NAGARJUNA
COLLEGE OF ENGINEERING & TECHNOLOGY

Nagarjuna College of Engineering & Technology, Bengaluru
An Autonomous Institute, Affiliated to VTU Belagavi

Department of Information Science and Engineering

Curriculum Scheme & Structure

7th Semester Syllabus

As per the NEP 2020 Guidelines

w.e.f.

Academic Year 2024-2025

NAGARJUNA COLLEGE OF ENGINEERING & TECHNOLOGY, BENGALURU

B.E. in Information Science & Engineering

Scheme of Teaching and Examination 2021-22

Outcome-Based Education (OBE) and Choice Based Credit System (CBCS)

(Effective from the academic year 2024-25)

VII SEMESTER

Sl.	Course and Course Code		Course Title	Teaching Department	Teaching Hours / Week				Duration in Hours	Examination			Credi
					Theory / Lecture	Tutorial	Practical /	Self-study		CIE Marks	SEE Marks	Total Marks	
					L	T	P	S					
1	PCC	21IST71	Cryptography & Network Security	CSEB	3	-	-	-	3	50	50	100	3
2	PCC	21ISI72	Cloud Computing	CSEB	2	-	-	-	2	50	50	100	2
3	PEC	21IST73x	**Professional Elective Course – II**	CSEB	3	-	-	-	3	50	50	100	3
4	PEC	21IST74X	**Professional Elective Course – III**	CSEB	3	-	-	-	3	50	50	100	3
5	OEC	21IST75X	**Open Elective – II**	Concern Dept.	3	-	-	-	3	50	50	100	3
6	Project	21ISP76	Project Work	CSEB	Two contact hours /week for interaction between the faculty and students.				2	100	100	200	10
				TOTAL	14	-	-	-	16	300	400	800	24

Professional Elective Course - II

21IST731	Object Oriented Modelling & Design	**21IST732**	Blockchain Technology	**21IST733**	Digital Image Processing	**21IST734**	User Interface Design

Professional Elective Course - III

21IST741	Natural Language Processing	**21IST742**	Precision Agriculture	**21IST743**	Storage Area Network	**21IST744**	DevOps

Open Elective - II

21IST751	R Programming	**21IST752**	Introduction to Machine Learning	**21IST753**	Digital Marketing	**21IST754**	Data Science & Visualization

CRYPTOGRAPHY AND NETWORK SECURITY

Course Code	L : T : P :S	Credits	Exam Marks	Exam Duration	Course Type
21IST71	3: 0: 0: 0	3	CIE:50 SEE:50	3 Hours	PCC

Course Objectives:

As a student will be able to learn:

- Acquire the knowledge of basic concepts of cryptography and network security and classify attacks on a network.
- Analyse the different process for hiding the information with conventionalcryptographic algorithms.
- Comprehend various block cipher cryptosystems.
- Learn the concepts of public cryptosystems and key management Systems.
- Apply authentication techniques to provide secure communication.

Prerequisites:

Students should have the knowledge of Computer Networks, Mathematics and Algorithm Concepts.

Syllabus

Module – I

Introduction: Service mechanisms and attacks, The OSI security architecture, A Model for Network Security. **Symmetric Ciphers:** Symmetric cipher model, substitution techniques.

08 Hours

Module – II

Symmetric Ciphers: Transposition techniques, Steganography. **Block Ciphers and DES**: Simplified DES. Block cipher principles, DES, Strength of DES, Block cipher design principles.

08 Hours

Module – III

Advanced Encryption Standard - AES Transformation Function: Cipher-Substitute Bytes Transformation, Shift Row Transformation, Mix Column Transformation, Add Round Key Transformation, AES key expansion. Block cipher modes of operation.

08 Hours

Module – IV

Asymmetric Ciphers - Public key cryptography and RSA: Principles of public key cryptosystems, RSA algorithm. **Other public key cryptosystems and key management:** Key management, Diffie-Hellman key exchange. Elliptic Curve Cryptography.

08 Hours

Module – V

Network Security Applications - Authentication Applications: X.509 Authentication Service, Kerberos. **Electronic Mail Security:** PGP.

08 Hours

Course Outcomes:

At the end of this course, students will be able to

CO1: Apply symmetric and asymmetric cryptographic algorithm to encrypt message for secure communication.

CO2: Design efficient algorithms for generation and management of encryption and decryption keys

CO3: Develop mechanisms for confidentiality, authentication protocols for network security

CO4: Analyse efficiency of various security models.

CO5: Demonstrate the working of DES, AES, RSA and Cryptographic techniques & E-mail security

Textbooks:

1) Cryptography and Network Security: William Stallings, Pearson Education, 2003
2) Behrouz A Forouzan, Debdeep Mukhopadhyay: Cryptography and Network Security, 2nd Edition, Special Indian edition, Tata McGraw-Hill, 2011.

Reference Books:

1) Cryptography and Network Security, Atul Kahate, TMH, 2003

Reference Online Resources:

1) https://nptel.ac.in/course.php

CO-PO MAPPING:

POS / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	2	1	1	-	-	-	-	-	-	1
CO2	3	3	2	2	2	-	-	-	-	-	-	1
CO3	2	2	3	3	2	-	-	-	-	-	-	1
CO4	2	3	3	2	3	-	-	-	-	-	-	1
CO5	2	2	3	3	2	-	-	-	-	-	-	1

Cloud Computing

Course Code	L:T:P	Credits	Exam marks	Exam Duration	Course Type
21ISI72	2:0:0	2	CIE:50 SEE:50	3 Hours	Core

Course Learning Objectives:

- Discuss the concepts, characteristics, delivery models and benefits of cloud computing.
- Explore the key technical, organisational and compliance challenges of cloud computing.
- Grasp the concepts of virtualization efficiently.
- Explore the security issues that arise from cloud computing architectures intended fordelivering Cloud based enterprise IT services.

Syllabus

Module – I

Introduction:

Cloud computing at a glance: The vision of cloud computing, Defining a cloud, A closerlook, The cloud computing reference model, Characteristics and benefits, Challenges ahead.

Historical developments: Distributed systems, Virtualization, Web 2.0, Service-orientedcomputing, Utility-oriented computing.

Building cloud computing environments: Application development, Infrastructure andsystem development, Computing platforms and technologies.

Virtualization: Introduction, Characteristics of virtualized environments, Increased security,Managed execution, Portability.

Taxonomy of virtualization techniques: Execution virtualization, Other types ofvirtualization, Virtualization and cloud computing.

Pros and cons of virtualization: Advantages of virtualization, The other side of the coin:disadvantages.

08 Hours

Module – II

Cloud Computing Architecture:

Introduction, The cloud reference model: Architecture,Infrastructure- and hardware-as-a-service Platform as a service, Software as a service.

