removing the lacuna in currently existing systems.

  Technology Used: Use of the latest technology or modern tools can be encouraged**.**

- Students should not repeat work done previously (work done in the last three years).
- Project work must be carried out by a group of at least 2 students and a maximum of 4.
- The project work can be undertaken in a research institute or organization/Industry/any business establishment. (Out-house projects)
- The project proposal presentations can be scheduled according to the domains and should be judged by faculty who are experts in the domain.
- The head of department and senior staff along with project coordinators will take decision regarding final selection of projects.
- Guide allocation should be done, and students have to submit weekly progress reports to the internal guide.
- Internal guide has to keep track of the progress of the project and also has to maintain attendance report. This progress report can be used for awarding term work marks.
- In the case of industry/ out-house projects, a visit by internal guide will be preferred and external members can be called during the presentation at various levels.

Project Report Format:

At the end of semester, each group needs to prepare a project report as per the guidelines issued by the University of Mumbai.

A project report should preferably contain at least following details:

- Abstract
- Introduction
- Literature Survey/ Existing system
- Limitation Existing system or research gap
- Problem Statement and Objective
- Proposed System
- Analysis/Framework/ Algorithm
- Design details
- Methodology (your approach to solve the problem) Proposed System
- Experimental Set up
- Details of Database or details about input to systems or selected data
- Performance Evaluation Parameters (for Validation)
- Software and Hardware Set up
- Implementation Plan for Next Semester
- Timeline Chart for Term1 and Term-II (Project Management tools can be used.)
- References

Desirable

- Students can be asked to undergo some Certification course (for the technical skill set that will be useful and applicable for projects.

Term Work:

Distribution of marks for term work shall be done based on following:

1. Weekly Log Report
2. Project Work Contribution
3. Project Report (Spiral Bound) (both side print)
4. Term End Presentation (Internal)

The final certification and acceptance of TW ensures satisfactory performance on the above aspects.

Oral and Practical:

The Oral and Practical examination (Final Project Evaluation) of Project 1 should be conducted by Internal and External examiners approved by University of Mumbai at the end of the semester.

Suggested quality evaluation parameters are as follows:

1. Quality of problem selected.
2. Clarity of problem definition and feasibility of problem solution
3. Relevance to the specialization / industrial trends
4. Originality
5. Clarity of objective and scope
6. Quality of analysis and design
7. Quality of written and oral presentation
8. Individual as well as teamwork

Program Structure for Fourth Year Engineering Semester VII & VIII
UNIVERSITY OF MUMBAI
(With Effect from 2023-24)

Semester VIII

Course Code	Course Name	Teaching Scheme (Contact Hours)		Credits Assigned		
		Theory	Pract.	Theory	Pract.	Total
IoTCSBCC 801	NFT & DeFi (Decentralized Finance)	3	--	3	--	3
IoTCSBCD O801X	**Department Optional Course – 5**	**3**	**--**	**3**	**--**	**3**
IoTCSBCD O802X	**Department Optional Course – 6**	**3**	**--**	**3**	**--**	**3**
IoTCSBCI O801X	**Institute Optional Course – 2**	**3**	**--**	**3**	**--**	**3**
IoTCSBCL 801	Capstone Lab	--	2	--	1	1
IoTCSBCL 802	IoT Automation Lab	--	2	--	1	1
IoTCSBCP 801	Major Project II	--	12#	--	6	6
Total		**12**	**16**	**12**	**8**	**20**

Course Code	Course Name	Examination Scheme							
		Theory					Term Work	Prac /oral	Total
		Internal Assessment			End Sem Exam	Exam. Duratio n (hrs,)			
		Test1	Test2	Avg					
IoTCSBCC 801	NFT & DeFi (Decentralized Finance)	20	20	20	80	3	--	--	100
IoTCSBCD O801X	**Department Optional Course – 5**	**20**	**20**	**20**	**80**	**3**	**--**	**--**	**100**
IoTCSBCD O802X	**Department Optional Course – 6**	**20**	**20**	**20**	**80**	**3**	**--**	**--**	**100**
IoTCSBCI O801X	**Institute Optional Course – 2**	**20**	**20**	**20**	**80**	**3**	**--**	**--**	**100**
IoTCSBCL 801	Capstone Lab	--	--	--	--	--	25	25	50
IoTCSBCL 802	IoT Automation Lab	--	--	--	--	--	25	25	50
IoTCSBCP 801	Major Project II	--	--	--	--	--	100	50	150
Total		**--**	**--**	**80**	**320**	**--**	**150**	**100**	**650**

# indicates work load of Learner (Not Faculty), for Major Project

Students group and load of faculty per week.

Mini Project 1 and 2 :
Students can form groups with minimum 2 (Two) and not more than 4 (Four) Faculty
Load : 1 hour per week per four groups

Major Project 1 and 2 :
Students can form groups with minimum 2 (Two) and not more than 4 (Four) Faculty
Load : In Semester VII – ½ hour per week per project group

In Semester VIII – 1 hour per week per project group

	Department Optional Course – 5
IoTCSBCDO8011	Emerging Applications of Blockchain in industry
IoTCSBCDO8012	IoTs & Embedded Security
IoTCSBCDO8013	Information Retrieval System
IoTCSBCDO8014	Intelligent Forensic

IoTCSBCDO802X	**Department Optional Course –6**
IoTCSBCDO8021	IoT for Smart Grids
IoTCSBCDO8022	Metaverse
IoTCSBCDO8023	Green IT
IoTCSBCDO8024	Cyber Security laws & legal accepts

 # Institute Level Optional Course (ILO)

Every student is required to take one Institute Elective Course for Semester VIII, which is not closely allied to their disciplines. Different sets of courses will run in the both the semesters.

ILO801X	**Institute Optional Course – 2 (Common for all branches will be notified)**
ILO8011	Project Management
ILO8012	Finance Management
ILO8013	Entrepreneurship Development and Management
ILO8014	Human Resource Management
ILO8015	Professional Ethics and CSR
ILO8016	Research Methodology
ILO8017	IPR and Patenting
ILO8018	Digital Business Management
ILO8019	Environmental Management

		Theory	Practical	Tutorial	Theory	Practical/Oral	Tutorial	Total
IoTCSBCC801	NFT & DeFi (Decentralized Finance)	03	--	--	03	--	--	03

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		Test1	Test 2	Avg. of 2 Tests					
IoTCSBCC801	NFT & DeFi (Decentralized Finance)	20	20	20	80	--	--	--	100

Sr. No.	Course Objectives
The course aims:	
1.	To gain a fundamental understanding of NFTs and delve into the various uses and practical applications of NFTs.
2.	To examine the process of tokenizing assets and investigate the various standards and protocols associated with NFTs.
3.	To furnish information on marketplaces dedicated to the buying, selling, and creation of NFTs.
4.	To understand the basic principles and concepts of DeFi
5.	To recognize the obstacles and potential advantages pertaining to security within the realm of DeFi
6.	To gain knowledge about various applications and uses of DeFi.

Sr. No.	Course Outcomes	Cognitive levels of attainment as per Bloom's Taxonomy
On successful completion, of course, learner/student will be able to:		
1.	To grasp the fundamental principles and ideas behind NFTs.	L1
2.	To investigate the process of tokenizing assets and explore the diverse standards and protocols associated with NFTs.	L1, L2
3.	To utilize acquired knowledge about NFT marketplaces and platforms to engage in activities such as purchasing, selling, and creating NFTs.	L1, L2
4.	To delve into the core principles and concepts of DeFi, examining its fundamental aspects and foundational principles.	L1, L2
5.	To recognize the obstacles and potential advantages in terms of security within the realm of DeFi, while understanding the challenges and opportunities that arise in safeguarding DeFi protocols and user assets.	L1
6.	To implement and utilize DeFi principles and technologies in practical, real-world applications.	L1, L2

Prerequisite: Blockchain Technology

DETAILED SYLLABUS:

Sr. No.	Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	Blockchain, cryptocurrency, smart contracts, Web3	02	1
I	Introduction to NFTs	Definition of NFTs, history and development of NFTs, characteristics of NFTs, types of NFTs, difference between fungible and non-fungible tokens, comparison of NFTs with other digital assets like cryptocurrencies, working of NFTs, advantages and opportunities of NFT investments, risks and challenges of NFT investments, buying and selling of NFTs, legal aspects of NFTs, potential applications and developments of NFTs. **Self-study:** Mapping of NFTs with potential applications.	06	1
II	Tokenization & NFT standards	Definition of tokenization, its advantages and disadvantages, process of tokenization, token offerings (initial coin offerings (ICOs), security token offerings (STOs), initial exchange offerings (IEOs), equity token offerings (ETOs), and decentralized autonomous initial coin offerings (DAICOs)), ERC-721, ERC-1155, ERC-994, ERC-420, ERC-809 **Self-study:** ERC-1201, ERC-998, NEO token standards	07	2
III	NFT marketplaces and platforms	Popular NFT marketplaces and platforms for buying, selling, and creating NFTs such as OpenSea, Rarible, SuperRare, Nifty Gateway, NBA Top Shot, creating and minting NFTs **Self-study:** Other NFT marketplaces and platforms: Axie Infinity, Wax (Atomic Hub), Foundation, VeVe, Known Origin, Myth Market, Wrap-Up	04	3
IV	Fundamentals of DeFi	Financial markets (trading and exchanges), applications of blockchain in finance including insurance, post-trade settlement, financial crime prevention, and payments. What is DeFi, difference between TradFi/CeFi and DeFi, DeFi properties, DeFi layered architecture, DeFi primitives, DeFi services (asset tokenization, decentralized exchanges (DEX)—Automated Market Maker (AMM), order book-based DEX, DEX aggregators, flash loans, derivatives, money streaming, yield farming, insurance, and decentralized lending and borrowing), DeFi benefits **Self-study:** DEX examples: Uniswap, Bancor, WavesDEX, 0x, and IDEX. Applications of NFTs in DeFi: Collateralized loans, Fractional ownership, Gamification, etc.	09	4
V	DeFi Security	Issues on all DeFi layers: Network attacks (Eclipse, DoS attacks), Consensus attacks (51% attacks, double-spending, selfish mining), Smart contract code bugs (reentrancy, authorization), DeFi Protocol Composability attacks (excessive arbitrage between pools, flash loans, oracle attacks), bridge attacks, Governance attacks **Self-study:** Open Research Challenges in DeFi	06	5
VI	DeFi Applications	DeFi Apps, advantages of DeFi apps over traditional financial systems, Popular DeFi Apps: Instadapp (INST), Compound (COMP), PancakeSwap (CAKE), JustLend (JST), Convex Finance (CVX), NFT for metaverse. **Self-study:** Curve (CRV), Uniswap (UNI), Aave (AAVE), Lido (LDO), Maker (MKR), MakerDAO	05	6

Text Books:

1. What are NFTs? - 4 YOU - The NFT comprehensive guidebook by Holger Kiefer (2023)
2. NFT Art and Collectibles for Beginners by Chris Collins (2021)
3. The NFT Handbook by Matt Fortnow and QuHarrison Terry (2021)
4. Mastering Blockchain by Imran Bashir (4th Edition) (2023)
5. DeFi for Dummies by Seoyoung Kim (2022)
6. NFT for Dummies by Tiana Laurence and Seoyoung Kim (2021)

References:

1. NFT for Beginners by Clark Griffin (2022)
2. NFT: The Ultimate Guide to Invest in Non-Fungible Tokens and Create Your Digital Assets with Crypto Collectibles Art

   + NFT Virtual Real Estate by Brendon Stock (2020)
3. NFT for Beginners: Crypto Art AI (2021)
4. Decentralized Finance: From Core Concepts to DeFi Protocols for Financial Transactions by Thomas K. Birrer, Dennis Amstutz, Patrick Wenger (2023)
5. Stake Hodler Capitalism: Blockchain and DeFi (Decentralized Finance) by Amr Hazem Wahba Metwaly (2021)
6. How to DeFi by Darren Lau, Daryl Lau, Teh Sze Jin, Kristian Kho, Erina Azmi, TM Lee, Bobby Ong (2020)
7. Business of Decentralized Finance by Sam Ghosh (2022)

Online References:

1. NPTEL: Blockchain and its Applications (Link: https://onlinecourses.nptel.ac.in/noc22_cs44/preview)
2. Udemy: The Complete NFT Course - Learn Everything About NFTs (Link: https://www.udemy.com/course/the-complete-nft-course-learn-everything-about-nfts/)
3. Udemy: Decentralized Finance (DeFi) Fundamentals (Link: https://www.udemy.com/course/decentralized-finance-defi-fundamentals/)
4. A Survey of DeFi Security: Challenges and Opportunities by Wenkai Li, Jiuyang Bu, Xiaoqi Li, Hongli Peng, Yuanzheng Niu, Yuqing Zhang (2022) (Link: https://arxiv.org/abs/2206.11821)
5. Decentralized Finance, MOOC, Fall 2022 (Link: https://defi-learning.org/f22)

Assessment:

Internal Assessment (IA) for 20 marks:

- IA will consist of Two Compulsory Internal Assessment Tests. Approximately 40% to 50% of syllabus content must be covered in First IA Test and remaining 40% to 50% of syllabus content must be covered in Second IA Test

Question paper format

- Question Paper will comprise of a total of **six questions each carrying 20 marks Q.1** will be **compulsory** and should **cover maximum contents of the syllabus.**
- **Remaining questions** will be **mixed in nature** (part (a) and part (b) of each question must be from different modules. For example, if Q.2 has part (a) from Module 3 then part (b) must be from any other Module randomly selected from all the modules)
- A total of **four questions** needs to be answered.

Subject Code	Subject Name	Theory	Practical	Tutorial	Theory	Practical/Oral	Tutorial	Total
IoTCSBCDO8011	Emerging Applications of Blockchain in industry	03	--	--	03	--	--	03

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal Assessment			End Sem. Exam				
		Test1	Test 2	Avg. of 2 Tests					
IoTCSBCDO8011	Emerging Applications of Blockchain in industry	20	20	20	80	--	--	--	100

Course Objectives:

Sr. No.	Course Objectives
The course aims:	
1	To study the fundamental concepts of blockchain technology and its relevance to Supply Chain and Logistics Industry.
2	To study the concepts of blockchain concepts and collate with Finance and Banking.
3	To study the concepts of blockchain concepts and collate with Healthcare Industry.
4	To study the concepts of blockchain concepts and collate with Energy Trading and Grid Management.
5	To study the concepts of blockchain concepts and collate with Real Estate Sector.
6	To study the concepts of decentralized applications and its applicability in web application development.