Types of clouds: Public clouds, Private clouds, Hybrid clouds, Community clouds, Economicsof the cloud.

Open challenges: Cloud definition, Cloud interoperability and standards, Scalability and faulttolerance, Security, trust, and privacy, Organizational aspects.

Aneka: Framework overview, Anatomy of the Aneka container: From the ground up: theplatform abstraction layer, Fabric services, Foundation services, Application services

Building Aneka clouds: Infrastructure organization, Logical organization Private clouddeployment mode, Public cloud deployment mode, Hybrid cloud deployment mode.

08 Hours

Module – III

Concurrent Computing:

Introducing parallelism for single-machine computation, Programming applications withthreads,What is a thread?,Thread APIs, Techniques for parallel computation with threads.

Data-Intensive Computing: What is data-intensive computing?, Characterizing data-intensivecomputations, Challenges ahead, Historical perspective.

Technologies for data-intensive computing: Storage systems, Programming platforms.

08 Hours

Module – IV

Cloud Platforms in Industry:

Amazon web services: Compute services, Storage services, Communication services,Additional services.

Google AppEngine: Architecture and core concepts, Application life cycle, Cost model,Observations.

Microsoft Azure: Azure core concepts,SQL Azure, Windows Azure platform appliance,Observation.

08Hours

Module – V

Cloud Applications:

Scientific applications: Healthcare: ECG analysis in the cloud, Biology: protein structure prediction,Biology: gene expression data analysis for cancer diagnosis, Geoscience: satellite image processing.

Business and Consumer Applications: CRM and ERP, Productivity, Social networking, Media applications, Multiplayer online gaming.

08 Hours

Assessment Details (both CIE and SEE):

Component		Weightage (%)	
CIE's	CIE 1 5th week	20	60
	CIE 2 10th week	20	
	CIE 3 15th week	20	
AAT's	AAT-1 10th week	10	
	AAT-2	10	
	AAT-3	20	
Continuous Internal Evaluation Total Marks: 100. Reduced to 50 Marks			
Semester End Examination (SEE) Total Marks: 100. Reduced to 50 Marks			

Suggested Learning Resources:

Text Books:

1. *Mastering Cloud Computing, by:* Rajkumar Buyya, Christian Vecchiola and S.Thamarai Selvi, Copyright @ 2013, Mc Graw Hill Education Pvt Ltd, 7th reprint, 2022.

Reference Books:

1. Thomas Erl: "Cloud Computing", Pearson Education, 1st Edition, 2014, ISBN-13: 978-9332535923.
2. Judith Hurwitz, Marcia Kaufman, Fern Halper: "Cloud Computing for dummies", Wiley,1st Edition, 2009, ISBN: 9780470484708.
3 . Velte, Anthony T., Toby J. Velte, and Robert Elsenpeter. "Cloud Computing: A PracticalApproach."(2009), ISBN: 9780071626941

Web links and Video Lectures (e-Resources):

- https://www.javatpoint.com/cloud-computing-tutorial
- https://www.tutorialspoint.com/cloud_computing/index.htm
- https://www.digimat.in/nptel/courses/video/106105167/L01.html (**Video Lectures**)

E-Resources:

1. http://www.buyya.com/MasteringClouds/ToC-Preface-TMH.pdf

Course outcome (Course Skill Set)

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

CO1	**Understand** cloud computing fundamentals, historical developments, virtualization, and evaluate its advantages and disadvantages in cloud environments.	L2
CO2	**Analyze** different cloud architectures, types of clouds, and address open challenges related to scalability, interoperability, and security.	L2
CO3	**Implement** concurrent computing techniques and explore solutions for data-intensive computing using parallel programming and storage technologies.	L3
CO4	**Evaluate** industry-leading cloud platforms (AWS, Google AppEngine, Microsoft Azure) and their services for computation, storage, and communication.	L2
CO5	**Apply** cloud technologies to scientific, business, and consumer applications,including healthcare, geoscience, CRM, social networking, and gaming.	L2

CO-PO-PSO Mapping:

COs/ POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3
CO 1	3	--	--	--	--	--	--	--	--	--	--	--	3	2	1
CO 2	2	2	--	--	--	--	--	--	--	--	--	--	2	1	2
CO 3	2	2	3	--	--	--	--	--	--	--	--	--	3	--	2
CO 4	2	2	1	--	2	--	--	--	--	--	--	--	3	--	1
CO 5	2	2	2	3	--	2	2	2	--		--	--	--	--	2

Notes:

- **CO1** is strongly aligned with **PO1** and **PSO1**, moderately aligned with **PSO2**, and slightly aligned with **PSO3**.
- **CO2** is moderately aligned with **PO1**, **PO2**, **PSO1**, and **PSO3**, while slightly aligned with **PSO2**.
- **CO3** is strongly aligned with **PO3** and **PSO1**, moderately aligned with **PO1**, **PO2**, and **PSO3**.
- **CO4** has moderate correlations with **PO1**, **PO2**, **PO5**, and **PSO1**, while **PO3** and **PSO3** have a slight correlation.
- **CO5** shows strong correlation with **PO4** and moderate alignment with **PO1**, **PO2**, **PO3**, **PO6**, **PO7**, **PO8**, and **PSO2**.

CO-PO-PSO Mapping Justification:

Here's a justification for the **CO-PO mapping** based on the table you provided. Each justification outlines why certain Course Outcomes (COs) are mapped to specific Program Outcomes (POs) and Program Specific Outcomes (PSOs) at different levels (1 to 3).

CO1:

Mapped POs: PO1 (3), PSO1 (3), PSO2 (2), PSO3 (1)

- **PO1 (3)** – This CO is strongly aligned with the application of **engineering knowledge** (PO1), as it focuses on fundamental principles that students need to learn and apply to solve engineering

problems.

- **PSO1 (3)** – Strongly correlates with the ability to apply engineering principles specific to the domain (Civil, Computer Science, etc.), demonstrating fundamental skills in the field.
- **PSO2 (2)** – Moderately aligned with the ability to analyze and design solutions specific to the program.
- **PSO3 (1)** – Slight alignment due to the involvement of innovation or technology management, as this CO provides basic insight into the process of applying fundamental concepts to real-world problems.

CO2:

Mapped POs: PO1 (2), PO2 (2), PSO1 (2), PSO2 (1), PSO3 (2)

- **PO1 (2)** – This CO moderately correlates with applying **engineering knowledge**, as it may build on foundational concepts but does not focus solely on theory.
- **PO2 (2)** – Aligned with the **problem analysis** process, this CO involves understanding and analyzing complex engineering problems to form basic conclusions.
- **PSO1 (2)** – Moderately aligns with program-specific application of skills.
- **PSO2 (1)** – This CO slightly correlates with more in-depth system design or implementation.
- **PSO3 (2)** – Aligned moderately with managing innovation or technological projects in the program.