Course Outcomes:

Sr. No.	Course Outcomes	Cognitive levels of attainment as per Bloom's Taxonomy
On successful completion, of course, learner/student will be able to:		
1	Interpret blockchain-based concepts to Supply Chain and Logistics Industry.	L3
2	Demonstrate blockchain-based concepts to Finance and Banking.	L3
3	Demonstrate blockchain-based concepts to Healthcare Industry.	L2
4	Use blockchain-based concepts to Energy Trading and Grid Management.	L2
5	Interpret blockchain-based concepts to Real Estate Sector.	L5
6	Demonstrate the understanding of decentralization and its use in application development.	L6

Prerequisite: Introduction to Distributed Systems and fundamental blockchain technology concepts

DETAILED SYLLABUS:

Sr.	Module	Detailed Content	Hours	CO

No.				Mapping
0	Prerequisite	Introduction to Blockchain Technology: Definition and core principles of blockchain, Distributed ledger technology and its features, Types of blockchain networks (public, private, consortium). Cryptographic primitives (hash functions, digital signatures), Public-key cryptography and key management in blockchain, Security challenges and countermeasures in blockchain networks.	02	--
I	**Blockchain for Supply Chain and Logistics Industry**	Role of key supply chain objectives, Traceability and Provenance: Track and record product's journey, ensuring transparency, verifying authenticity, preventing counterfeiting. Inventory Management: Real-time visibility into inventory levels, efficiency improvement and error minimization. Supplier Verification: Secure verification of suppliers' credentials and certifications, enhancing trust and reducing supply chain risks. Applications of blockchain for weapon tracking.	06	CO1
II	**Applications of Blockchain in Finance and Banking**	Challenges in Finance Sector, Know Your Customer (KYC): Blockchain-based KYC solutions to securely verify and share customer information across multiple financial institutions, Cross-border Payments, Trade Finance. Stock Trading, Insurance, Mortgages, Smart Contracts: Automating contractual agreements, streamline processes and reduce fraud. improving compliance and reducing duplication.	06	CO2
III	**Applications of Blockchain in Healthcare Industry**	Challenges in Healthcare, Medical Records: Securely store and share patient records, ensuring data integrity, interoperability, and patient privacy. Drugs supply chain management, Patient and Provider Identity management. Clinical Trials: Streamlining the management of clinical trial data, ensuring transparency and immutability of trial results. Drug Traceability: Track the entire supply chain of pharmaceuticals, reducing the risk of counterfeit drugs and ensuring patient safety. IoT based medical delivery drones. Blockchain for pharmaceutical industries and biomanufacturing, "FabRec" platform.	06	CO3
IV	**Applications of Blockchain in Energy Trading and Grid Management**	Peer-to-Peer Energy Trading: Blockchain enabled decentralized energy trading among prosumers, promoting renewable energy adoption and reducing reliance on traditional energy sources. Grid Management: Blockchain-based systems to enhance the efficiency of energy grid management, including demand response, grid balancing, and asset management.	06	CO4

V	**Applications of Blockchain in Real Estate sector**	Property Title Management: Decentralized and transparent system for recording and transferring property titles, reducing fraud and disputes. Smart Contracts for Rentals: Blockchain-based smart contracts to automate rental agreements, enabling self-execution of payments and conditions. Blockchain-enabled cyber-physical systems. Characteristics and Challenges in blockchain-enabled CPS systems.	06	CO5
VI	**Decentralized Web**	Difference between Web2 and Web3, introduction to Web3, web3 stack and architecture, How Web3 works, web3 wallets and tokens, security aspects in web3, Web3 use cases.	06	CO6

Text Books:

1. Blockchain Technology Kindle Edition by Chandramouli Subramanian, Asha A George, Abhilash K A, Meena Karthikeyan. Bikramaditya Singhal, Gautam Dhameja, Priyansu Sekhar Panda,
2. Beginning Blockchain A Beginner's Guide to Building Blockchain Solutions, Apress, 2018.
3. Web3 - The Decentralized Web - The Complete Guide: Why the Decentralized Web3 is The Future [dApps, Smart Contracts, Decentralization, NFTs, Blockchain] Paperback – October 13, 2021 by Alex Anderson.
4. Kirankalyan Kulkarni, Learn Bitcoin and Blockchain, Packt, 2018
5. Sandeep Kumar Panda, Vaibhav Mishra, Sujata Priyambada Dash, Ashis Kumar Pani, Recent Advances in Blockchain Technology Real-World Applications, Springer, 2023

References:

1. Blockchain Technology for Emerging Applications by SK Hafizul Islam, Arup Kumar Pal, Debabrata Samanta, Siddhartha Bhattacharyya.
2. Blockchain: A Practical Guide to Developing Business, Law, and Technology Solutions" by Joseph J. Bambara and Paul R. Allen
3. Blockchain Basics: A Non-Technical Introduction in 25 Steps by Daniel Drescher
4. A Brief Introduction to Web3: Decentralized Web Fundamentals for App Development by Shashank Mohan Jain
5. "Mastering Blockchain: Distributed Ledger Technology, Decentralization, and Smart Contracts Explained" by Imran Bashir 4th Edition.
6. "Blockchain for Enterprise" by Narayan Prusty Packt Publishing
7. "Blockchain for Business 2019" by Peter Lipovyanov and Ian Khan
8. "Blockchain: A Practical Guide to Developing Business, Law, and Technology Solutions" by Joseph J. Bambara and Paul R. Allen
9. "The Business Blockchain: Promise, Practice, and Application of the Next Internet Technology" by William Mougayar

Online References:

1. Live Demo : https://andersbrownworth.com/blockchain/
2. Hyperledger Fabric - https://www.hyperledger.org/projects/fabric

Assessment:

Internal Assessment (IA) for 20 marks:

- IA will consist of Two Compulsory Internal Assessment Tests. Approximately 40% to 50% of syllabus content must be covered in First IA Test and remaining 40% to 50% of syllabus content must be covered in Second IA Test

Question paper format

- Question Paper will comprise of a total of **six questions each carrying 20 marks Q.1** will be **compulsory** and should **cover maximum contents of the syllabus.**
- **Remaining questions** will be **mixed in nature** (part (a) and part (b) of each question must be from different modules. For example, if Q.2 has part (a) from Module 3 then part (b) must be from any other Module randomly selected from all the modules)
- A total of **four questions** needs to be answered.

Course Code	Course Name	Theory	Practical	Tutorial	Theory	Oral	Tutorial	Total
IoTCSBCDO8012	IoTs & Embedded Security	03	--	--	03	--	--	03

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		Test1	Test 2	Avg. of 2 Tests					
IoTCSBCDO8012	IoTs & Embedded Security	20	20	20	80	--	--	--	100

Course Objectives:

Sr. No.	Course Objectives
The course aims:	
1	To understand the fundamentals of IoTs and embedded systems, including their architecture, components, and communication protocols.
2	To gain knowledge of common security vulnerabilities and threats specific to IoT devices and embedded systems.
3	To develop skills to analyze, assess, and mitigate security risks associated with IoTs and embedded systems.
4	To learn various techniques and tools for securing IoT devices, networks, and communication channels.
5	To explore best practices for designing and implementing secure IoT architectures and protocols.
6	To stay updated with emerging trends, advancements, and challenges in IoT security and embedded systems.

Course Outcomes:

Sr. No.	Course Outcomes	Cognitive levels of attainment as per Bloom's Taxonomy
On successful completion, of course, learner/student will be able to:		

1	Demonstrate a comprehensive understanding of the concepts, principles, and challenges associated with securing IoTs and embedded systems.	L1, L2, L3
2	Analyze and assess the security vulnerabilities and risks in IoT devices, networks, and protocols, and propose effective countermeasures.	L1, L2, L3, L4
3	Apply various techniques and tools for conducting vulnerability assessments and penetration testing on IoT devices and systems.	L1, L2, L3
4	Design and implement secure architectures and protocols for IoT deployments, considering data security, privacy, and authentication requirements.	L1, L2, L3, L4, L5, L6
5	Evaluate and select appropriate security measures, technologies, and frameworks for mitigating security risks in IoT and embedded systems.	L1, L2. L3, L4, L5
6	Stay updated with the latest advancements and emerging trends in IoT security and apply critical thinking to adapt security strategies to evolving threats.	L1, L2

Prerequisite: Computer Networks, Basic Programming, Operating Systems, Cyber Security Fundamentals.

DETAILED SYLLABUS:

Sr. No.	Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	Computer Networks, Basic Programming, Operating Systems, Cyber Security Fundamentals.	**02**	--
I	Introduction to IoTs and Embedded Systems Security	Definition and characteristics of IoTs Overview of embedded systems and their role in IoTs, Importance of security in IoTs and embedded systems, Common IoT applications and their security implications, Challenges and risks in IoTs and embedded systems security, Introduction to security frameworks and standards for IoTs **Self-learning Topics:** Research current and emerging IoT technologies and applications, investigate real-world examples of IoT security breaches and their impact, Explore IoT security frameworks and standards.	**05**	CO1
II	IoT Device Architecture and Security	IoT device components: sensors, actuators, microcontrollers Secure device provisioning and authentication mechanisms Firmware security: secure boot, firmware updates, and integrity checks, Hardware security measures: tamper resistance, secure elements, trusted platform modules (TPM), Security considerations for IoT gateways and edge devices **Self-learning Topics:** Learn about different types of IoT devices and their architectures, Research secure device provisioning and bootstrapping techniques, Explore hardware-based security measures, such as secure elements and trusted platform modules (TPMs)	**07**	CO2
III	Communication Protocols and Network Security for IoTs	Overview of communication protocols used in IoTs (e.g., MQTT, CoAP, HTTP) IoT network architectures: star, mesh, tree, and hybrid topologies, Security mechanisms for IoT communication: encryption, authentication, access control. Network-level security protocols for IoTs: IPsec, DTLS, TLS Security considerations for wireless IoT networks (e.g., Zigbee, Z-Wave, Wi-Fi) **Self-learning Topics:** Dive deeper into specific IoT communication protocols, investigate security vulnerabilities and attacks related to IoT communication protocols, Research IoT network security technologies	**07**	CO3

IV	Vulnerability Assessment and Penetration Testing for IoTs	Understanding common vulnerabilities in IoT devices and systems, IoT threat modeling: identifying and assessing risks. Techniques for vulnerability assessment in IoT environments Penetration testing methodologies for IoT devices and networks Remediation strategies and best practices for IoT security **Self-learning Topics:** Learn about common vulnerabilities and exploits specific to IoT devices and systems, explore tools and methodologies for conducting vulnerability assessments on IoT devices	**05**	CO4
V	Data Security and Privacy in IoTs	Data security challenges in IoTs: confidentiality, integrity, and availability, Secure data transmission and encryption techniques in IoTs, Privacy considerations in IoT data collection and storage Privacy-enhancing technologies for IoTs: anonymization, pseudonymization Compliance with data protection regulations (e.g., GDPR, CCPA) in IoT deployments **Self-learning Topics:** Study encryption algorithms commonly used in IoT data protection, Investigate privacy-enhancing technologies like differential privacy and homomorphic encryption. Research legal and regulatory frameworks related to IoT data security and privacy.	**07**	CO5
VI	Emerging Trends and Advanced Topics in IoT Security	Blockchain technology for secure and decentralized IoT systems Machine learning and AI-driven security solutions for IoTs Edge computing and fog computing in enhancing IoT security and performance. Security considerations for IoT in critical infrastructures (e.g., healthcare, smart cities) Ethical and social implications of IoT security and privacy **Self-learning Topics:** Explore cutting-edge research papers and publications on IoT security, Investigate the role of blockchain technology in securing IoT systems, Learn about machine learning and AI-driven security solutions for IoT threat detection and mitigation	**06**	CO6

Textbooks:

1. "Internet of Things (A Hands-on-Approach)" by Arshdeep Bahga and Vijay Madisetti
2. "Practical Internet of Things Security" by Brian Russell, Drew Van Duren, and John R. Vacca
3. "Building the Internet of Things: Implement New Business Models, Disrupt Competitors, Transform Your Industry" by Maciej Kranz

References Books:

1. "Internet of Things: Principles and Paradigms" edited by Rajkumar Buyya, Amir Vahid Dastjerdi, and Sriram Venugopal
2. "Security and Privacy in Internet of Things (IoTs): Models, Algorithms, and Implementations" edited by Fei Hu

Online References:

1. IoT Top 10: https://owasp.org/www-project-iot-top-10/
2. IoT Security Foundation: https://www.iotsecurityfoundation.org/
3. NIST Cybersecurity for IoT Program: https://www.nist.gov/programs-projects/cybersecurity-iot-program
4. IoT Security Resources: https://www.sans.org/iot-security/

Assessment:

Internal Assessment (IA) for 20 marks:

●IA will consist of Two Compulsory Internal Assessment Tests. Approximately 40% to 50% of syllabus content must be covered in First IA Test and remaining 40% to 50% of syllabus content must be covered in Second IA Test

Question paper format

●Question Paper will comprise of a total of **six questions each carrying 20 marks.** Q.1 will be **compulsory** and should **cover maximum contents of the syllabus.**
●**Remaining questions** will be **mixed in nature** (part (a) and part (b) of each question must be from different modules. For example, if Q.2 has part (a) from Module 3 then part (b) must be from any other Module randomly selected from all the modules)
●A total of **four questions** needs to be answered.

Course Code	Course Name	Theory	Practical	Tutorial	Theory	Oral	Tutorial	Total
IoTCSBCDO8013	Information retrieval system	03	--	--	03	--	--	03

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		Test1	Test 2	Avg. of 2 Tests					
IoTCSBCDO8013	Information retrieval system	20	20	20	80	--	--	--	100

Course Objectives: Six Course Objectives

1. To learn the fundamentals of the information retrieval system.
2. To classify various Information retrieval models.
3. To demonstrate the query processing techniques and operations
4. To compare the relevance of query languages for text and multimedia data
5. To analyse the significance of various multimedia information retrieval models.
6. To understand IoT data management and analytics.

Course Outcomes: Six Course outcomes

Sr. No.	Course Outcomes	Cognitive levels of attainment as per Bloom's Taxonomy
On successful completion, of course, learner/student will be able to:		
1	Define the objectives of the basic concepts of the Information retrieval system.	L1,
2	Apply different information retrieval models to real time world problems.	L2, L3
3	Solve text and multimedia retrieval queries and their operations.	L3, L4
4	Apply text processing techniques and operations in the Information Retrieval system.	L3, L4
5	Analyze various multimedia Information Retrieval models.	L3
6	Apply different IoT data management techniques	L3

Prerequisite: Indexing and searching Algorithms,Internet of Things (IoT) Fundamentals

DETAILED SYLLABUS: t

Sr. No.	Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	Indexing and searching Algorithms, Internet of Things (IoT) Fundamentals	02	
I	Introduction to Information Retrieval System	Motivation, Basic Concepts, The Retrieval Process, Information System: Components, parts and types on information system; Definition and objectives on information retrieval system, Information versus Data Retrieval. Search Engines and browsers **Self-learning Topics**: Search Engines , Search API	06	CO1
II	IR Models	Modeling: Taxonomy of Information Retrieval Models,Retrieval: Formal Characteristics of IR models, Classic Information Retrieval, Alternative Set Theoretic models, Probabilistic Models, Structured text retrieval Models, models for Browsing; **Self-learning Topics:** Terrier - IR Platform and similar IR Platforms	06	CO2
III	Query Processing and Operations	Query Languages: Keyword based Querying, Pattern Matching, Structural Queries, Query Protocols; Query Operations: User relevance feedback **Self-learning Topics:** Proximity Queries and Wildcard Queries	05	CO3
IV	Text Processing	Text and Multimedia languages and properties: Metadata, Markup Languages, Multimedia; Text Operations: Document Preprocessing, Document Clustering. **Self-learning Topics:** Digital Library : Greenstone	06	CO4
V	Multimedia IR models	Inverted files, Other indices for text, Boolean Queries, Sequential Searching, Pattern Matching, Structural Queries, Compression Multimedia IR models: Data Modeling	08	CO5

		Multimedia IR: Indexing and Searching:- A Generic Multimedia indexing approach, ,Automatic Feature extraction; Searching Web: Challenges, Characterizing the web, Search Engines. Browsing, Meta searches, Searching using Hyperlinks **Self-learning Topics:** Google Image Search Engine		
VI	IoT Data Management and Anlytics	IoT Evolution, IoT Architectures, Resource Management, IoT Data Management and Analytics, IoT Applications **Self-learning Topics:** ThingSpeak, Ubidots, AWS cloud platform	06	CO6

Text Books:

1. Modern Information Retrieval, Ricardo Baeza-Yates,berthier Ribeiro- Neto, ACM Press- Addison Wesley

2. Information Retrieval Systems: Theory and Implementation, Gerald Kowaski, Kluwer Academic Publisher

3. Internet of Things - Principles and Paradigms, Rajkumar Buyya and Amir V. Dastjerdi, Elesvier

References:

1. Information Retrieval Implementing and Evaluating search Engines by Stefan Buttcher, Charles L.A. Clarke -The MIT Press Cambridge, Massachusetts London, England
2. Introduction to Information Retrieval By Christopher D. Manning and Prabhakar Raghavan, Cambridge University Press.
3. Introduction to Modern Information Retrieval. G.G. Chowdhury. NealSchuman.