CO3:

Mapped POs: PO1 (2), PO2 (2), PO3 (3), PSO1 (3), PSO3 (2)

- **PO1 (2)** – A moderate correlation to **engineering knowledge**, as this CO requires a balance between theory and practical application.
- **PO2 (2)** – Moderately aligned with **problem analysis**, as it involves identifying problems and reaching conclusions, but not to a complex degree.
- **PO3 (3)** – Strongly mapped to **designing solutions**, as this CO requires students to work on complex design projects or system components.
- **PSO1 (3)** – Strong correlation, as it involves in-depth application of program-specific skills.
- **PSO3 (2)** – Moderately aligned with project management or innovative applications in the field.

CO4:

Mapped POs: PO1 (2), PO2 (2), PO3 (1), PO5 (2), PSO1 (3), PSO3 (1)

- **PO1 (2)** – Moderately related to **engineering knowledge**, involving both theory and practice.
- **PO2 (2)** – Moderate correlation with **problem analysis**, requiring students to analyze certain problems and form conclusions.
- **PO3 (1)** – Slight correlation to **design solutions**, as some design thinking is involved, but it is not a primary focus.
- **PO5 (2)** – Moderately aligned with the use of **modern tools**, as students will have to select and apply technologies for their work.
- **PSO1 (3)** – Strong correlation, as it involves a significant application of program-specific knowledge and practices.
- **PSO3 (1)** – Slight correlation with managing and applying innovative techniques.

CO5:

Mapped POs: PO1 (2), PO2 (2), PO3 (2), PO4 (3), PO6 (2), PO7 (2), PO8 (2), PSO2 (2)

- **PO1 (2)** – Moderately aligned with the application of **engineering knowledge**.
- **PO2 (2)** – Moderately aligned with **problem analysis**, requiring students to analyze problems and apply relevant knowledge.
- **PO3 (2)** – Moderate correlation with **designing solutions**, as the CO likely involves practical design tasks.
- **PO4 (3)** – Strong correlation with **conducting investigations** into complex problems, as this CO seems to involve research, experimentation, or data analysis.
- **PO6 (2)** – Moderately related to considering **societal issues**, possibly touching on ethics, environmental, or social aspects of engineering.
- **PO7 (2)** – Moderately aligned with understanding the **impact on environment and sustainability**.
- **PO8 (2)** – Moderate correlation with applying **ethics and professional responsibility** in the course's tasks.
- **PSO2 (2)** – Aligned moderately with the ability to contribute to program-specific outcomes through research or project design.

General Justification for CO-PO Mapping:

1. **Strong Mapping (3)**: When a CO directly addresses a particular PO/PSO through significant course content or activities, the alignment is rated 3. For example, design-centric COs are strongly mapped to PO3 (Design/Development of Solutions), while fundamental theoretical knowledgewould strongly map to PO1 (Engineering Knowledge).
2. **Moderate Mapping (2)**: If a CO partially addresses or moderately contributes to a PO/PSO, it is rated as 2. For instance, courses that involve some degree of problem-solving and investigation but do not fully emphasize it are mapped with 2.
3. **Slight Mapping (1)**: When a CO touches on a PO/PSO only slightly or indirectly, it is rated as 1. This may be seen in courses where certain outcomes are not a primary focus but are present as ancillary tasks or secondary outcomes.
4. **No Mapping (--)**: When a CO does not contribute to a particular PO/PSO, it is not mapped, indicating no correlation.

This mapping helps ensure that the curriculum addresses the desired program outcomes and that studentsare gaining the necessary knowledge, skills, and competencies throughout the course.

General Program Outcomes(PO's) :

Here is the list of **Program Outcomes (POs 1-9)** as per the **National Board of Accreditation (NBA)** for engineering programs:

PO1: Engineering Knowledge

- Apply the knowledge of mathematics, science, engineering fundamentals, and an engineeringspecialization to the solution of complex engineering problems.

PO2: Problem Analysis

of Solutions

- Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for public health and safety, cultural, societal, and environmental considerations.

PO4: Conduct Investigations of Complex Problems

- Use research-based knowledge and research methods including the design of experiments, analysis, and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5: Modern Tool Usage

- Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools, including prediction and modeling, to complex engineering activities, with an understanding of the limitations.

PO6: The Engineer and Society

- Apply reasoning informed by contextual knowledge to assess societal, health, safety, legal, and cultural issues, and the consequent responsibilities relevant to professional engineering practice.

PO7: Environment and Sustainability

- Understand the impact of professional engineering solutions in societal and environmental contexts and demonstrate the knowledge of, and need for sustainable development.

PO8: Ethics

- Apply ethical principles and commit to professional ethics, responsibilities, and norms of the engineering practice.

PO9: Individual and Team Work

- Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

These outcomes are aimed at preparing graduates to tackle real-world engineering challenges with the necessary skills, knowledge, and professional behavior expected in the industry and society.

OBJECT ORIENTED MODELLING AND DESIGN

Course Code	L : T : P	Credits	Exam Marks	Exam Duration	Course Type
21IST731	3:0:0	3	100	3hrs	PEC

Course Description: Regardless of the software development approach, from the classic waterfallto extreme programming (XP), all of the experts agree that quality software development requiresboth analysis and design. The Unified Modeling Language (UML) provides a common, standard notation for recording both analysis models and design artifacts. This course delves into the processes of both object-oriented analysis and object-oriented design using UML as the notation language.

Prerequisite:Software Engineering (Software Design) Basic concepts: encapsulation, abstraction, inheritance, and polymorphism.

Course Objectives:

- To learn the importance of modeling in the software development life cycle.
- To apply the UML notation and symbols.
- To know the design patterns.
- To learn the object-oriented approach systems design and software solutions.
- To know the object oriented software testing.

Module – 1

Basic concepts

Basic concepts: objects, classes, abstract classes, data types, ADT, encapsulation and information hiding, inheritance, association, aggregation, composition, polymorphism, dynamic binding, object-oriented principles.

Module – 2

Modelling Using UML

UML Diagrams: Use case diagrams, class diagrams, various relationships among classes: generalization, association, aggregation, composition, inheritance, dependency etc., object diagram, UML packages, activity diagram, state machine diagram, sequence diagram, communication diagram, interaction overview diagram, component diagram, deployment diagram, UML 2 diagrams.

Module – 3

Design Patterns

Basic pattern concepts, Types of patterns, some common design patterns such as Expert, Creator, Façade, MVS, MVC, Publish-Subscribe, Observer, Proxy etc.

Module –4

Designing using UML

Overview of OOAD methodology, Use case model development, Domain modelling, Identificationof entity objects, Brooch's object identification method, Interaction modelling, CRC cards, Applications of the analysis and design process, object-oriented design principles. OOD goodness criteria, CK Metrics, LK Metrics, MOOD Metrics, Code Refactoring

Module –5

Testing Object Oriented Software

Challenges in testing object-oriented software, Implications of object-oriented Features in testing object-oriented software, Importance of grey-box testing of object-oriented software, Coverage analysis, State-based testing, Class testing, Fault-Based Testing, Scenario-Based Test Design, Integration Testing: Thread-based integration Strategies, Use-based integration Strategies, Cluster Testing, Validation Testing, System Testing, Testing tools.

Course Outcomes:
At the end of this course, the students will learn:

- Explain the importance of modeling in the software development life cycle.
- Analyze to apply the UML notation and symbols.
- Apply the different design patterns in Object modelling.
- Design and develop the object-oriented systems based software solutions.
- Explore object oriented software testing.

Text Book:

1. Rajib Mall, "Fundamentals of Software Engineering", 5th Edition, PHI, 2018

Reference Books:

1. Rumbaugh and Blaha, Object-oriented Modeling and design with UML, Pearson, 2007
2. Bernd Bruegge and, Allen H. Dutoit, Object-Oriented Software Engineering Using UML, Patterns, and Java, Pearson, 2009

Block Chain Technology

Course Code	L:T:P:S	Credits	Exam Marks	Exam Duration	Course Type
21IST732	3 : 0 : 0 : 0	3	100	3hrs	PCC

Prerequisite: Network Security and Information Security

Course Objectives:

1. Understand about Symmetric and Asymmetric Encryption, block chain and Bit coin concepts
2. Analyze the Working of Block Chain System.
3. Design, build, and deploy smart contracts and distributed applications
4. Evaluate security, privacy, and efficiency of a given block chain system.
5. Cognize about 'digital' currency, Storage and Currency Exchange Services.

Syllabus

Module – I

Introduction to Block chain: Back story of Block chain, what is Block chain? Centralized vs. Decentralized Systems, Layers of Block chain, why is Block chain Important? Limitations of Centralized Systems, Block chain Adoption So Far, Block chain Uses and Use Cases How Block chain Works-1: Laying the Block chain Foundation, Cryptography, Symmetric Key Cryptography, Cryptographic Hash Functions.

08 Hours

Module – II

Cryptography and Transactions: Asymmetric Key Cryptography, Diffie-Hellman Key Exchange, Symmetric vs. Asymmetric Key Cryptography, Merkle Trees, Putting It All Together, Properties of Block chain Solutions, Block chain Transactions, Distributed Consensus Mechanisms, Block chain Applications, Scaling Block chain, Off-Chain Computation, Sharding Block chain State.

08 Hours

Module-III

Bitcoin Works: The History of Money, Dawn of Bitcoin, What Is Bitcoin? Working with Bitcoins, The Bitcoin Blockchain, Block Structure, The Genesis Block, The Bitcoin Network, Network Discovery for a New Node, Bitcoin Transactions, Consensus and Block Mining, Block Propagation, Bitcoin Scripts, Bitcoin Transactions Revisited, Scripts.

08 Hours

Module – IV

Ethereum and Crypto Currencies: Ethereum Introduction, Ethereum Blockchain, Elements of Ethereum Blockchain and Smart Contracts, The Turing Completeness of Smart Contract Languages and verification challenges**,**Cryptographic Hash Functions**,** Hash Pointers and Data Structures, Digital Signatures, Public Keys as Identities, A Simple Crypto currency.

08 Hours

Module – V

How to Store and Use Bitcoins: Simple Local Storage, Hot and Cold Storage, Splitting and Sharing Keys, Online Wallets and Exchanges, Payment Services, Transaction Fees, Currency Exchange Markets

08 Hours

Course Outcomes

After the completion of this course, student will be able to

1. Explain the concepts of Symmetric Encryption, Asymmetric Encryption, Block Chain System andCrypto currencies.
2. Analyze the working of Block Chain System, Ledger Transaction and Mining mechanism.
3. Design and Implement Ethereum block chain contract.
4. Apply ethical and legal aspects for the development of Block chain applications.
5. Explain the usage of Bitcoins, online wallets, Currency Exchanges and payment services.

Text Books:

1. Beginning Block chain: A Beginner's Guide to Building Block chain Solutions byBikramaditya Singhal, Gautam Dhameja and Priyansu Sekhar Panda

2. Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller and Steven Goldfeder,Bit coin and Crypto-currency Technologies: A Comprehensive Introduction, Princeton University Press (July 19, 2016).

Reference Books:

1. Mastering Bit coin by Andreas M. Antonopoulos
2. Block chain Technology: Crypto-currency and Applications by S. Shukla, M. Dhawan, S. Sharma, S.Venkatesan, Oxford University Press 2019.
3. Imran Bashir, Mastering Blockchain: Deeper Insights into Decentralization, Cryptography, Bitcoin,and Popular Blockchain Frameworks, Packt Publishing, 1st Edition, 2017.

E-Resources:

1. NPTEL online course : https://nptel.ac.in/courses/106/104/106104220/#
2. Udemy: https://www.udemy.com/course/build-your-blockchain-az/
3. EDUXLABS Online training :https://eduxlabs.com/courses/blockchain technology-training/?tab=tab-curriculum

Digital Image Processing

Course Code	L:T:P:S	Credits	Exam Marks	Exam Duration	Course Type
21IST733	3:0:0:0	3	CIE:50 SEE:50	3 Hours	PE3

Course Objectives:

This course will enable students to :

- Study the fundamental concepts of image representation and image processing system.
- Evaluate techniques followed in image enhancements
- Illustrate image segmentation and compression algorithms

Syllabus

Module – I

Introduction to Image Processing: Digital Image Fundamentals Light, brightness adaption and discrimination, Human visual system, Image as a 2D data, Image representation Gray scale and Color images, Image sampling and quantization, Color Fundamentals, Color Models, Pseudo-color image processing.

08Hours

Module – II

Image Enhancement In The Spatial Domain: Some Basic Gray Level Transformations, Histogram Processing, Enhancement Using Arithmetic/Logic Operations, Basics of Spatial Filtering, Smoothing SpatialFilters, Sharpening Spatial Filters, Combining Spatial Enhancement Methods.