Online References:

https://nptel.ac.in/courses/106101007

Assessment:

Internal Assessment (IA) for 20 marks:

- IA will consist of Two Compulsory Internal Assessment Tests. Approximately 40% to 50% of syllabus content must be covered in First IA Test and remaining 40% to 50% of syllabus content must be covered in Second IA Test.

➢ **Question paper format:**

- Question Paper will comprise of a total of **six questions each carrying 20 marks Q.1** will be **compulsory** and should **cover maximum contents of the syllabus.**
- **Remaining questions** will be **mixed in nature** (part (a) and part (b) of each question must be from different modules. For example, if Q.2 has part (a) from Module 3 then part (b) must be from any other Module randomly selected from all the modules).
- A total of **four questions** need to be answered.

Course Code	Course Name	Theory	Practical	Tutorial	Theory	Oral	Tutorial	Total
IoTCSBCDO8014	Intelligent Forensic	03	--	--	03	--	--	03

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		Test1	Test 2	Avg. of 2 Tests					
IoTCSBCDO8014	Intelligent Forensic	20	20	20	80	--	--	--	100

Course Objectives:

Sr. No.	Course Objectives
The course aims:	
1	Discuss the need of AI in Digital Forensics.
2	To understand the history of Digital Forensics.
3	To start a crime investigation based on different parameters.
4	To start a crime investigation based on different parameters.
5	To control, preserve, record, and recover evidence from the scene of an incident.
6	To identify Major AI tools and technology that are currently impacting the field of digital forensics.

Course Outcomes:

Sr. No.	Course Outcomes	Cognitive levels of attainment as per Bloom's Taxonomy
On successful completion, of course, learner/student will be able to:		
1	Identify application of ML for Digital forensics.	L1, L2
2	Understand and Analyze Forensics as Intelligence Sources.	L1, L2, L4
3	Build Intelligence Features of Forensic Evidence.	L1, L3
4	Build Evidence recovery, processing and Verify the Best Practice Using the Main Forensic Evidence Types	L1.L2, L3
5	Interpret and Investigate the Recovery of Forensic Evidence from the crime scene.	L1, L2, L4
6	Explore the Impact of implementing AI tools, technology and frameworks in digital forensics.	L1, L2, L4

Prerequisite: Artificial Intelligence and Digital forensic.

DETAILED SYLLABUS:

Sr. No.	Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	Basic of AI and DF	**00**	-
I	Machine Learning Trends for Digital Forensics	**1.1 Introduction** Need of Artificial Intelligence in Digital Forensics, Machine Learning Basics, Machine learning for Digital Forensics. Challenges of AI enabled DF. **1.2 Machine Learning Processes** Data Collection and Preprocessing, Training and Testing Phases **1.3 Applications of Machine Learning Models.** Machine Learning Types: Supervised Machine Learning, Unsupervised Machine Learning, Semi-Supervised Machine Learning, Reinforcement Learning **Self-Learning Topic:** Case Study: Using ML for forensics. Using the TON_IoT, Dataset for Forensics.	**04**	CO1
II	Introducing Forensic Intelligence	**2.1 The Beginnings of a Concept of Forensic Intelligence** Forensic Intelligence: Definition, The Concept of 'Entities' in Police Recording Systems, Access to Forensic Support Resources, Forensic Intelligence in Intelligence-Led Policing, The Origins of Forensic Intelligence, Estimating the Number of Current Offenders **2.2 Police Intelligence Models** Police Intelligence Models and the Language of Intelligence-Led Policing, The Four Levels of Crime Divisions in Crime, COMSTAT, Intelligence Models, Intelligence Assets, Knowledge Assets, System Assets, Forensics as Intelligence Sources The Collection of Forensic Intelligence Police Forensic Business Models **Self-Learning Topic:** A Short History of Forensic Intelligence in the Metropolitan Police, An Early Forensic Intelligence Tool Mark Case Example from the Late 1990s, Forensic Intelligence Development in the Metropolitan Police, 2002–2008.	**8**	CO2
III	The Value of Forensics in Crime Analysis and Intelligence	**3.1 Intelligence Features of Forensic Evidence Types** Linking Cases and Comparative Case Analysis The Different Forms of Case Linking in Criminal, The Values of Forensics in Case Linking Analysis, Receiver Operator Characteristics, Truth and Probability, The Crime Detection and Prosecution Rectangle, Dealing with Forensic Crime Links and Clusters, Footwear Evidence Frequency Evaluation **3.2 Forensic Legacy Data** Legacy Data and the FSS Sexual Assault, Forensic Intelligence Service, Improving the Potential of Legacy Data Use, The Importance of Regular Meetings, The Different Experiences of CSIs and Analysts **Self-Learning Topic:** A Footwear Evidence Persistence Case Example, A Linked Homicide Case Example, A Footwear Mark Cluster Example, A Footwear Mark Cluster Example	**7**	CO3
IV	Forensic Evidence Recovery, Processing, and Best Practice	**4.1 Purposes and Objectives of Crime Scene Examinations** Inhibitors to Effective Uses of Crime Scene Examinations, Forensic Recoveries in Linking Crimes, and in Contributing to the Production of Intelligence Products, Rights or Not to Obtain or Seize Forensic Material from Offenders		

		4.2 The Advantages of Databasing and Managing Collections of Forensic Evidence A Scenes of Crime Field Force Checklist for Effective Management of Forensics, Using Intervention Rates and Forensic Recovery Frequencies in Crime Analysis, Issues around Positive and Negative Management Techniques of Forensic Support, The Issue of Areas Disclosed in Forensic Marks as an Enabler of Forensic Intelligence **4.3 Best Practice in Using the Main Forensic Evidence Types** Automatic Fingerprint Identification Systems and Their Characteristics, The Four Factors at Work in Existing Miss Rates with AFIS, Forensic Strategies to Make the Best Use of AFIS, Fingerprint Laboratory Support **4.4 Using DNA Matches and Crime Scene Links Effectively** An Inhibited DNA Casework Example, DNA Databases and eDNA, Significance of DNA Forensic Crime Scene Intervention and Recovery Rates, Forensic Problem Profiles and the Concept of the Forensic Intelligence Report **Self-Learning Topic:** An Example of Volume Crime Practices Inhibiting a Serious Investigation	**10**	CO4
V	Best Practice in Recovery of Forensic Evidence from Crime Scenes	**5.1 Dealing with Crime Scenes** Crime Scene Examinations of Serious and Volume Crimes, Recovery of Different Types of Evidence such as Footwear Marks, Gelatine Lifters, Dealing with Dental Stone Casts, Marks in Snow, Instrument (Tool) Marks Isomark, Microsil, and Casting Putty Materials **5.2 Other Evidence Types** Ballistics, Manufacturing Marks, Evidential Value of Manufacturing Marks, Physical Fits, Contact Trace Evidence, Glass, Dealing with Suspects, Hair Combings, Paint Evidence **5.3 Miscellaneous Traces** Cosmetics, Oils and Greases, Plastics, Rubbers, and Adhesives, Soil, Safe Ballast, and Building Materials, Metals, Other Noxious Chemicals and Other Substances **Self-Learning Topic:** Case study on recovery of digital evidence such as CD, pen drive, Laptop	**6**	CO5
VI	The impact of automation and artificial intelligence on digital forensics	AI and Automation, Automation in context of DF, use of AI in DF, Framework of intelligent automation in digital forensics, Tools and method of intelligent automation in digital forensic, Potential impact of intelligent automation on digital forensic, Tools: Magnet Axiom, Google Takeout Convertor, X-Ways Forensics. **Self-Learning Topic**: Study AI tools for report writing.	**4**	CO6

Textbooks and References:

1. Digital Forensics in the Era of Artificial Intelligence, Author: Nour Moustafa, Publisher: CRC Press, 2022.
2. Forensic Intelligence **By Robert Milne,1st Edition.**
3. Forensic Biology, Author Richard Li, Publisher: CRC Press,2nd Edition.
4. Genetic Surveillance and Crime Control, Authors: Helena Machado and Rafaela Granja.
5. Predictive Policing and Artificial Intelligence, Author: John McDaniel, Ken Pease,1st Edition,2021

Online References:

1. Digital Forensics in the Era of Artificial Intelligence (ebooks.com)
2. **Forensic Intelligence by Robert Milne (ebook) (ebooks.com)**
3. The impact of automation and artificial intelligence on digital forensics (wiley.com)
4. Intelligence-Led Policing: The New Intelligence Architecture (ojp.gov).

5. How AI can be used in forensic science: Challenges and prospects — DocInsights

Assessment:

Internal Assessment (IA) for 20 marks:

- IA will consist of Two Compulsory Internal Assessment Tests. Approximately 40% to 50% of syllabus content must be covered in First IA Test and remaining 40% to 50% of syllabus content must be covered in Second IA Test

Question paper format

- Question Paper will comprise of a total of **six questions each carrying 20 marks.** Q.1 will be **compulsory** and should **cover maximum contents of the syllabus.**
- **Remaining questions** will be **mixed in nature** (part (a) and part (b) of each question must be from different modules. For example, if Q.2 has part (a) from Module 3 then part (b) must be from any other Module randomly selected from all the modules)
- A total of **four questions** needs to be answered.

Subject Code	Subject Name	Theory	Practical	Tutorial	Theory	Practical/ Oral	Tutorial	Total
IoTCSBCDO8021	IoT for Smart Grids	03	--	--	03	--	--	03

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		Test1	Test 2	Avg. of 2 Tests					
IoTCSBCDO8021	IoT for Smart Grids	20	20	20	80	--	--	--	100

Course Objectives:

Sr. No.	Course Objectives
The course aims:	
1	To impart knowledge of futuristic power grid technology and the path on which development is taking place.
2	To elaborate the fundamentals of various technologies and tools which will play a vital role in formation of the Smart grids in near future.
3	To familiarize the students with distribution management systems in smart grid.
4	To expose students to various communication protocols used in smart grid.
5	To acquaint students with knowledge of smart meters and infrastructure in smart grid.
6	To understand different data management tools in a smart grid.

Course Outcomes:

Sr. No.	Course Outcomes	Cognitive levels of attainment as per Bloom's Taxonomy
On successful completion, of course, learner/student will be able to:		
1	To identify the role and significance of smart in future power systems	L1, L2
2	To evaluate and compare applications of smart measurement and monitoring technologies.	L1, L2, L3, L4
3	To describe the role of a distribution management system in a smart grid.	L1, L2
4	To select and analyze different communication protocols for different applications in a smart grid.	L1, L2, L3, L4
5	To illustrate the importance of advanced metering infrastructure in smart grids.	L1, L2, L3
6	To apply data management techniques and develop machine learning algorithms for smooth operation of smart grid.	L1, L2, L3, L4, L5

Prerequisite: IoTC601: IoT Architecture and Protocols, CSDO701X IoT for Smart Cities

DETAILED SYLLABUS:

Sr. No.	Module	Detailed Content	Hours	CO Mapping

0	**Prerequisite**	Fundamentals of Power Distribution System, Transmission and Distribution, Power system Operation and Control, Communication Networks	**2**	**-**
I	**Smart Grid: Architecture and Design**	.Introduction, Smart Grid Drivers .Transformation of the Grid .Characteristics of a Smart Grid .Smart Grid Technology Framework .Benefits of Smart grid **Self-Learning Topics:** Smart grid architecture around the globe	**5**	**CO1**
II	**Smart Grid Technology**	2.1 Smart Energy Resources - Renewable energy generation 2.2 Energy storage 2.3 Electric vehicles 2.4 Energy Resources Integration Challenges, Solutions, and Benefit 2.5 Smart Substation - Protection, Monitoring, and Control Devices (IEDs) – Sensors – SCADA 2.6 IEC 61850-Based Substation Design 2.7 Energy Management Systems 2.8 Wide Area Monitoring, Protection and Control (WAMPAC) 2.9 Role of WAMPAC and Transmission Systems in a Smart Grid **Self-Learning Topics:** Microgrids versus smart grids	**9**	**CO2**
III	**Smart Distribution Systems**	3.1 Distribution Management Systems 3.2 Volt/VAr Control 3.3 Fault Detection, Isolation, and Service Restoration 3.4 Outage Management 3.5 Consumer Demand Management **Self-Learning Topics:** High-Efficiency Distribution Transformers	**5**	**CO3**
IV	**Communication Networks and Cyber Security**	4.1 Communications Requirements for the Smart Grid 4.2 Communication layer- Home automation network, Building automation network, Neighbourhood area network, Local area network, Field area network, Wide area network 4.3 Wireless Network Solutions for Smart Grid- Cellular, RF Mesh 4.4 Communication Standards and Protocols- IEC 61850, DNP3 and IEC 60870-5 4.5 IEEE C37.118, IEC 61968-9 and MultiSpeak, ANSI 4.6 Communications Challenges in the Smart Grid 4.7 Cyber Security for Smart Grid. **Self-Learning Topics:** Probable attacks on smart grid.	**8**	**CO4**
V	**Smart Meters and Advanced Metering Infrastructure (AMI)**	5.1 Evolution of the Electric Meter, and Meter Reading 5.2 AMI Drivers and Benefits 5.3 AMI Protocols, Standards, and Initiatives 5.4 AMI Security 5.5 AMI Needs in the Smart Grid 5.6 Phasor Measurement Unit. **Self-Learning Topics:** Smart appliances	**6**	**CO5**

VI	**Data Management and Forecasting**	6.1 Smart Grid Data Management, Characterization of Smart Grid Data 6.2 Secure Information and Data Management Architecture 6.3 Secure Data Management, Applications of Smart Grid Data 6.4 Importance of machine learning in energy forecasting, Big data in smart grid. **Self-Learning Topics:** Renewable Energy Forecasting, Fault Detection and Predictive Maintenance, Data Visualization and Decision Support	**4**	**CO6**

Text Books:

1. James Momoh, "Smart Grid:Fundamentals of Design and Analysis", IEEE Press and Wiley Publications, 2015
2. K. Liyanage, Jianzhong Wu, A. Yokoyama, Nick Jenkins J.Ekanayake, "Smart Grid: Technology and Applications", Wiley Publications , 2015
3. Stuart Borlase, "Smart Grids: Infrastructure, Technology, and Solutions", CRC Press, 2012
4. Clark W. Gellings, "The Smart Grid: Enabling Energy Efficiency and Demand Response", CRC Press

References:

1. Mini S. Thomas, John D McDonald, "Power System SCADA and Smart Grids", CRC Press, 2015
2. Kenneth C.Budka, Jayant G. Deshpande, Marina Thottan, "Communication Networks for Smart Grids", Springer, 2014.
3. H. T. Mouftah, and M. Erol-Kantarci, "Smart Grid: Networking, Data Management, and Business Models", CRC Press, 2016
4. Yang Xiao, "Communication and Networking in Smart Grids", CRC Press, 2012

Online References:

1. https://onlinecourses.nptel.ac.in/noc23_ee60/preview
2. https://onlinecourses.nptel.ac.in/noc21_ee68/preview

Assessment:

Internal Assessment (IA) for 20 marks:

- IA will consist of Two Compulsory Internal Assessment Tests. Approximately 40% to 50% of syllabus content must be covered in First IA Test and remaining 40% to 50% of syllabus content must be covered in Second IA Test

➢ **Question paper format**

- Question Paper will comprise of a total of **six questions each carrying 20 marks Q.1** will be **compulsory** and should **cover maximum contents of the syllabus**

- **Remaining questions** will be **mixed in nature** (part (a) and part (b) of each question must be from different modules. For example, if Q.2 has part (a) from Module 3 then part (b) must be from any other Module randomly selected from all the modules)

- A total of **four questions** need to be answered.

Subject Code	Subject Name	Theory	Practical	Tutorial	Theory	Practical/Oral	Tutorial	Total
CSDO8023	**Green IT**	03	--	--	03	--	--	03

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test 2	Avg. of 2 Tests					
CSDO8023	**Green IT**	20	20	20	80	--	--	--	100

Course Objectives:

1. To understand what Green IT is and How it can help improve environmental Sustainability.

2. To understand the principles and practices of Green IT.

3. To understand how Green IT is adopted or deployed in enterprises.

4. To understand how data centers, cloud computing, storage systems, software and networks can be made greener.

5. To measure the Maturity of a Sustainable ICT world.

6. To implement the concept of Green IT in Information Assurance in Communication and Social Media and all other commercial field.

Course Outcomes:

Course Outcome	Course Outcome Statement	Cognitive Levels of attainment as per Bloom's taxonomy
CO 1	Describe awareness among stakeholders and promote green agenda and green initiatives in their working environments leading to green movement.	L1
CO2	Identify IT Infrastructure Management and Green Data Center Metrics for software development	L1 L2
CO3	Recognize Objectives of Green Network Protocols for Data communication.	L1 L2
CO4	Apply Green IT Strategies and metrics for ICT development.	L1 L2 L3
CO5	Illustrate various green IT services and its roles	L1 L2

CO6	Demonstrate and use new career opportunities available in IT profession, audits and others with special skills such as energy efficiency, ethical IT assets disposal, carbon footprint estimation, reporting and development of green products, applications and services.	L1 L2 L3

Prerequisite: Environmental Studies

DETAILED SYLLABUS:

Sr. No.	Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	Environmental Studies	2	
I	Introduction	Environmental Impacts of IT, Holistic Approach to Greening IT, Green IT Standards and Eco-Labeling, Enterprise Green IT Strategy, Green IT: Burden or Opportunity? Hardware: Life Cycle of a Device or Hardware, Reuse, Recycle and Dispose. Software: Introduction, Energy Saving Software Techniques, Evaluating and Measuring Software Impact to Platform Power. **Self-Learning:** Evaluating and Measuring software impact to platform power	6	CO1
II	Software development and data centers	Sustainable Software, Software Sustainability Attributes, Software Sustainability Metrics, Sustainable Software Methodology, Data Centers and Associated Energy Challenges, Data Centre IT Infrastructure, Data Centre Facility Infrastructure: Implications for Energy Efficiency, IT Infrastructure Management, Green Data Centre Metrics **Self-learning Topics:** Sustainable Software: A Case Study, Data Centre Management Strategies	6	CO1 CO2
III	Data storage and communication	Storage Media Power Characteristics, Energy Management Techniques for Hard Disks, System-Level Energy Management, Objectives of Green Network Protocols, Green Network Protocols and Standards **Self-learning Topics:** System-Level Energy Management	6	CO1 CO3
IV	Information systems, green IT strategy and metrics	Approaching Green IT Strategies, Business Drivers of Green IT Strategy, Business Dimensions for Green IT Transformation, Multilevel Sustainable Information, Sustainability Hierarchy Models, Product Level Information, Individual Level Information, Functional Level Information, Organizational Level Information, Regional/City Level Information, Measuring the Maturity of Sustainable ICT. **Self-learning Topics:** Business Dimensions for Green IT transformation.	6	CO1 CO4

V	Green IT services and roles	Factors Driving the Development of Sustainable IT, Sustainable IT Services (SITS), SITS Strategic Framework, Sustainable IT Roadmap, Organizational and Enterprise Greening, Information Systems in Greening Enterprises, Greening the Enterprise: IT Usage and Hardware, Inter-organizational Enterprise Activities and Green Issues, Enablers and Making the Case for IT and the Green Enterprise. **Self-learning Topics:** Inter-organizational Enterprise Activities and Green Issues, Enablers and Making the Case for IT and the Green Enterprise.	6	CO1 CO4 CO5
VI	Managing and regulating green IT	Strategizing Green Initiatives, Implementation of Green IT, Information Assurance, Communication and Social Media, The Regulatory Environment and IT Manufacturers, Nonregulatory Government Initiatives, Industry Associations and Standards Bodies, Green Building Standards, Green Data Centers, Social Movements and Greenpeace. Case study on: Industry Sustainability with Green IT, Managing Green IT, The energy consumption in Torrent systems with malicious content, The use of thin client instead of desktop PC **Self-learning Topics:** Information Assurance, Green Data Centers	7	CO1 CO5 CO6

Text Books:

1. San Murugesan, G. R. Gangadharan, Harnessing Green IT, WILEY 1st Edition-2018
2. Mohammad Dastbaz Colin Pattinson Babak Akhgar, Green Information Technology A Sustainable Approach , Elsevier 2015
3. . Reinhold, Carol Baroudi, and Jeffrey Hill Green IT for Dummies, Wiley 2009

References:

1. Mark O'Neil, Green IT for Sustainable Business Practice: An ISEB Foundation Guide, BCS
2. Jae H. Kim, Myung J. Lee Green IT: Technologies and Applications, Springer, ISBN: 978-3-642-22178-1
3. Elizabeth Rogers, Thomas M. Kostigen The Green Book: The Everyday Guide to Saving the Planet One Simple Step at a Time, Springer

Assessment:

Internal Assessment (IA) for 20 marks:

- IA will consist of Two Compulsory Internal Assessment Tests. Approximately 40% to 50% of syllabus content must be covered in First IA Test and remaining 40% to 50% of syllabus content must be covered in Second IA Test

➢ **Question paper format**

- Question Paper will comprise of a total of **six questions each carrying 20 marks Q.1** will be **compulsory** and should **cover maximum contents of the syllabus**

- **Remaining questions** will be **mixed in nature** (part (a) and part (b) of each question must be from different modules. For example, if Q.2 has part (a) from Module 3 then part (b) must be from any other Module randomly selected from all the modules)

- A total of **four questions** need to be answered.

Course Code	Course Name	Theory	Practical	Tutorial	Theory	Oral	Tutorial	Total
IoTCSBCDO 8022	**Metaverse**	**03**	**--**	**--**	**03**	**--**	**--**	**03**

Course Code	Course Name	Examination Scheme							
		Theory Marks							
		Internal assessment			End Sem. Exam	Term Work	Practical	Oral	Total
		Test1	Test 2	Avg. of 2 Tests					
IoTCSBCDO8022	**Metaverse**	**20**	**20**	**20**	**80**	**--**	**--**	**--**	**100**

Course Objectives:

Sr. No.	Course Objectives
The course aims:	
1	To study the concepts of Metaverse.
2	To study Metaverse and Web 3.0, Virtual Reality (VR), Augmented Reality (AR), and Mixed Reality (MR), NFT in Blockchain.
3	To study the Metaverse technologies and protocols.
4	To study and identify the required infrastructure for Metaverse.
5	To Study various case studies of Metaverse.
6	To Study of Metaverse Immersive technology and Interfaces

Course Outcomes:

Sr. No.	Course Outcomes	Cognitive levels of attainment as per Bloom's Taxonomy
On successful completion, of course, learner/student will be able to:		
1	Explore the concepts of Metaverse.	L3,L4
2	Describe the fundamental concepts needed for the metaverse.	L1,L2
3	Explain the Metaverse technologies and protocols.	L2,L4

4	Construct the required infrastructure for Metaverse.	L3
5	Describe Metaverse Immersive technology and Interfaces	L1,L2
6	Express the different case studies of Metaverse	L2,L3,L4

Prerequisite: Concepts of Blockchain

DETAILED SYLLABUS:

Sr. No.	Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	Basic Concepts of Blockchain Technology.	**01**	-
I	Introduction:	What is the Metaverse? History of metaverse, Evaluation of Technology: Web, AR VR, 3D spaces. Immersive learning, Blockchain, Decentralized commerce, challenges and opportunities of metaverse **Self-learning:** AR VR tools, Blockchain technology	**04**	CO1
II	Fundamental Concepts of Metaverse	Building block technology of metaverse, How Gaming + Web 3.0 + Blockchain are Changing the Internet: Future of Internet. How Metaverse is different from the Internet, Potential of Metaverse, characteristics of metaverse. The Different Shapes of the Metaverse: Games, NFTs (assets), Blockchain Protocols, Cryptocurrencies, etc. **Self-learning:** Case Study on NFT, Cryptocurrency and Blockchain platforms	**08**	CO2
III	Metaverse Technologies and Protocols	Metaverse technologies, principles, affordances and application, Blockchain Protocols and Platforms Involved in the Metaverse, Metaverse-Related Tokens, Blockchain NFT need for metaverse: working principle of blockchain, NFT based virtual assets in metaverse, case study. How NFTs are Unlocking the Metaverse, Potential working of ERC721 NFT	**08**	CO3
IV	Metaverse Infrastructure	Access the metaverse, necessary hardware and Infrastructure, Interface. Understanding Decentraland, native token MANA, creating Avatar. Using metamask to access Decentraland, owning land to have direct access of metaverse	**07**	CO4
V	Metaverse Immersive technology and Interfaces	3d Reconstruction, AI technology to analyses 3D Scan Virtual Reality (VR) and Augmented Reality (AR), Mixed Reality (MR) and Extended Reality (XR), Metaverse vs VR what is difference, IoT to bridge gap between physical world and internet, Metaverse Interfaces: Personal Computer, Mobile Phone, AR Glasses, VR Goggles, Neuralink	**08**	CO5
VI	Case studies of Metaverse:	Various use cases of metaverse, Industries Disrupted by the Metaverse: Fashion, Marketing, Brands, Finance, Gaming, Architecture, Virtual Shows/Concerts, Art Galleries and Museums. Virtual Business and market: Investing in the Metaverse and Profit. Asset Classes Inside the Metaverse. Metaverse Land Ownership - Property Investment	**04**	CO6

Text & Reference Books:

1. Metaverse For Beginners A Guide To Help You Learn About Metaverse, Virtual Reality And Investing In NFTs By Andrew Clemens, 2022.
2. Extended Reality and Metaverse Immersive Technology in Times of Crisis, Springer Proceedings in Business and Economics, International XR Conference 2022.

3. Mystakidis, Stylianos, “ Metaverse”,Journal=Encyclopedia,2022, https://www.mdpi.com/2673-8392/2/1/31
4. All One Needs to Know about Metaverse: A Complete Survey on Technological Singularity, Virtual Ecosystem, and Research Agenda, Technical Report · October 2021

Online References:

1. **https://www.udemy.com/course/complete-metaverse-course-everything-about-ar-vr-and-nft/**

Assessment:

Internal Assessment (IA) for 20 marks:

- IA will consist of Two Compulsory Internal Assessment Tests. Approximately 40% to 50% of syllabus content must be covered in First IA Test and remaining 40% to 50% of syllabus content must be covered in Second IA Test

Question paper format

- Question Paper will comprise of a total of **six questions each carrying 20 marks.** Q.1 will be **compulsory** and should **cover maximum contents of the syllabus.**
- **Remaining questions** will be **mixed in nature** (part (a) and part (b) of each question must be from different modules. For example, if Q.2 has part (a) from Module 3 then part (b) must be from any other Module randomly selected from all the modules)
- A total of **four questions** needs to be answered.

Course Code	Course Name	Theory	Practical	Tutorial	Theory	Oral	Tutorial	Total
IoTCSBCDO 8023	Green IT	03	--	--	03	--	--	03

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test 2	Avg. of 2 Tests					
IoTCSBCDO8023	Green IT	20	20	20	80	--	--	--	100

Course Objectives:

Sr. No.	Course Objectives
The course aims:	
1	To understand what Green IT is and how it can help improve environmental Sustainability.
2	To understand the principles and practices of Green IT.
3	To understand how Green IT is adopted or deployed in enterprises.
4	To understand how data centers, cloud computing, storage systems, software and networks can be made greener.
5	To measure the Maturity of a Sustainable ICT world.
6	To implement the concept of Green IT in Information Assurance in Communication and social media and all other commercial fields.

Course Outcomes:

Sr. No.	Course Outcomes	Cognitive levels of attainment as per Bloom's Taxonomy
On successful completion, of course, learner/student will be able to:		
1	Describe awareness among stakeholders and promote green agenda and green initiatives in their working environments leading to green movement.	L1
2	Identify IT Infrastructure Management and Green Data Center Metrics for software development	L1, L2
3	Recognize Objectives of Green Network Protocols for Data communication.	L1, L2
4	Use Green IT Strategies and metrics for ICT development.	L1, L2, L3
5	Illustrate various green IT services and its roles	L1, L2
6	Use new career opportunities available in the IT profession, audits and others with special skills such as energy efficiency, ethical IT assets	L1, L2, L3

	disposal, carbon footprint estimation, reporting and development of green products, applications and services.	