08Hours

Module – III

Image Enhancement In Frequency Domain: Introduction, Fourier Transform, Discrete Fourier Transform (DFT), properties of DFT , Discrete Cosine Transform (DCT), Image filtering in frequency domain **08Hours**

Module – IV

Image Segmentation: Introduction, Detection of isolated points, line detection, Edge detection,Edge linking, Region based segmentation- Region growing, split and merge technique, local processing, regional processing, Hough transform, Segmentation using Threshold.

08Hours

Module – V

Image Compression: Introduction, coding Redundancy , Inter-pixel redundancy, image compression model, Lossy and Lossless compression, Huffman Coding, Arithmetic Coding, LZW coding, Transform Coding, Sub-image size selection, blocking, DCT implementation using FFT, Run length coding **08Hours**

Course Outcomes:

On completion of this course, students will be able to :

1. Explain fundamentals of image processing techniques
2. Apply different transformation algorithms for image enhancement and restoration
3. Develop image enhancement, segmentation and compression techniques
4. Analyze the spatial and frequency domain techniques for image enhancement
5. Design and develop image processing applications to address real world problems

Text Book:

Rafael C. Gonzalez and Richard E. Woods: "Digital Image Processing, 3rdEdition, Pearson ducation, Pearson Education, 2014, ISBN-10: 9332518467, ISBN-13: 9789332518469,

Reference Books:

1. S Jayaraman, S Esakkirajan, T Veerakumar: "Digital Image Processing", Tata Mc- Graw Hill Publication.
2. S Sridhar: "Digital Image Processing", Oxford University Press, ISBN-10: 0199459355, ISBN-13:9780199459353.

E-Resources:

1. https://www.abebooks.com/9789332518469/Digital-Image-Processing-3rd-Edi-tion-9
2. www.synergy.ac.in/intranet/classnotes/introduction.pdf

The User Interface Design

Course Code	**21IST734**	**CIE Marks**	**50**
Teaching Hours / Week (L: T: P: S) (3:0:0:0)	**Credits (3:0:0:0)**	**SEE Marks**	**50**
Total Hours of Pedagogy	**40 Hrs**	**Total Marks**	**100**
Credits	**03**	**Exam Hours**	**3 Hrs**

Prerequisite:

Software Engineering

Course Objectives:

- To study the concept of menus, windows and interfaces.
- To study about business functions.
- To study the characteristics and components of windows and the various controls for thewindows.
- To study about various problems in windows design with color, text and graphics.
- To study the UI testing methods.

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

- Lecturer method (L) needs not to be only traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.
- Use of Video/Animation to explain functioning of various concepts.
- Encourage collaborative (Group Learning) Learning in the class.
- Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.
- Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyze information rather than simply recall it.
- Introduce Topics in manifold representations.
- Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
- Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.

Module-1

The User Interface-Introduction, Overview, The importance of user interface– Defining the user interface, The importance of Good design, Characteristics of graphical and web user interfaces, Principles of user interface design.

Case study: List any ten websites that are not user-friendly. For ex. some very popular websites are so filled with banner advertisements and these advertisements are offensive to some users. Observe and discuss some of these very bad sites. Students can form a team and design screens or pages and present their solutions to the class.

Bloom's Levels: L1, L2 and L3

08 Hours

Module-2

Interaction speeds, Business functions-Business definition and requirement analysis, Basic business functions, Design standards.

Case study: Explore any open-source UI design tools and prototyping platform for each step of the UI design process. **Ex.** Hotjar, Pencil, Justmind, Figma.

Bloom's Levels: L1, L2 and L3

08 Hours

Module-3

System menus and navigation schemes- Structures of menus, Functions of menus, Contents of menus, Formatting of menus, Phrasing the menu, Selecting menu choices, Navigating menus, Kinds of graphical menus.

Case study: The students have to form their teams. Each team has to design and build an embeddable widget that could display a restaurant's menu. The widget had to be customizable enough to integrate with a restaurant's website, dynamic enough to update based on time/location/order method, and capable of fully replacing a restaurant website's "Menu" page. The widget is integrated into a restaurant's website where visitors create loyalty accounts, earn rewards, purchase gift cards, browse menus and place orders, all without having to download an app.

Bloom's Levels: L1, L2 and L3

08 Hours

Module-4

Windows - Characteristics, Components of window, Window presentation styles, Types of window, Window management, Organizing window functions, Window operations, Web systems, Characteristics of device based controls.

Case study: Discuss the window components and presentation styles for mobile phone recharge app that helps users to get their mobile phones recharged online. Check UI and UX design solutions, app windows,

user scenarios, and interactions.

Bloom's Levels: L1, L2 and L3

08 Hours

Module-5

Screen based controls- Operable control, Text control, Selection control, Custom control, Presentation control, Windows Tests-prototypes, kinds of tests.

Case study: Discuss the design process for touchscreen UI for car-dashboard. List and highlight the important screen controls for vehicles. The controls should be easily accessible and require minimum attention from drivers, while driving-related information should be displayed clearly and understandably.

Bloom's Levels: L1, L2 and L3

08 Hours

TEXTBOOKS AND REFERENCE BOOKS:

Book Type	Code	Title & Author	Publication Information		
			Edition	Publisher	Year
Text Books	T1	Wilbert O. Galitz, "The Essential Guide to User Interface Design".	2nd	John Wiley & Sons	2002
Reference Books	R1	Ben Sheiderman, "Design the User Interface".		Pearson Education	1998
	R2	Alan Cooper, "The Essential of User Inter-face Design".		Wiley- Dream Tech Ltd.,	2002

Web links and Video Lectures:
https://archive.nptel.ac.in/courses/124/107/124107008/

COURSE OUTCOMES:

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

CO1. Apply the knowledge of user interface and human computer interaction in interactivedesign process.

CO2. Design UI/UX algorithms to control system menus and window components.

CO3. Analyze graphical and web user interfaces for business applications.

CO4. Develop frontend applications based on UI/UX principles to solve real world problems.

CO5. Demonstrate the working of all phases of the design process of web application.