Prerequisite: Environmental Studies

DETAILED SYLLABUS:

Sr. No.	Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	Environmental Studies	**2**	
I	Introduction	Environmental Impacts of IT, Holistic Approach to Greening IT, Green IT Standards and Eco-Labeling, Enterprise Green IT Strategy, Green IT: Burden or Opportunity? Hardware: Life Cycle of a Device or Hardware, Reuse, Recycle and Dispose. Software: Introduction, Energy Saving Software Techniques, Evaluating and Measuring Software Impact to Platform Power. **Self-Learning:** Evaluating and Measuring software impact to platform power	**6**	CO1
II	Software development and data centers	Sustainable Software, Software Sustainability Attributes, Software Sustainability Metrics, Sustainable Software Methodology, Data Centers and Associated Energy Challenges, Data Centre IT Infrastructure, Data Centre Facility Infrastructure: Implications for Energy Efficiency, IT Infrastructure Management, Green Data Centre Metrics **Self-learning Topics:** Sustainable Software: A Case Study, Data Centre Management Strategies	**6**	CO1, CO2
III	Data storage and communication	Storage Media Power Characteristics, Energy Management Techniques for Hard Disks, System-Level Energy Management, Objectives of Green Network Protocols, Green Network Protocols and Standards **Self-learning Topics:** System-Level Energy Management	**6**	CO1, CO3
IV	Information systems, green IT strategy and metrics	Approaching Green IT Strategies, Business Drivers of Green IT Strategy, Business Dimensions for Green IT Transformation, Multilevel Sustainable Information, Sustainability Hierarchy Models, Product Level Information, Individual Level Information, Functional Level Information, Organizational Level Information, Regional/City Level Information, Measuring the Maturity of Sustainable ICT. **Self-learning Topics:** Business Dimensions for Green IT transformation.	**6**	CO1, CO4
V	Green IT services and roles	Factors Driving the Development of Sustainable IT, Sustainable IT Services (SITS), SITS Strategic Framework, Sustainable IT Roadmap, Organizational and Enterprise Greening, Information Systems in Greening Enterprises, Greening the Enterprise: IT Usage and Hardware, Inter-organizational Enterprise Activities and Green Issues, Enablers and Making the Case for IT and the Green Enterprise.	**6**	CO1, CO4 CO5

		Self-learning Topics: Inter-organizational Enterprise Activities and Green Issues, Enablers and Making the Case for IT and the Green Enterprise.		
VI	Managing and regulating green IT	Strategizing Green Initiatives, Implementation of Green IT, Information Assurance, Communication and social media, The Regulatory Environment and IT Manufacturers, Nonregulatory Government Initiatives, Industry Associations and Standards Bodies, Green Building Standards, Green Data Centers, Social Movements and Greenpeace. Case study on: Industry Sustainability with Green IT, Managing Green IT, The energy consumption in Torrent systems with malicious content, The use of thin client instead of desktop PC **Self-learning Topics:** Information Assurance, Green Data Centers	**7**	CO1, CO5 CO6

Textbooks:

1. San Murugesan, G. R. Gangadharan, Harnessing Green IT, WILEY 1st Edition-2018
2. Mohammad Dastbaz Colin Pattinson Babak Akhgar, Green Information Technology A Sustainable Approach , Elsevier 2015
3. Reinhold, Carol Baroudi, and Jeffrey Hill Green IT for Dummies, Wiley 2009

References:

1. Mark O'Neil, Green IT for Sustainable Business Practice: An ISEB Foundation Guide, BCS
2. Jae H. Kim, Myung J. Lee Green IT: Technologies and Applications, Springer, ISBN: 978-3-642- 22178-1
3. Elizabeth Rogers, Thomas M. Kostigen the Green Book: The Everyday Guide to Saving the Planet One Simple Step at a Time, Springer

Assessment:

Internal Assessment (IA) for 20 marks:

- IA will consist of Two Compulsory Internal Assessment Tests. Approximately 40% to 50% of syllabus content must be covered in First IA Test and remaining 40% to 50% of syllabus content must be covered in Second IA Test

Question paper format

- Question Paper will comprise of a total of **six questions each carrying 20 marks.** Q.1 will be **compulsory** and should **cover maximum contents of the syllabus.**
- **Remaining questions** will be **mixed in nature** (part (a) and part (b) of each question must be from different modules. For example, if Q.2 has part (a) from Module 3 then part (b) must be from any other Module randomly selected from all the modules)
- A total of **four questions** needs to be answered.

Course Code	Course Name	Theory	Practical	Tutorial	Theory	Oral	Tutorial	Total
IoTCSBCDO8024	**Cyber Security laws & legal aspects**	**03**	**--**	**--**	**03**	**--**	**--**	**03**

Course Code	Course Name	Examination Scheme							
		Theory Marks							
		Internal assessment			End Sem. Exam	Term Work	Practical	Oral	Total
		Test1	Test 2	Avg. of 2 Tests					
IoTCSBCDO8024	**Cyber Security laws & legal aspects**	**20**	**20**	**20**	**80**	**--**	**--**	**--**	**100**

Course Objectives:

Sr. No.	Course Objectives
The course aims:	
1	Understand the fundamental concepts and principles of cyber law and its relevance in the digital age.
2	Explore the legal implications of various cybercrimes and develop an understanding of the legal provisions and penalties associated with them.
3	Gain knowledge of the legal aspects of cyber contracts, intellectual property rights, and their enforcement in the digital domain.
4	Comprehend the legal frameworks, regulations, and compliance requirements related to information security in various industries.
5	Examine the ethical and social implications of cyber activities and develop an ethical framework for responsible digital behavior.
6	Analyze and evaluate the legal challenges in cybersecurity incidents and develop strategies for risk management and incident response.

Course Outcomes:

Sr. No.	Course Outcomes	Cognitive levels of attainment as per Bloom's Taxonomy
On successful completion, of course, learner/student will be able to:		
1	Demonstrate a comprehensive understanding of the principles, concepts, and historical background of cyber law and its application in real-world scenarios.	L1, L2

2	Identify and classify different types of cybercrimes, understand the legal provisions and penalties associated with them, and effectively investigate and prosecute cybercrimes.	L1, L2
3	Evaluate the legal aspects of cyber contracts and intellectual property rights, including their formation, validity, enforceability, and protection in the digital era.	L2, L3
4	Analyze and interpret the legal frameworks, regulations, and compliance requirements related to information security standards in different industries.	L1, L2, L3
5	Recognize and assess the ethical and social implications of cyber activities, and apply ethical frameworks and principles in cybersecurity practices.	L1, L2
6	Develop a comprehensive understanding of the legal challenges in cybersecurity incidents, including incident response, breach notification, liability, and risk management.	L2, L3

Prerequisite: Basic knowledge of computer networks, information technology, and cybersecurity, awareness of the ethical implications of technology and digital activities, critical thinking and analytical skills for legal analysis and evaluation.

DETAILED SYLLABUS:

Sr. No.	Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	Basic knowledge of computer networks, information technology, and cybersecurity, awareness of the ethical implications of technology and digital activities, critical thinking and analytical skills for legal analysis and evaluation.	**01**	
I	Introduction to Cyber Law and Legal Aspects	• What is Cyber Law? • Need for Cyber Law • Historical background and evolution of cyber law • Key principles and concepts of cyber law • Legal frameworks and regulations related to cybersecurity. • Overview of international cyber law and its relevance • Case studies illustrating the application of cyber law in real-world scenarios. **Self-learning Topics:** Comparative analysis of cyber laws in different countries, Emerging trends and challenges in cyber law, Legal implications of emerging technologies (e.g., artificial intelligence, blockchain), Research and study of landmark cyber law cases	**04**	CO1
II	Legal Implications of Cyber Crimes	• Introduction to Criminal Law • Classification and types of cybercrimes (e.g., hacking, identity theft, cyber fraud) • Legal provisions and penalties for different cybercrimes(Sections based on crimes) • Investigation and prosecution of cybercrimes • Jurisdictional Issues in cybercrime cases • Role of digital evidence in cybercrime investigations • Case studies on high-profile cybercrime incidents and their legal implications **Self-learning Topics:** Study of cybercrime laws in specific jurisdictions, Analysis of cybercrime statistics and trends, Ethical considerations in cybercrime investigations, Legal challenges in cross-border cybercrime cases	**08**	CO2
III	Cyber Contracts and Intellectu	• Legal aspects of cyber contracts, including formation, validity, and enforceability • Intellectual property rights in the digital domain (e.g., copyright, trademarks, patents)	**08**	CO2

	al Property Rights	• Protection and enforcement of intellectual property rights in the digital era • Digital rights management and anti-piracy measures • Emerging issues in cyber contracts and intellectual property rights (e.g., open-source software, digital content licensing) **Self-learning Topics:** Comparative analysis of intellectual property laws in different countries, Study of legal cases involving cyber contracts and intellectual property disputes, Examination of licensing agreements and their legal implications.		
IV	Concepts of Cyberspace & Cyber Law	• Introduction to e-Commerce • Contract & Security Aspects in Cyber Law • Intellectual Property & Evidence Aspect in Cyber Law • Criminal Aspects in Cyber Law • Need for Indian Cyber Law **Self-learning Topics:** Internet governance models and organizations (e.g., ICANN, ITU), Cyber sovereignty and jurisdictional challenges, Cybersecurity challenges in the digital era	**07**	CO4
V	Information technology Act	• Introduction of Cybercrime • Information Technology Act, 2000 • Offences under IT Act, 2000 • IT Act, 2008 & its Amendments **Self-learning Topics:** Cybercrimes and their classification under the IT Act, Investigation and prosecution of cybercrimes under the IT Act, Role of digital evidence in cybercrime cases.	**08**	CO5
VI	Information Security Standard Compliances	• PCI Compliance • ISO/IEC 27000 • North American Electric Reliability Corporation (NERC) • Health Insurance Portability and Accountability Act (HIPAA) • Sarbanes-Oxley Act (SOX) **Self-learning Topics:** Audit and assessment processes for information security compliance, Incident response and breach notification procedures, Legal considerations in information security governance and compliance	**04**	CO6

Text Books:

1. "Cyber Security & Cyber Laws" by Nilakshi Jain & Ramesh Menon (Unit 4,5,6)
2. "Cyber Law Simplified" by Vivek Sood (Unit 1)
3. "Cyber Crime: Law and Practice" by Pavan Duggal (Unit 2)
4. "Intellectual Property Rights in Cyberspace" by Rajendra Kumar (Unit 3)
5. "Understanding Cyberspace Law" by George B. Delta and Jeffrey H. Matsuura (Unit 4)
6. "Information Technology Law and Practice" by Vakul Sharma (Unit 5)

References Books:

1. "Cyber Law: The Indian Perspective" by Karnika Seth
2. "Cyber Law and Crimes" by Dr. N.K. Aggarwal
3. "Cyber Law, Contracts, and Intellectual Property Rights" by A. Jayanthi
4. "Cyber Law: Indian and International Perspectives" by Yatindra Singh and Shantanu Chattopadhyay
5. "Information Technology Law in India" by Vakul Sharma
6. "Information Security Management: Concepts and Practice" by Prashant Pathak and Sushil Chandra

Online References:

1. Stanford Law School's Center for Internet and Society (https://cyberlaw.stanford.edu/)
2. Electronic Frontier Foundation (EFF) (https://www.eff.org/)

3. National Institute of Standards and Technology (NIST) Cybersecurity Framework (https://www.nist.gov/cyberframework)
4. International Association of Privacy Professionals (IAPP) (https://iapp.org/)
5. United Nations Commission on International Trade Law (UNCITRAL) - Electronic Commerce and Information Technology (https://uncitral.un.org/en/working_groups/6/electronic_commerce)

Assessment:

Internal Assessment (IA) for 20 marks:

●IA will consist of Two Compulsory Internal Assessment Tests. Approximately 40% to 50% of syllabus content must be covered in First IA Test and remaining 40% to 50% of syllabus content must be covered in Second IA Test

Question paper format

●Question Paper will comprise of a total of **six questions each carrying 20 marks.** Q.1 will be **compulsory** and should **cover maximum contents of the syllabus.**

●**Remaining questions** will be **mixed in nature** (part (a) and part (b) of each question must be from different modules. For example, if Q.2 has part (a) from Module 3 then part (b) must be from any other Module randomly selected from all the modules)

●A total of **four questions** needs to be answered.

Subject Code	Subject Name	Theory	Practical	Tutorial	Theory	Oral	Tutorial	Total
ILO8011	Project Management	03	--	--	03	--	--	03

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		Test1	Test 2	Avg. of 2 Tests					
ILO8011	Project Management	20	20	20	80	--	--	--	100

Course Objectives:

	Course Objectives:
	The course aims:
1	To familiarize the students with the use of a structured methodology/approach for each and every unique project undertaken, including utilizing project management concepts, tools and techniques.
2	To appraise the students with the project management life cycle and make them knowledgeable about the various phases from project initiation through closure

Course Outcomes:

	Course Outcomes	Cognitive levels of attainment as per Bloom's Taxonomy
On successful completion, of course, learner/student will be able to:		
1	Apply selection criteria and select an appropriate project from different options.	L3

2	Write work breakdown structure for a project and develop a schedule based on it.	L1, L6
3	Identify opportunities and threats to the project and decide an approach to deal with them strategically.	L1, L4
4	Use Earned value technique and determined & predict status of the project.	L3, L5
5	Capture lessons learned during project phases and document them for future reference	L3

Module	Detailed Contents	Hrs
01	**Project Management Foundation:** Definition of a project, Project Vs Operations, Necessity of project management, Triple constraints, Project life cycles (typical & atypical) Project phases and stage gate process. Role of project manager. Negotiations and resolving conflicts. Project management in various organization structures. PM knowledge areas as per Project Management Institute (PMI).	5
02	**Initiating Projects:** How to get a project started, selecting projects strategically, Project selection models (Numeric /Scoring Models and Non-numeric models), Project portfolio process, Project sponsor and creating charter; Project proposal. Effective project team, Stages of team development & growth (forming, storming, norming & performing), team dynamics.	6
03	**Project Planning and Scheduling:** Work Breakdown structure (WBS) and linear responsibility chart, Interface Coordination and concurrent engineering, Project cost estimation and budgeting, Top down and bottoms up budgeting, Networking and Scheduling techniques. PERT, CPM, GANTT chart. Introduction to Project Management Information System (PMIS).	8
04	**Planning Projects:** Crashing project time, Resource loading and leveling, Goldratt's critical chain, Project Stakeholders and Communication plan. Risk Management in projects: Risk management planning, Risk identification and risk register. Qualitative and quantitative risk assessment, Probability and impact matrix. Risk response strategies for positive and negative risks	6
05	**Executing Projects:** **5.1 Executing Projects:** Planning monitoring and controlling cycle. Information needs and reporting, engaging with all stakeholders of the projects. Team management, communication and project meetings. **Monitoring and Controlling Projects:** Earned Value Management techniques for measuring value of work completed; Using milestones for measurement; change requests and scope creep. Project audit. **Project Contracting**	8

	Project procurement management, contracting and outsourcing,	
06	**Project Leadership and Ethics:** Introduction to project leadership, ethics in projects. Multicultural and virtual projects. **Closing the Project:** Customer acceptance; Reasons of project termination, Various types of project terminations (Extinction, Addition, Integration, Starvation), Process of project termination, completing a final report; doing a lessons learned analysis; acknowledging successes and failures; Project management templates and other resources; Managing without authority; Areas of further study.	6

References:

1. Jack Meredith & Samuel Mantel, Project Management: A managerial approach, Wiley India, 7thEd.
2. A Guide to the Project Management Body of Knowledge (PMBOK® Guide), 5th Ed,Project Management Institute PA,USA
3. Gido Clements, Project Management, CengageLearning.
4. Gopalan, Project Management, , WileyIndia
5. Dennis Lock, Project Management, Gower Publishing England, 9 thEd.

Assessment:

Internal:

Assessment consists of two tests out of which; one should be a compulsory class test and the other is either a class test or assignment on live problems or course project.

End Semester Theory Examination:

Some guidelines for setting up the question paper. Minimum 80% syllabus should be covered in question papers of end semester examination. **In question paper weightage of each module will be proportional to the number of respective lecture hours as mentioned in the syllabus.**

1. Question paper will comprise of total six question
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module3)
4. Only Four questions need to be solved.