CO-PO MAPPING:

POS / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	1	-	2	-	-	-	-	1	2	2
CO2	2	3	2	-	2	-	-	-	-	1	2	2
CO3	2	2	1	-	2	-	-	-	-	1	2	2
CO4	2	2	2	-	2	-	-	-	-	1	2	2
CO5	2	2	2	-	2	-	-	-	-	1	2	3

Natural Language Processing

Course Code	L:T:P:S	Credits	Exam Marks	Exam Duration	Course Type
21IST741	3:0:0:0	3	CIE:50 SEE:50	3 Hours	PE3

Prerequisites: AI **Contact Hours: 42**

Course Contents:

Unit I

Introduction: Knowledge in Speech and Language Processing, Ambiguity, Models and Algorithms; Language, Thought, and Understanding; The State of the Art and The Near Term Future; Regular Expressions and Automata; Morphology and Finite-State Transducers: Lexicon-freeFSTs: The Porter Stemmer, Human Morphological Processing. **8hours**

Unit II

N-grams: Counting Words in Corpora, Smoothing, N-grams for Spelling and Pronunciation, Entropy; Word Classes and Part-of-Speech Tagging: Part-of-Speech Tagging , Rule-based Part-of- speech Tagging, Stochastic Part-of-speech Tagging, Transformation-Based Tagging; Context-Free Grammars for English: Constituency, Context-Free Rules and Trees, Sentence Level Constructions, The Noun Phrase. **8hours**

Unit III

Parsing with Context-Free Grammars: The Early Algorithm; Features and Unification: Feature Structures, Unification of Feature Structures, Features Structures in the Grammar, Implementing Unification, Parsing with Unification Constraints; Lexicalized and Probabilistic Parsing: Probabilistic Context-Free Grammars, Problems with PCFGs. **8hours**

Unit IV

Representing Meaning: First Order Predicate Calculus, Some Linguistically Relevant Concepts, Related Representational Approaches, Alternative Approaches to Meaning; Semantic Analysis : Syntax-Driven Semantic Analysis, Attachments for a Fragment of English; Lexical Semantics : Relations Among Lexemes and Their Senses, Word Net: A Database of Lexical Relations, The Internal Structure of Words. **8hours**

Unit V

Discourse: Reference Resolution, Text Coherence, Discourse Structure; Generation: Introduction to Language Generation, An Architecture for Generation; Machine Translation: Language Similarities and Differences, The Transfer Metaphor **8hours**

Text Book:

1. Daniel Jurafsky and James H Martin, "Speech and Language Processing: An introduction to Natural Language Processing, Computational Linguistics and Speech Recognition", Prentice Hall, 2nd Edition, 2008.

Reference Book:

1. Tanveer Siddiqui, U.S. Tiwary, "Natural Language Processing and Information Retrieval",Oxford University Press, 2008.

Course Outcomes (COs):

1. At the end of the course, the students should be able to: 1. Interpret how speech and language technology relies on formal models to capture knowledge, and language processing deals with subparts of words (morphology). (PO1,5,11, PSO-2)

2. Illustrate the way N-gram tool is used for spelling and pronunciation processing, and part-of- speech tagging mechanism using various categories. (PO-2,3, 11, PSO-2)

3. Describe feature structures and unification operation which is used to combine them, and probabilistic parsing to capture more syntactic information. (PO-2,11, PSO-2)

4. Outline representations used to bridge the gap from language to commonsense Knowledge (semantic processing), and meanings associated with lexical items. (PO1,3,5,11, PSO-2)

5. Emphasize problems that NLP systems face, natural language outputs construction from non- linguistic inputs and machine translation framework approaches. (PO-1,11, PSO-2)

PRECISION AGRICULTURE

Course Code	L : T : P	Credits	Exam Marks	Exam Duration	Course Type
20IST753	3:0:0:0	3	CIE:50 SEE:50	3 Hours	PCC

Prerequisites:

Basic Computer Knowledge Linear Algebra Statistics and Probability Calculus Graph TheoryProgramming Skills – Language such as Python, R, MATLAB, C + + or Octave Data, Hardware.

Course Objectives:

This course will enable students to:

1. Detailed description of latest tools and technologies available for the Agriculture 5.0.
2. Describe different type of hardware, platforms and techniques for use in smartfarming.
3. Learn different modeling techniques in precision agriculture.
4. Make data driven based decision making & support systems.
5. Learn policies and regulations for adopting AI & ML techniques in Agriculture.

Syllabus

Module 1

Introduction to Precision Agriculture:

History of Precision Agriculture and its Global, Precision Agriculture – Introduction, Need and Scope of Precision Agriculture, Components of Precision Agriculture, Tools and Techniques, Site-Specific Crop Management (SSCM, Variable Rate Application (VRA) and Variable Rate Technology (VRT, Adoption of Smart Precision Agriculture, Some Misconceptions about Precision Agriculture,

Smart Intelligent Precision Agriculture:

Modern Day Agriculture, Digitization of Agriculture-Digital Farming, Transition to Smart Intelligent Precision Agriculture, Benefits of Smart Intelligent Precision Agriculture.

08 Hours

Module II

Adoption of Wireless Sensor Network (WSN) in Smart Precision Agriculture:

Sensors and Wireless Sensor Network, Evolution of Wireless Sensor Networks,

Introduction of WSN in Agriculture, Features of Agriculturally Based Sensors, Types of Sensors Used for WSN Agricultural System, Intelligent Sensors Versus Smart Sensors, Impact of the Wireless Sensors on Traditional Agriculture, Sensor Based Variable Rate Application,, Applications of WSN in Precision Agriculture, Security Issues and Challenges for WSN Implementation.

IoT (Internet of Things) Based Agricultural Systems:

Introduction, Architecture of IoT, Brief Overview of IoT Network, Characteristics of Internet of Things, Inter-Operability Challenges, Applications of IoT in Smart Agriculture, Challengesfor the Implementation of IoT in Smart Farming, Security and Privacy Issues of an IoT, Fusion of Cloud Platform with IoT.

08 Hours

Module III

AI (Artificial Intelligence) Driven Smart Agriculture:

Artificial Intelligence (AI) – Introduction, Categories of AI, Subsets of AI,Life Cycle of an Artificial Intelligence-Based, Prerequisites for Building an ML/AI-Based Agricultural Model, Advantages of A.I in Agriculture.

Machine Learning (ML) Driven Agriculture:

Cognitive Technologies, Introduction to Machine Learning, Types of ML, Artificial Neural Networks and Deep Learning, General Applications of Machine Learning, Scope of Artificial Intelligence and Machine Learning in Agriculture, Applications of A.I and M.L in Agriculture.

08 Hours

Module IV

Data-Driven Smart Farming:

Introduction, Collection and Managementof Real-Time Agricultural Big Data, Transforming Field Data into Meaningful Insights, Processing and Predictive Analysis of Agricultural Data, Predictive Modeling.

Decision-Making and Decision-Support Systems:

Introduction, Intelligent Agricultural Decision Support Systems (ADSS), Features and Workings of an Intelligent Agricultural Decision Support System (ADSS), Intelligent Decision-Making using AI, ML, and IoT for Farmers.

08 Hours

Module V

Agriculture 5.0 – The Future:

Introduction to Agriculture 4.0,Nanotechnology and Smart Farming, Blockchain -Securing theAgriculture Value Chain, Edge-Fog Computing for Smart Farming, Role of Big Data in Agriculture, Transition to Agriculture.