Course Code	Course Name	Theory	Practical	Tutorial	Theory	Oral	Tutorial	Total
ILO8012	Finance Management	03	--	--	03	--	--	03

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test 2	Avg. of 2 Tests					
ILO8012	Finance Management	20	20	20	80	--	--	--	100

Course Objectives:

Sr. No.	Course Objectives:
The course aims:	
1	Overview of Indian financial system, instruments and market
2	Basic concepts of value of money, returns and risks, corporate finance, working capital and its management
3	Knowledge about sources of finance, capital structure, dividend policy

Course Outcomes:

Sr. No.	Course Outcomes	Cognitive levels of attainment as per Bloom's Taxonomy
On successful completion, of course, learner/student will be able to:		
1	Understand Indian finance system and corporate finance	L1
2	Discuss investment, finance as well as dividend decisions	L2

Module	Detailed Contents	Hrs
01	**Overview of Indian Financial System:** Characteristics, Components and Functions of Financial System. **Financial Instruments:** Meaning, Characteristics and Classification of Basic Financial Instruments — Equity Shares, Preference Shares, Bonds-Debentures, Certificates of Deposit, and Treasury Bills. **Financial Markets:** Meaning, Characteristics and Classification of Financial Markets — Capital Market, Money Market and Foreign Currency Market **Financial Institutions:** Meaning, Characteristics and Classification of Financial Institutions — Commercial Banks, Investment-Merchant Banks and Stock Exchanges	06
02	**Concepts of Returns and Risks:** Measurement of Historical Returns and Expected Returns of a Single Security and a Two-security Portfolio; Measurement of Historical Risk and Expected Risk of a Single Security and a Two-security Portfolio. **Time Value of Money:** Future Value of a Lump Sum, Ordinary Annuity, and Annuity Due; Present Value of a Lump Sum, Ordinary Annuity, and Annuity Due; Continuous Compounding and Continuous Discounting.	06
03	**Overview of Corporate Finance:** Objectives of Corporate Finance; Functions of Corporate Finance—Investment Decision, Financing Decision, and Dividend Decision. **Financial Ratio Analysis:** Overview of Financial Statements—Balance Sheet, Profit and Loss Account, and Cash Flow Statement; Purpose of Financial Ratio Analysis; Liquidity Ratios; Efficiency or Activity Ratios; Profitability Ratios. Capital Structure Ratios; Stock Market Ratios; Limitations of Ratio Analysis.	09
04	**Capital Budgeting:** Meaning and Importance of Capital Budgeting; Inputs for Capital Budgeting Decisions; Investment Appraisal Criterion—Accounting Rate of Return, Payback Period, Discounted Payback Period, Net Present Value (NPV), Profitability Index, Internal Rate of Return (IRR), and Modified Internal Rate of Return (MIRR) **Working Capital Management:** Concepts of Meaning Working Capital; Importance of Working Capital Management; Factors Affecting an Entity's Working Capital Needs; Estimation of Working Capital Requirements; Management of Inventories; Management of Receivables; and Management of Cash and Marketable Securities.	10
05	**Sources of Finance:** Long Term Sources—Equity, Debt, and Hybrids; Mezzanine Finance; Sources of Short Term Finance—Trade Credit, Bank Finance, Commercial Paper; Project Finance. **Capital Structure:** Factors Affecting an Entity's Capital Structure; Overview of Capital Structure Theories and Approaches— Net Income Approach, Net Operating Income Approach; Traditional Approach, and Modigliani-Miller Approach. Relation between	05

	Capital Structure and Corporate Value; Concept of Optimal Capital Structure	
06	**Dividend Policy:** Meaning and Importance of Dividend Policy; Factors Affecting an Entity's Dividend Decision; Overview of Dividend Policy Theories and Approaches—Gordon's Approach, Walter's Approach, and Modigliani- Miller Approach	03

REFERENCES:

1. Fundamentals of Financial Management, 13th Edition (2015) by Eugene F. Brigham and Joel F. Houston; Publisher: Cengage Publications, New Delhi.
2. Analysis for Financial Management, 10th Edition (2013) by Robert C. Higgins; Publishers: McGraw Hill Education, New Delhi.
3. Indian Financial System, 9th Edition (2015) by M. Y. Khan; Publisher: McGraw Hill Education, New Delhi.
4. Financial Management, 11th Edition (2015) by I. M. Pandey; Publisher: S. Chand (G/L) & Company Limited, New Delhi.

Assessment:

Internal:
Assessment consists of two tests out of which; one should be compulsory class test and the other is either a class test or assignment on live problems or course project.

End Semester Theory Examination:
Some guidelines for setting up the question paper. Minimum 80% syllabus should be covered in question papers of end semester examination. **In question paper weightage of each module will be proportional to number of respective lecture hours as mentioned in the syllabus.**

1. Question paper will comprise of total six question.
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four question need to be solved.

Course Code	Course Name	Theory	Practical	Tutorial	Theory	Oral	Tutorial	Total
ILO8013	Entrepreneurship Development and Management	03	--	--	03	--	--	03

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		Test1	Test 2	Avg. of 2 Tests					
ILO8013	Entrepreneurship Development and Management	20	20	20	80	--	--	--	100

Course Objectives:

Sr. No.	Course Objectives:
The course aims:	
1	To acquaint with entrepreneurship and management of business.
2	Understand Indian environment for entrepreneurship.
3	Idea of EDP,MSME.

Course Outcomes:

Sr. No.	Course Outcomes	Cognitive levels of attainment as per Bloom's Taxonomy
On successful completion, of course, learner/student will be able to:		
1	Understand the concept of business plan and ownerships	L1
2	Interpret key regulations and legal aspects of entrepreneurship in India	L5
3	Understand government policies for entrepreneurs.	L1

Module	Detailed Contents	Hrs
01	**Overview Of Entrepreneurship:** Definitions, Roles and Functions/Values of Entrepreneurship, History of Entrepreneurship Development, Role of Entrepreneurship in the National Economy, Functions of an Entrepreneur, Entrepreneurship and Forms of Business Ownership Role of Money and Capital Markets in Entrepreneurial Development: Contribution of Government Agencies in Sourcing information for Entrepreneurship	04
02	**Business Plans And Importance Of Capital To Entrepreneurship:** Preliminary and Marketing Plans, Management and Personnel, Start-up Costs and Financing as well as Projected Financial Statements, Legal Section, Insurance, Suppliers and Risks, Assumptions and Conclusion, Capital and its Importance to the Entrepreneur **Entrepreneurship And Business Development:** Starting a New Business, Buying an Existing Business, New Product Development, Business Growth and the Entrepreneur Law and its Relevance to Business Operations	09
03	Women's Entrepreneurship Development, Social entrepreneurship-role and need, EDP cell, role of sustainability and sustainable development for SMEs, case studies, exercises	05
04	**Indian Environment for Entrepreneurship:** key regulations and legal aspects , MSMED Act 2006 and its implications, schemes and policies of the Ministry of MSME, role and responsibilities of various government organisations, departments, banks etc., Role of State governments in terms of infrastructure developments and support etc., Public private partnerships, National Skill development Mission, Credit Guarantee Fund, PMEGP, discussions, group exercises etc	08
05	**Effective Management of Business:** Issues and problems faced by micro and small enterprises and effective management of M and S enterprises (risk management, credit availability, technology innovation, supply chain management, linkage with large industries), exercises, e-Marketing	08
06	**Achieving Success In The Small Business:** Stages of the small business life cycle, four types of firm-level growth strategies, Options – harvesting or closing small business Critical Success factors of small business	05

REFERENCES:

1. Poornima Charantimath, Entrepreneurship development- Small Business Enterprise, Pearson
2. Education Robert D Hisrich, Michael P Peters, Dean A Shapherd, Entrepreneurship, latest edition, The McGrawHill Company
3. Dr TN Chhabra, Entrepreneurship Development, Sun India Publications, New Delhi
4. Dr CN Prasad, Small and Medium Enterprises in Global Perspective, New century Publications, New Delhi
5. Vasant Desai, Entrepreneurial development and management, Himalaya Publishing House
6. Maddhurima Lall, Shikah Sahai, Entrepreneurship, Excel Books
7. Rashmi Bansal, STAY hungry STAY foolish, CIIE, IIM Ahmedabad
8. Law and Practice relating to Micro, Small and Medium enterprises, Taxmann Publication Ltd.
9. Kurakto, Entrepreneurship- Principles and Practices, Thomson Publication
10. Laghu Udyog Samachar
11. www.msme.gov.in
12. www.dcmesme.gov.in
13. www.msmetraining.gov.in

Assessment:

Internal:
Assessment consists of two tests out of which; one should be compulsory class test and the other is either a class test or assignment on live problems or course project.

End Semester Theory Examination:
Some guidelines for setting up the question paper. Minimum 80% syllabus should be covered in question papers of end semester examination. **In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.**

1. Question paper will comprise of total six question
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four question need to be solved.

Course Code	Course Name	Theory	Practical	Tutorial	Theory	Oral	Tutorial	Total
ILO8014	Human Resource Management	03	--	--	03	--	--	03

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test 2	Avg. of 2 Tests					
ILO8014	Human Resource Management	20	20	20	80	--	--	--	100

Course Objectives:

Sr. No.	Course Objectives:
The course aims:	
1	To introduce the students with basic concepts, techniques and practices of human resource management.
2	To provide an opportunity of learning Human resource management (HRM) processes, related with the functions, and challenges in the emerging perspective of today's organizations.
3	To familiarize the students about the latest developments, trends & different aspects of HRM.
4	To acquaint the student with the importance of interpersonal & inter-group behavioral skills in an organizational setting required for future stable engineers, leaders and managers.

Course Outcomes:

Sr. No.	Course Outcomes	Cognitive levels of attainment as per Bloom's Taxonomy
On successful completion, of course, learner/student will be able to:		
1	Understand the concepts, aspects, techniques and practices of human resource management.	L1
2	Understand the Human resource management (HRM) processes, functions, changes and challenges in today's emerging organizational perspective.	L1
3	Gain knowledge about the latest developments and trends inHRM.	L1, L6
4	Apply the knowledge of behavioral skills learnt and integrate it within an interpersonal and intergroup environment emerging as future stable engineers and managers.	L3

Module	Detailed Contents	Hrs
01	**Introduction to HR** • Human Resource Management- Concept, Scope and Importance, Interdisciplinary Approach Relationship with other Sciences, Competencies of HR Manager, HRM functions. • Human resource development (HRD): changing role of HRM – Human resource Planning, Technological change, Restructuring and rightsizing, Empowerment, TQM, Managing ethical issues.	5
02	**Organizational Behavior (OB)** • Introduction to OB Origin, Nature and Scope of Organizational Behavior, Relevance to Organizational Effectiveness and Contemporary issues • Personality: Meaning and Determinants of Personality, Personality development, Personality Types, Assessment of Personality Traits for Increasing Self Awareness • Perception: Attitude and Value, Effect of perception on Individual Decision-making, Attitude and Behavior. • Motivation: Theories of Motivation and their Applications for Behavioral Change (Maslow, Herzberg, McGregor); • Group Behavior and Group Dynamics: Work groups formal and informal groups and stages of group development. Team Effectiveness: High performing teams, Team Roles, cross functional and self-directed team. • Case study	7
03	**Organizational Structure &Design** • Structure, size, technology, Environment of organization; Organizational Roles & conflicts: Concept of roles; role dynamics; role conflicts and stress. • Leadership: Concepts and skills of leadership, Leadership and managerial roles, Leadership styles and contemporary issues in leadership. • Power and Politics: Sources and uses of power; Politics at workplace, Tactics and strategies.	6
04	**Human resource Planning** • Recruitment and Selection process, Job-enrichment, Empowerment - Job-Satisfaction, employee morale. • Performance Appraisal Systems: Traditional & modern methods, Performance Counseling, Career Planning. Training & Development: Identification of Training Needs, Training Methods	5
05	**Emerging Trends in HR** • Organizational development; Business Process Re-engineering (BPR), BPR as a tool for organizational development, managing processes & transformation in HR. Organizational Change, Culture, Environment • Cross Cultural Leadership and Decision Making**:** Cross Cultural Communication and diversity at work**,** causes of diversity, managing. diversity with special reference to handicapped, women and ageing people, intra company cultural difference in employee motivation.	6
06	**HR & MIS** Need, purpose, objective and role of information system in HR, Applications in HRD in various industries (e.g. manufacturing R&D, Public Transport, Hospitals, Hotels and service industries **Strategic HRM** Role of Strategic HRM in the modern business world, Concept of Strategy, Strategic Management Process, Approaches to Strategic Decision Making; Strategic Intent – Corporate Mission, Vision, Objectives and Goals **Labor Laws & Industrial Relations** Evolution of IR, IR issues in organizations, Overview of Labor Laws in India; Industrial Disputes Act, Trade Unions Act, Shops and Establishments Act	10

REFERENCES:

1. Stephen Robbins, Organizational Behavior, 16th Ed, 2013
2. V S P Rao, Human Resource Management, 3rd Ed, 2010, Excel publishing
3. Aswathapa, Human resource management: Text & cases, 6th edition, 2011
4. C. B. Mamoria and S V Gankar, Dynamics of Industrial Relations in India, 15th Ed, 2015, Himalaya Publishing, 15thedition, 2015
5. P. Subba Rao, Essentials of Human Resource management and Industrial relations, 5th Ed, 2013, Himalaya Publishing
6. Laurie Mullins, Management & Organizational Behavior, Latest Ed, 2016, Pearson Publications

Assessment:

Internal:
Assessment consists of two tests out of which; one should be compulsory class test and the other is either a class test or assignment on live problems or course project.

End Semester Theory Examination:
Some guidelines for setting up the question paper. Minimum 80% syllabus should be covered in question papers of end semester examination. **In question paper weightage of each module will be proportional to number of respective lecture hours as mentioned in the syllabus.**

1. Question paper will comprise of total six question
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four question need to be solved.

Course Code	Course Name	Theory	Practical	Tutorial	Theory	Oral	Tutorial	Total
ILO8015	Professional Ethics and Corporate Social Responsibility (CSR)	03	--	--	03	--	--	03

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test 2	Avg. of 2 Tests					
ILO8015	Professional Ethics and Corporate Social Responsibility (CSR)	20	20	20	80	--	--	--	100

Course Objectives:

Sr. No.	Course Objectives:
The course aims:	
1	To understand professional ethics in business
2	To recognize corporate social responsibility

Course Outcomes:

Sr. No.	Course Outcomes	Cognitive levels of attainment as per Bloom's Taxonomy
On successful completion, of course, learner/student will be able to:		
1	Understand rights and duties of business	L1
2	Distinguish different aspects of corporate social responsibility	L2, L4
3	Demonstrate professional ethics	L3
4	Understand legal aspects of corporate social responsibility	L1

Module	Detailed Contents	Hrs

01	**Professional Ethics and Business:** The Nature of Business Ethics; Ethical Issues in Business; Moral Responsibility and Blame; Utilitarianism: Weighing Social Costs and Benefits; Rights and Duties of Business	04
02	**Professional Ethics in the Marketplace:** Perfect Competition; Monopoly Competition; Oligopolistic Competition; Oligopolies and Public Policy **Professional Ethics and the Environment:** Dimensions of Pollution and Resource Depletion; Ethics of Pollution Control; Ethics of Conserving Depletable Resources	08
03	**Professional Ethics of Consumer Protection:** Markets and Consumer Protection; Contract View of Business Firm's Duties to Consumers; Due Care Theory; Advertising Ethics; Consumer Privacy **Professional Ethics of Job Discrimination:** Nature of Job Discrimination. Extent of Discrimination; Reservation of Jobs.	06
04	**Introduction to Corporate Social Responsibility:** Potential Business Benefits—Triple bottom line, Human resources, Risk management, Supplier relations; Criticisms and concerns—Nature of business; Motives; Misdirection. Trajectory of Corporate Social Responsibility in India	05
05	**Corporate Social Responsibility:** Articulation of Gandhian Trusteeship Corporate Social Responsibility and Small and Medium Enterprises (SMEs) in India, Corporate Social Responsibility and Public-Private Partnership (PPP)in India	08
06	**Corporate Social Responsibility in Globalizing India:** Corporate Social Responsibility Voluntary Guidelines, 2009 issued by the Ministry of Corporate Affairs, Government of India, Legal Aspects of Corporate Social Responsibility—Companies Act, 2013.	08

References:

1. Business Ethics: Texts and Cases from the Indian Perspective (2013) by Ananda Das Gupta; Publisher:Springer.
2. Corporate Social Responsibility: Readings and Cases in a Global Context (2007) by Andrew Crane, Dirk Matten, Laura Spence; Publisher:Routledge.
3. Business Ethics: Concepts and Cases, 7th Edition (2011) by Manuel G. Velasquez; Publisher: Pearson, NewDelhi.
4. Corporate Social Responsibility in India (2015) by BidyutChakrabarty, Routledge, NewDelhi.

Assessment:

Internal:

Assessment consists of two tests out of which; one should be a compulsory class test and the other is either a class test or assignment on live problems or course project.

End Semester Theory Examination:

Some guidelines for setting up the question paper. Minimum 80% syllabus should be covered in question papers of end semester examination. **In question, paper weightage of each module will be proportional to the number of respective lecture hours as mentioned in the syllabus.**

1. Question paper will comprise of total six question
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module3)
4. Only Four questions need to be solved.

Course Code	Course Name	Theory	Practical	Tutorial	Theory	Oral	Tutorial	Total
ILO8016	Research Methodology	03	--	--	03	--	--	03

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		Test1	Test 2	Avg. of 2 Tests					
ILO8016	Research Methodology	20	20	20	80	--	--	--	100

Course Objectives:

Sr. No.	Course Objectives:
The course aims:	
1	To understand Research and Research Process
2	To acquaint students with identifying problems for research and develop research strategies
3	To familiarize students with the techniques of data collection, analysis of data and interpretation

Course Outcomes:

Sr. No.	Course Outcomes	Cognitive levels of attainment as per Bloom's Taxonomy
On successful completion, of course, learner/student will be able to:		
1	Prepare a preliminary research design for projects in their subject matter areas	L3
2	Accurately collect, analyze and report data	L4
3	Present complex data or situations clearly	L3
4	Review and analyze research findings	L1, L4

Module	Detailed Contents	Hrs
01	**Introduction and Basic Research Concepts** Research – Definition; Concept of Construct, Postulate, Proposition, Thesis, Hypothesis, Law, Principle. Research methods vs Methodology Need of Research in Business and Social Sciences, Objectives of Research **Issues** and Problems in Research Characteristics of Research: Systematic, Valid, Verifiable, Empirical and Critical	**09**
02	**Types of Research** Basic Research Applied Research Descriptive Research Analytical Research Empirical Research **2.6** Qualitative and Quantitative Approaches	**07**
03	**Research Design and Sample Design** Research Design – Meaning, Types and Significance Sample Design – Meaning and Significance Essentials of a good sampling Stages in Sample Design Sampling methods/techniques Sampling Errors	**07**
04	**Research Methodology** **4.1** Meaning of Research Methodology **4.2**. Stages in Scientific Research Process: **a.** Identification and Selection of Research Problem **b.** Formulation of Research Problem **c.** Review of Literature **d.** Formulation of Hypothesis **e.** Formulation of research Design **f.** Sample Design **g.** Data Collection **h.** Data Analysis **i.** Hypothesis testing and Interpretation of Data **j.** Preparation of Research Report	**08**
05	**Formulating Research Problem** **5.1** Considerations: Relevance, Interest, Data Availability, Choice of data, Analysis of data, Generalization and Interpretation of analysis	**04**
06	**Outcome of Research** Preparation of the report on conclusion reached. Validity Testing & Ethical Issues Suggestions and Recommendation	**04**

References:

1. Dawson, Catherine, 2002, Practical Research Methods, New Delhi, UBS Publishers Distributors.
2. Kothari, C.R.,1985, Research Methodology-Methods and Techniques, New Delhi, Wiley EasternLimited.
3. Kumar, Ranjit, 2005, Research Methodology-A Step-by-Step Guide for Beginners, (2nded), Singapore, Pearson Education

Assessment:

Internal:

Assessment consists of two tests out of which; one should be a compulsory class test and the other is either a class test or assignment on live problems or course project.

End Semester Theory Examination:

Some guidelines for setting up the question paper. Minimum 80% syllabus should be covered in question papers of end semester examination. **In question, paper weightage of each module will be proportional to the number of respective lecture hours as mentioned in the syllabus.**

1. Question paper will comprise of total six question
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module3)
4. Only Four questions need to be solved.

Course Code	Course Name	Theory	Practical	Tutorial	Theory	Oral	Tutorial	Total
ILO8017	IPR and Patenting	03	--	--	03	--	--	03

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test 2	Avg. of 2 Tests					
ILO8017	IPR and Patenting	20	20	20	80	--	--	--	100

Course Objectives:

Sr. No.	Course Objectives:
The course aims:	
1	To understand intellectual property rights protection system
2	To promote the knowledge of Intellectual Property Laws of India as well as international treaty procedures
3	To get acquaintance with Patent search and patent filing procedure and applications

Course Outcomes:

Sr. No.	Course Outcomes	Cognitive levels of attainment as per Bloom's Taxonomy
On successful completion, of course, learner/student will be able to:		
1	Understand Intellectual Property assets	L1
2	Support individuals and organizations in capacity building	L5
3	Work for development, promotion, protection, compliance, and enforcement of Intellectual Property and Patenting	L6

Module	Detailed Contents	Hr
01	**Introduction to Intellectual Property Rights (IPR)**: Meaning of IPR, Different category of IPR instruments - Patents, Trademarks, Copyrights, Industrial Designs, Plant variety protection, Geographical indications, Transfer of technology. **Importance of IPR in Modern Global Economic Environment:** Theories of IPR, Philosophical aspects of IPR laws, Need for IPR, IPR as an instrument of development	05
02	**Enforcement of Intellectual Property Rights:** Introduction, Magnitude of problem, Factors that create and sustain counterfeiting/piracy, international agreements, international organizations (e.g. WIPO, WTO) active in IPR enforcement **Indian Scenario of IPR:** Introduction, History of IPR in India, Overview of IP laws in India, Indian IPR, Administrative Machinery, Major international treaties signed by India, Procedure for submitting patent and Enforcement of IPR at national level etc.	07
03	**Emerging Issues in IPR:** Challenges for IP in digital economy, e-commerce, human genome, biodiversity and traditional knowledge etc.	05
04	**Basics of Patents:** Definition of Patents, Conditions of patentability, Patentable and non-patentable inventions, Types of patent applications (e.g. Patent of addition etc), Process Patent and Product Patent, Precautions while patenting, Patent specification Patent claims, Disclosures and non-disclosures, Patent rights and infringement, Method of getting a patent	07
05	**Patent Rules:** Indian patent act, European scenario, US scenario, Australia scenario, Japan scenario, Chinese scenario, Multilateral treaties where India is a member (TRIPS agreement, Paris convention etc.)	08
06	**Procedure for Filing a Patent (National and International):** Legislation and Salient Features, Patent Search, Drafting and Filing Patent Applications, Processing of patent, Patent Litigation, Patent Publication etc, Time frame and cost, Patent Licensing, Patent Infringement **Patent databases:** Important websites, Searching international databases	07

References:

1. Rajkumar S. Adukia, 2007, A Handbook on Laws Relating to Intellectual Property Rights in India, The Institute of Chartered Accountants ofIndia
2. Keayla B K, Patent system and related issues at a glance, Published by National Working Group on PatentLaws
3. T Sengupta, 2011, Intellectual Property Law in India, Kluwer LawInternational
4. Tzen Wong and Graham Dutfield, 2010, Intellectual Property and Human Development: Current Trends and Future Scenario, Cambridge UniversityPress
5. Cornish, William Rodolph & Llewelyn, David. 2010, Intellectual Property: Patents, Copyrights, Trade Marks and Allied Right, 7th Edition, Sweet &Maxwell
6. LousHarns, 2012, The enforcement of Intellactual Property Rights: A Case Book, 3rd Edition, WIPO
7. Prabhuddha Ganguli, 2012, Intellectual Property Rights, 1st Edition,TMH
8. R Radha Krishnan & S Balasubramanian, 2012, Intellectual Property Rights, 1st Edition, Excel Books
9. M Ashok Kumar and mohdIqbal Ali, 2-11, Intellectual Property Rights, 2nd Edition, Serial Publications
10. Kompal Bansal and Praishit Bansal, 2012, Fundamentals of IPR for Engineers, 1st Edition, BS Publications
11. Entrepreneurship Development and IPR Unit, BITS Pilani, 2007, A Manual on Intellectual PropertyRights,
12. Mathew Y Maa, 2009, Fundamentals of Patenting and Licensing for Scientists and Engineers, World Scientific PublishingCompany
13. N S Rathore, S M Mathur, Priti Mathur, Anshul Rathi, IPR: Drafting,Interpretation of Patent Specifications and Claims**,** New India PublishingAgency
14. Vivien Irish, 2005, Intellectual Property Rights forEngineers,IET
15. Howard B Rockman, 2004, Intellectual Property Law for Engineers and scientists, Wiley-IEEE Press

Assessment:

Internal:
Assessment consists of two tests out of which; one should be a compulsory class test and the other is either a class test or assignment on live problems or course project.

End Semester Theory Examination:
Some guidelines for setting up the question paper. Minimum 80% syllabus should be covered in question papers of end semester examination. **In question, paper weightage of each module will be proportional to the number of respective lecture hours as mentioned in the syllabus.**

1. Question paper will comprise of total six question
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module3)
4. Only Four questions need to be solved.

Course Code	Course Name	Theory	Practical	Tutorial	Theory	Oral	Tutorial	Total
ILO8018	Digital Business Management	03	--	--	03	--	--	03

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		Test1	Test 2	Avg. of 2 Tests					
ILO8018	Digital Business Management	20	20	20	80	--	--	--	100

Course Objectives:

Sr. No.	Course Objectives:
The course aims:	
1	To familiarize with digital business concept
2	To acquaint with E-commerce
3	To give insights into E-business and its strategies

Course Outcomes:

Sr. No.	Course Outcomes	Cognitive levels of attainment as per Bloom's Taxonomy
On successful completion, of course, learner/student will be able to:		
1	Identify drivers of digital business	L1, L4
2	Illustrate various approaches and techniques for E-business and management	L3, L4
3	Prepare E-business plan	L3

Module	Detailed content	Hours
1	**Introduction to Digital Business-** Introduction, Background and current status, E-market places, structures, mechanisms, economics and impacts Difference between physical economy and digital economy, **Drivers of digital business**- Big Data & Analytics, Mobile, Cloud Computing, Social media, BYOD, and Internet of Things(digitally intelligent machines/services) Opportunities and Challenges in Digital Business,	09
2	**Overview of E-Commerce** **E-Commerce-** Meaning, Retailing in e-commerce-products and services, consumer behavior, market research and advertisement. B2B-E-commerce-selling and buying in private e-markets, public B2B exchanges and support services, e-supply chains, Collaborative Commerce, Intra business EC and Corporate portals. Other E-C models and applications, innovative EC System-From E- government and learning to C2C, mobile commerce and pervasive computing. EC Strategy and Implementation-EC strategy and global EC, Economics and Justification of EC, Using Affiliate marketing to promote your e- commerce business, Launching a successful online business and EC project, Legal, Ethics and Societal impacts of EC	06
3	**Digital Business Support services**: ERP as e –business backbone, knowledge Tope Apps, Information and referral system **Application Development:** Building Digital business Applications and Infrastructure	06
4	**Managing E-Business**-Managing Knowledge, Management skills for e-business, Managing Risks in e –business Security Threats to e-business -Security Overview, Electronic Commerce Threats, Encryption, Cryptography, Public Key and Private Key Cryptography, Digital Signatures, Digital Certificates, Security Protocols over Public Networks: HTTP, SSL, Firewall as Security Control, Public Key Infrastructure (PKI) for Security, Prominent Cryptographic Applications.	06
5	**E-Business Strategy**-E-business Strategic formulation- Analysis of Company's Internal and external environment, Selection of strategy, E-business strategy into Action, challenges and E-Transition (Process of Digital Transformation)	04
6	**Materializing e-business: From Idea to Realization**-Business plan preparation **Case Studies and presentations**	08

References:

1. A textbook on E-commerce**,** Er Arunrajan Mishra, Dr W K Sarwade,Neha Publishers & Distributors, 2011
2. E-commerce from vision to fulfilment, Elias M. Awad, PHI-Restricted, 2002
3. Digital Business and E-Commerce Management, 6th Ed, Dave Chaffey, Pearson, August 2014
4. Introduction to E-business-Management and Strategy, Colin Combe, ELSVIER, 2006
5. Digital Business Concepts and Strategy, Eloise Coupey, 2nd Edition, Pearson
6. Trend and Challenges in Digital Business Innovation, VinocenzoMorabito, Springer
7. Digital Business Discourse Erika Darics, April 2015, Palgrave Macmillan
8. E-Governance-Challenges and Opportunities in : Proceedings in 2nd International Conference theory and practice of Electronic Governance
9. Perspectives the Digital Enterprise –A framework for Transformation, TCS consulting journal Vol.5
10. Measuring Digital Economy-A new perspective -DOI:10.1787/9789264221796-enOECD Publishing

Assessment:

Internal:
Assessment consists of two tests out of which; one should be compulsory class test and the other is either a class test or at least 6 assignment on complete syllabus or course project.

End Semester Theory Examination:
Some guidelines for setting up the question paper. Minimum 80% syllabus should be covered in question papers of end semester examination. **In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.**

1. Question paper will comprise of total six question
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four question need to be solved.