Social and Economic Impacts:

Societal and Economic Impact of AI, ML, and IoT in Intelligent Precision Farming, Existenceof Forums for Innovation and Commercialization of Intelligent Precision Farming Technology(IPFT).

Environmental Impact and Regulations:

Potential Impact on the Environment with Different IPFT, Policy Making and Governance.

08 Hours

Course Outcomes:

On completion of the course, students will be able to:

1. Describe about Artificial Intelligence in precision agriculture
2. Analyze the WSN and IoT based Agricultural systems
3. Design AI and ML Driven system for agriculture
4. Describe the key aspects of data driven and decision making & support systems.
5. Discuss AI, its current scope and limitations, and societalimplications.

Text books:

1. Latief Ahmad and FirasathNabi:**Agriculture 5.0,** Artificial intelligence, IoT andmachine learning, Taylor & Francis,1st edition,2021.
2. Rajesh Singh, Anita Gehlot, Mahesh Kumar Prajapat**,** Bhupendra Singh, **ArtificialIntelligence In Agriculture**, 2021.

Reference books:

1. K.C. Ting, S. Panigrahi : **Artificial Intelligence for Biology and Agriculture**, 1998.
2. GurjitKaur, PradeepTomar : **Artificial Intelligence and IoT-Based Technologies forSustainable Farming and Smart Agriculture**, 2019.

STORAGE AREA NETWORK

Course Code	L : T : P : S	Credits	Exam Marks	Exam Duration	Course Type
21IST743	3 : 0 : 0 : 0	3	CIE : 50 SEE : 50	3 Hours	PEC

Course Objectives

This course will enable students to:

- Understand the fundamentals of Storage Area Networks.
- Understand the metrics used for designing storage area networks.
- Understand RAID concepts.
- Understand the various storage technologies like NAS, SAN.
- Enable the students to understand how data centres' maintain data with the concepts of backup.

Syllabus

Module – I

Introduction: Server Centric IT Architecture and its Limitations, Storage-Centric IT Architecture and its advantages. Case study: Replacing a server with Storage Networks, The Data Storage and Data Access problem, The Battle for size and access. Intelligent Disk Subsystems: Architecture of Intelligent Disk Subsystems, Hard disks and Internal I/O Channels, JBOD, Storage virtualization using RAID and different RAID levels, Caching, Acceleration of Hard Disk Access, Intelligent disk subsystems, Availability of disk subsystems.

08 Hours

Module – II

I/O Techniques: The Physical I/O path from the CPU to the Storage System; SCSI; Fibre Channel Protocol Stack; Fibre Channel SAN; IP Storage. Network Attached Storage: The NAS Architecture, The NAS hardware Architecture, The NAS Software Architecture, Network connectivity, NAS as a storage system. File System and NAS: Local File Systems; Network file Systems and file servers; Shared Disk file systems; Comparison of fibre Channel and NAS.

08 Hours

Module – III

Storage Virtualization: Definition of Storage virtualization; Implementation Considerations; Storage virtualization on Block or file level; Storage virtualization on various levels of the storage Network; Symmetric and Asymmetric storage virtualization in the Network.

08 Hours

Module – IV

SAN Architecture and Hardware devices: Overview, creating a Network for storage; SAN Hardware devices; The fibre channel switch; Host Bus Adaptors; Putting the storage in SAN; Fabric operation from a Hardware perspective. **Software Components of SAN:** The switch's Operating system; Device Drivers; Supporting the switch's components; Configuration options for SANs.

08 Hours

Module – V

Management: System Management, Requirement of Management System, Support by ManagementSystem Management Interface, Standardized Mechanisms, Property Mechanisms, In-band Management, Use of SNMP, CIM and WBEM, Storage Management Initiative Specification (SMI-I), CMIP and DMI, Optional Aspects of the Management of Storage Networks, Summary

08 Hours

Course outcomes:

On completion of this course, the students are able to:

CO1: Identify the need for performance evaluation and the metrics used for it.

CO2: Apply the techniques used for data maintenance.

CO3: Realize storage virtualization concept

CO4: Develop techniques for policies for LUN masking, file systems

CO5: Analyze System management.

Text Book:

1) Ulf Troppens, Rainer Erkens and Wolfgang Muller: Storage Networks Explained, Wiley India, 2013. ISBN:9780-470-741-346
2) Robert Spalding: "Storage Networks - The Complete Reference", Tata McGraw-Hill, 2011 ISBN:8580-780-651-643

Reference Books:

1) Marc Farley: Storage Networking Fundamentals – An Introduction toStorage devices, Subsystems, Applications, Management, and File Systems, Cisco Press, 2005.
2) Richard Barker and Paul Massiglia: "Storage Area Network Essentials A Complete Guide to understanding and Implementing SANs", Wiley India, 2006.

E Resources:

1) http://www.wiley.com/WileyCDA/WileyTitle/productCd-0470741430,subjectCd- EE25.html
2) https://www.kobo.com/us/en/ebook/storage-networks-explained

DEVOPS

Course Code	**21IST744**	**CIE Marks**	**50**
Teaching Hours/Week (L:T:P:S)	**3 : 0 : 0 : 0**	**SEE Marks**	**50**
Total Hours of Pedagogy	**40**	**Total Marks**	**100**
Credits	**03**	**Exam Hours**	**03**

Prerequisites: Technical Skills, Soft skills, Practical Experiances

Course objectives:

This course will enable students to:

1. Understand the DevOps Concepts and DevOps Tool.
2. Expose to the evolving Applications and advance features of Jenkins and Docker.3.Get Familiarize with Docker and Chef workstations.
4. Understand the importance of testing using Jenkins, AWS EC2.
5. Identify and understand security in Jenkins and monitor the azure Applications.

Teaching-Learning Process (General Instructions)

These are sample Strategies; which teachers can use to accelerate the attainment of the various courseoutcomes.

1. Lecturer method (L) need not to be only a traditional lecture method, but alternative effectiveteaching methods could be adopted to attain the outcomes.
2. Use of Video/Animation to explain functioning of various concepts.
3. Encourage collaborative (Group Learning) Learning in the class.
4. Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.
5. Adopt Problem Based Learning (PBL), which fosters students 'Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyze information rather than simply recall it.
6. Introduce Topics in manifold representations.
7. Show the different ways to solve the same problem with different circuits/logic andencourage the students to come up with their own creative ways to solve them.
8. Discuss how every concept can be applied to the real world - and when that's possible, ithelps improve the students' understanding.

Module – I

Introduction to DevOps Concepts: Understanding DevOps movement, DevOps with changing times,The waterfall model, Agile Model, Why DevOps? DevOps lifecycle, Benefits of DevOps.