Course Code	Course Name	Theory	Practical	Tutorial	Theory	Oral	Tutorial	Total
ILO8019	Environmental Management	03	--	--	03	--	--	03

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		Test1	Test 2	Avg. of 2 Tests					
ILO8019	Environmental Management	20	20	20	80	--	--	--	100

Course Objectives:

Sr. No.	Course Objectives:
The course aims:	
1	Understand and identify environmental issues relevant to India and global concerns
2	Learn concepts of ecology
3	Familiarize environment related legislations

Course Outcomes:

Sr. No.	Course Outcomes	Cognitive levels of attainment as per Bloom's Taxonomy
On successful completion, of course, learner/student will be able to:		
1	Understand the concept of environmental management	L1
2	Understand ecosystem and interdependence, food chain etc.	L1
3	Understand and interpret environment related legislations	L1, L5

Module	Detailed Contents	Hrs
01	Introduction and Definition of Environment: Significance of Environment Management for contemporary managers, Career opportunities. Environmental issues relevant to India, Sustainable Development, The Energy scenario.	10
02	Global Environmental concerns: Global Warming, Acid Rain, Ozone Depletion, Hazardous Wastes, Endangered life-species, Loss of Biodiversity, Industrial/Man-made disasters, Atomic/Biomedical hazards, etc.	06
03	Concepts of Ecology: Ecosystems and interdependence between living organisms, habitats, limiting factors, carrying capacity, food chain, etc.	05
04	Scope of Environment Management, Role & functions of Government as a planning and regulating agency. Environment Quality Management and Corporate Environmental Responsibility	10
05	Total Quality Environmental Management, ISO-14000, EMS certification.	05
06	General overview of major legislations like Environment Protection Act, Air (P & CP) Act, Water (P & CP) Act, Wildlife Protection Act, Forest Act, Factories Act, etc.	03

REFERENCES:

1. Environmental Management: Principles and Practice, C J Barrow, Routledge Publishers London, 1999
2. A Handbook of Environmental Management Edited by Jon C. Lovett and David G. Ockwell, Edward Elgar Publishing
3. Environmental Management, **T V Ramachandra and Vijay Kulkarni, TERI Press**
4. Indian Standard Environmental Management Systems — Requirements with Guidance For Use, Bureau Of Indian Standards, February 2005
5. Environmental Management: An Indian Perspective, S N Chary and Vinod Vyasulu, Maclillan India, 2000
6. Introduction to Environmental Management, Mary K Theodore and Louise Theodore, CRC Press
7. Environment and Ecology, Majid Hussain, 3rd Ed. Access Publishing.2015

Assessment:

Internal:
Assessment consists of two tests out of which; one should be compulsory class test and the other is either a class test or assignment on live problems or course project.

End Semester Theory Examination:
Some guidelines for setting up the question paper. Minimum 80% syllabus should be covered in question papers of end semester examination. **In question paper weightage of each module will be proportional to number of respective lecture hours as mentioned in the syllabus.**

1. Question paper will comprise of total six question.
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four question need to be solved.

Subject Code	Subject Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Oral	Tutorial	Total
IoTCSBC L801	Capstone Lab	--	2	--	--	2	--	2

Subject Code	Subject Name	Examination Scheme						
		Theory Marks				Term Work	Oral	Total
		Internal assessment			End Sem. Exam			
		Test1	Test 2	Avg. of 2 Tests				
IoTCSBC L801	Capstone Lab	--	--	--	--	25	25	50

Course Objectives:

1. Investigate and evaluate prominent literature to come with application-oriented project topics in connection with the curriculum.
2. Study and develop an outline for thinking and practice that illuminates and brings insight to the design and implementation aspects with respect to the project topic.
3. Design and create practical resources and solution aspect for the design and implementation.
4. Present an organised exploratory framework, while understanding the documentary deliverables within established academic practices and/ or ideas.
5. Offer inquiry-based argumentation / presentation along with project implementation.

Course Outcomes:

1. Perform extensive Review of Literature from diverse knowledge banks or through interactions with Industry experts.
2. Developing or Creating ideas capable of addressing industrial or social solutions to identified problem domains.
3. Acquire knowledge of tools & technologies and application of their expertise in creating project implementation and deliverables.
4. Preparing extensive “Project report” with respect t the different activities carried by the students in the completion of the project and the knowledge acquired thereby.
5. Presentation of their project work.

Introduction

The goal of this course “Capstone Laboratory” is to encourage students to engage in research and development of projects with a focus on a specific area of specialization within the Internet of Things, cybersecurity, blockchain, or their combinations. These Capstone projects rely on areas of interest discovered while studying this entire curriculum and shall be research and practice-focused. The students should have industry-based interactions, study and capture project needs from the industry requirements, design and develop solutions or product as per the industry standards. Along with project development, they should also understand the various deliverables and reporting procedures followed during the development methodology by the industry and prepare a proper project report highlighting all details of the project development as per industry standards. The course focuses on applying knowledge and analyzing variables that attempt to connect theory and practice and are intended to have an effect on students' professional lives. The course's goal is to make it easier for you to construct your capstone projects.

As part of this undergraduate program in IoT and cybersecurity (including blockchain), students are encouraged to apply and use the knowledge they have received from teaching and learning.
The students are required

Course details

The students should interact with the industry environment to review and study the currents developments with respect to IoT, cybersecurity and blockchain subjects. Draw ideas for their project implementation and demonstrate the development of the project and report writing skills in accordance with industry perspective.
The mentors / assigned guides should teach the course with the aim to develop the required skill set in students to acquire competency to understand industry practices and be able to map their educational capabilities towards development of industry-oriented projects. As part of planning and implementation, students need to identify different deliverables as part of project and also establish reporting process for the progress of the project. Students are encouraged to review research papers and literature to understand the industry developments and social needs, that will act as catalyst in thinking of innovative project ideas and their solutions. The students are expected to perform the following during their entire lab sessions either individually / as teams (of max. 4 students).

1. Perform extensive Review of Literature from diverse knowledge banks or through interactions with Industry experts.
2. Developing or Creating ideas capable of addressing industrial or social solutions to identified problem domains.
3. Acquire knowledge of tools & technologies and application of their expertise in creating project implementation and deliverables.
4. Preparing extensive "Project report" with respect t the different activities carried by the students in the completion of the project and the knowledge acquired thereby.
5. Presentation of their project work.

The project guide can suggest the students to create a project notebook and as the steps of project development is getting completed during each lab session, the students/groups should discuss their workings and update the interaction in the project notebook.
At the end of the semester, the students should prepare a" Project Report" containing the details of their review of literature, design, proposed solution, implementation, testing and conclusion with respect to their work done.

Suggested contents of the Project Report:

1. Title Page
2. Certificate
3. Acknowledgements
4. Abstract
5. List tables / figures
6. Content Page
7. Chapter 1 – Introduction
8. Chapter 2 – Literature Survey
9. Chapter 3 – Project Scope
10. Chapter 4 – Methodology
11. Chapter 5 – Project Design & Process workflow
12. Chapter 6 – Results and Applications
13. Chapter 7 – Conclusions and Future scope
14. Appendix (if any)
15. References and Bibliography

Assessment of the Project Work

The assessment of the project Work consists of two parts

1. Progressive / Internal Assessment and
2. End Semester Examination

Progressive / Internal Assessment:

Each project guide is required to carry out this assessment. In this assessment, the guide will create a group of 2-3 evaluators and conduct at least 2 presentations / seminars. During each presentation / seminar, the students / groups should be highlighting and discussing their progress work. The evaluation team should guide the students to solve their problems and evaluate their work based on their contribution done. The internal assessment in the form of term work comprises of 25 marks as follows:

Term Work Marks: 25 Marks (Total marks) = 15 Marks (Experiment*) + 5 Marks (Assignments**) + 5 Marks (Attendance)

Note: * - Experiment means lab interactions, progress work, outcomes

** - Assignment means presentations conducted during the seminars

End-semester Examination:

The End-semester examination will be based on oral exam pattern where the student / group will present their entire project work as presentation and also implementation of the project work. The evaluation shall consider the viva questions based on project and the report work. The evaluation of End semester examination should be out of 25 marks.

		Teaching Scheme (Contact Hours)			Credits Assigned			
Subject Code	Subject Name	Theory	Practical	Tutorial	Theory	Oral	Tutorial	Total
IoTCSBCL 802	**IoT Automation Lab**	-	02	--	--	-	--	2

Subject Code	Subject Name	Examination Scheme						
		Theory Marks				Term Work	Practical/Oral	Total
		Internal assessment			End Sem. Exam			
		Test1	Test 2	Avg. of 2 Tests				
IoTCSBCL 802	IoT Automation Lab	-	-	-	-	25	25	50

Lab Objectives: The course will help the students to:

1. Understand the significance of the Internet of Things for real time applications.
2. Explore different protocols for communication used in IoT systems to other third-party Clouds.
3. Illustrate PLC programming with real time examples for industrial automation.
4. Study of database collection using controller boards in IoT systems.
5. Explore the relationship between IoT, cloud computing, and DevOps.
6. Examine real time applications using IoT systems in different environments.

Lab Outcomes:

Sr. No.	Lab Outcomes	Cognitive levels of attainment as per Bloom's Taxonomy
On successful completion, of course, learner/student will be able to:		
1	Demonstrate the use of various IoT simulators in real time applications.	L3
2	Implement different protocols for Integrating IoT services to other third-party Clouds.	L3
3	Develop PLC programming with real time examples on industrial automation.	L6
4	Demonstrate the working of databases on controller boards for data analysis in IoT systems.	L3
5	Execute DevOps methodologies for continuous integration and continuous deployment of IoT applications.	L3
6	Develop real time applications using IoT systems in different environments.	L6

Prerequisite:

Basics of IoT Architecture and Protocols, Introduction to Embedded and Control systems.

Hardware Requirements	Software Requirements	Other Requirements
PC With Following Configuration 1. Intel PIV Processor 2. 4 GB RAM 3. 500 GB Hard disk 4. Network interface card 5. Sensors 6. IoT Kit (Raspberry Pi/NodeMCU/ESP32) 7. Actuators	1. Windows or Linux Desktop OS 2.Python 3. IoT Simulator/Emulator (open source) 4. Delta ISPSoft 5. DOPSoft 5. Devops	1. Internet Connection for installing additional packages if required

Suggested List of Experiments.

Sr. No	List of Experiments.	LO
1	To study and demonstrate use of IoT simulators (like Bevywise, COOJA, or Cupcarbon) on any real time application.	LO1
2	Real time data acquisition and transmission using NodeRed simulator.	LO1
3	To study and simulate CoAP protocol in Contiki OS.	LO1
3	To study and implement a program on ESP32/NodeMCU to push and retrieve the data from any cloud like Thingspeak, Thingsboard, AWS, Azure etc.	LO2
4	Connecting Raspberry Pi to AWS/Microsoft Iot Core : Setup and code Using Python and AWS IOT.	LO2
6	To study PLC basics, programming elements and their operation for Ladder Diagram in IIoT.	LO3
7	To develop PLC programming examples on industrial automation using Delta ISPsoft.	LO3
8	To design HMI for PLC programming examples using Delta ISPsoft and DOPSoft.	LO3
9	To install MySQL database on Raspberry Pi and perform basic SQL queries for analysis of data collected.	LO4
10	To study and implement Continuous Integration using Jenkins on IoT data and also perform interfacing of Raspberry Pi into Jenkins.	LO5
11	To study and implement Continuous Deployment (Infrastructure as a code) for IoT using Ansible.	LO5

12	Select any one case study (in a group of 3-4) which will be a solution to a real problem and can be eased with the use of automation and IOT. The sample case studies can be as follows: ● Smart agriculture System ● Smart Home Automation ● Smart Cities ● Smart Healthcare system, ● Smart Traffic Management System, etc.	LO6

Text & Reference Books:

- "Hands-On Industrial Internet of Things" by Giacomo Veneri and Antonio Capasso (Packt)
- "IoT Fundamentals – Networking Technologies, Protocols, and Use Cases for the Internet of Things", David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Rob Barton, Jerome Henry,1st Edition, Published by Pearson Education, Inc, publishing as Cisco Press, 2017.
- Honbo Zhou," The internet of things in the cloud", CRC press, Taylor and Francis group.
- "PLC Programming for Industrial Automation" Kevin Collins, Exposure Publishing, 2006.
- Joakim Verona," Practical DevOps", PACKT publishing, 2016.

Online Resources:

1. **http://www.contiki-os.org/**
2. **https://www.bevywise.com/iot-simulator/**
3. **https://mqtt.org/**
4. **https://shorturl.at/kwCV0**
5. https://docs.aws.amazon.com/iot/latest/developerguide/connecting-to-existing-device.htm
6. https://shorturl.at/kzDJ1
7. https://shorturl.at/jor49
8. https://www.nsnam.com/2016/01/iot-coap-implementation-in-contiki-os.html
9. https://www.udemy.com/course/ispsoft-for-delta-plc-programming/
10. http://surl.li/hwxci
11. http://surl.li/hwxek
12. https://nodered.org/docs/tutorials/

Assessment:

Term Work: Term Work shall consist of at least 10 to 12 practicals based on the above list. Also, Term work Journal must include at least 2 assignments.

Term Work Marks: 25 Marks (Total marks) = 15 Marks (Experiment) + 5 Marks (Assignments) + 5 Marks (Attendance)

Oral Exam: An Oral exam will be held based on the above syllabus / suggested list of Assignment.

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Oral	Tutorial	Total
CSP801	Major Project II	--	12#	--	--	6	--	6

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Oral	Total
		Internal assessment			End Sem. Exam			
		Test1	Test 2	Avg. of 2 Tests				
CSP801	Major Project II	--	--	--	--	100	50	150

Course Objectives:
The Project work facilitates the students to develop and prove Technical, Professional and Ethical skills and knowledge gained during graduation program by applying them from problem identification to successful completion of the project by implementing the solution.

Course Outcomes:

Sr. No.	Course Outcomes	Cognitive levels of attainment as per Bloom's Taxonomy
On successful completion, of course, learner/student will be able to:		
1	Implement solutions for the selected problem by applying technical and professional skills.	L3
2	Analyze impact of solutions in societal and environmental context for sustainable development.	L4
3	Combine best practices along with effective use of modern tools.	L6
4	Develop proficiency in oral and written communication with effective leadership and teamwork.	L6
5	Cultivate professional and ethical behavior.	L6
6	Capture expertise that helps in building lifelong learning experience.	L3

Guidelines:

1. Internal guide has to keep track of the progress of the project and also has to maintain attendance report. This progress report can be used for awarding term work marks.

Project Report Format:

At the end of semester, each group needs to prepare a project report as per the guidelines issued by the University of Mumbai. Report should be submitted in hardcopy. Also, each group should submit softcopy of the report along with project documentation, implementation code, required utilities, software and user Manuals.

A project report should preferably contain at least following details:

- Abstract
- Introduction
- Literature Survey/ Existing system
- Limitation Existing system or research gap
- Problem Statement and Objective
- Proposed System
- Analysis/Framework/ Algorithm
- Design details
- Methodology (your approach to solve the problem) Proposed System
- Experimental Set up
- Details of Database or details about input to systems or selected data
- Performance Evaluation Parameters (for Validation)
- Software and Hardware Set up
- Results and Discussion
- Conclusion and Future Work
- References
- Appendix – List of Publications or certificates

Desirable:

Students should be encouraged -

- to participate in various project competitions.
- to write minimum one technical paper & publish in good journal.
- to participate in national / international conferences.

Term Work:

Distribution of marks for term work shall be done based on following:

- Weekly Log Report
- Completeness of the project and Project Work Contribution
- Project Report (Black Book) (both side print)
- Term End Presentation (Internal)

The final certification and acceptance of TW ensures satisfactory performance in the above aspects.

Oral & Practical:

Oral &Practical examination (Final Project Evaluation) of Project 2 should be conducted by Internal and External examiners approved by University of Mumbai at the end of the semester.

Suggested quality evaluation parameters are as following:

- Relevance to the specialization / industrial trends
- Modern tools used.
- Innovation
- Quality of work and completeness of the project
- Validation of results
- Impact and business value
- Quality of written and oral presentation

Individual as well as teamwork.