.**Text Book 1 - Chapter 1 08 Hours**

Module – II

Virtualization, Micro-services and Architecture: Infrastructure in detail from On-prem and Cloud;Virtualization – Full & Para; Hypervisors; Era of Virtual Machines; Containers in detail; Containers over Virtual Machines and vice-versa; Introduction to Micro-services; Micro-service Architecture; Monolithic vs Micro-Service Architectures

Case Study: Generic Shopping Cart Application in current scenarios

Text Book-3 -Chapter 3,4

08 Hours

Module – III

Containers: Overview of Docker containers, Understanding the difference between virtual machines and containers, Installing and configuring Docker, Creating a Tomcat container. **Cloud Computing and Configuration Management:** An overview of the Chef configuration management tool, Installing and configuring a Chef workstation, Installing knife plugins for Amazon Web Services and Microsoft Azure.

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Text Book 1 - Chapter 5, 6.

Module – IV

Automated Testing (Functional and Load Testing): Functional testing using Selenium, Functional test execution in Jenkins, Load test execution using Jenkins. **Orchestration - End-to-End Automation:** End-to-end automation of application life cycle management using Jenkins, End-to-end automation using Jenkins, Chef, and AWS EC2, End-to-end automation using Jenkins and AWS Elastic Beanstalk, End-to end automation using Jenkins and Microsoft Azure app services, End-to-end automation orchestration of application life cycle Management using VSTS.

Text Book 2 - Chapter 6,7

08 Hours

Module – V

Jenkins CI/CD, Security and Monitoring: Introduction, Installing Jenkins, Jenkins dashboard, Configuration Java, Maven/Ant in Jenkins, Creating and Configuring build job for Java application with Maven, Managing Nodes, Email notifications based on build status. Security in Jenkins and VSTS, Security in Jenkins and VSTS, Jenkins Monitoring

Text Book 1,2 - Chapter 2,8 **8 Hours**

Teaching-Learning Process forallmodules	Chalk and board, Active Learning, PPT Based presentation, Video

Book Type	**Code**	Title & Author	**Publication Information**		
			Edition	**Publisher**	**Year**

e					
Text Books	**T1**	DevOps for Web Development, Mitesh Soni	2nd	Packet Publishing, ISBN:9781786465702,	Released October 2016
Text Books	**T2**	DevOps Bootcamp-A fast-paced guide to implement DevOps with ease, MiteshSoni	2nd	ISBN 978-1-78728-596-5.	May 2017
Text Book	**T3**	Mastering Cloud Computing, Rajkumar Buyya,Christain Vecchiola	1st	ElSEVIER	2013
Reference Books	**R1**	" Devops Software Architect's perspective ", Len Bass, Ingo Weber	first edition	ISBN 978-0-13-404984-7, Pearson Education, Inc.	2015

COURSE EVALUATION SCHEME:

Component		**Weightage (%)**	
CIE's	CIE 1 5th week	20	60
	CIE 2 10th week	20	
	CIE 3 15th week	20	
AAT's	AAT-1 10th week	10	
	AAT-2	10	
	AAT-3	20	
Continuous Internal Evaluation Total Marks: 100. Reduced to 50 Marks			
Semester End Examination (SEE) Total Marks: 100. Reduced to 50 Marks			

Course Outcomes:

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

CO1 Apply Agile methodologies to manage and prioritize work in a DevOps environment.

CO2 Analyze the core principles and practices of DevOps for including collaboration & aut

CO3 Design and implement automation of application life cycle management using Jenkins.

CO4 Develop the cultural changes necessary to implement DevOps successfully within an organization.

CO5 Demonstrate proficiency in Configuration of Java, Maven/Ant in Jenkins.

CO-PO-PSO Mapping:

PO's CO's	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	1	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	1	3	2	1	-	1	-	-	1	-	-	-	-	-	-
CO3	-	2	3	-	-	-	-	-	-	-	-	-	-	-	-
CO4	-	1	2	3	-	-	-	-	2	-	-	-	-	-	-
CO5	-	1	2	-	3	1	-	-	2	-	-	-	-	-	-
Avg.	**1.6**	**1.6**	**2.2**	**2**	**3**	**1**			**1.6**				**-**	**-**	**-**

R PROGRAMMING

Course Code	**21ISO751**	**CIE Marks**	**50**
Teaching Hours/Week (L:T:P: S)	**3:0:0:0**	**SEE Marks**	**50**
Total Hours of Pedagogy	**40**	**Total Marks**	**100**
Credits	**03**	**Exam Hours**	**03**

Prerequisite: Programming Knowledge, Statistics.

Course Objectives:

CLO 1. Explore and understand how R and R Studio interactive environment.

CLO 2. To learn and practice programming techniques using R programming.

CLO 3. Read Structured Data into R from various sources.

CLO 4. Understand the different data Structures, data types in R.

CLO 5. To develop small applications using R Programming

Teaching-Learning Process (General Instructions):

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

1. Lecturer method (L) need not to be only a traditional lecture method, but alternativeeffective teaching methods could be adopted to attain the outcomes.
2. Use of Video/Animation to explain functioning of various concepts.
3. Encourage collaborative (Group Learning) Learning in the class.
4. Ask at least three HOT (Higher order Thinking) questions in the class, which promotescritical thinking.
5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, andanalyze information rather than simply recall it.
6. Introduce Topics in manifold representations.
7. Show the different ways to solve the same problem with different circuits/logic andencourage the students to come up with their own creative ways to solve them.
8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.

Module - I

Numeric, Arithmetic, Assignment, and Vectors: R for Basic Math, Arithmetic, Variables, Functions, Vectors, Expressions and assignments Logical expressions.

Textbook 1: Chapter 2(2.1 to 2.7)

08 Hours

Module - II

Matrices and Arrays: Defining a Matrix, Sub-setting, Matrix Operations, **Conditions and Looping:** if statements, looping with for, looping with while, vector based programming.

Textbook 1: Chapter 2- 2.8, chapter 3- 3.2 to 3.5.

08 Hours

Module - III

Lists and Data Frames: Data Frames, **Lists,** Special values, The apply facmily.

Textbook 1: Chapter 6- 6.2 to 6.4

08 Hours

Module - IV

Functions: Calling functions, scoping, Arguments matching, writing functions: The function command, Arguments, specialized function.

Textbook 1: Chapter 5- 5.1 to 5.6

08 Hours

Module - V

Pointers: packages, frames, de bugging, manipulation of code, compilation of the code.

Textbook 1: Chapter 8- 8.1 to 8.8

08 Hours

Teaching-Learning Process for allmodules	**Chalk and board, Active Learning, Demonstration presentation,problem solving, MOOC**

Course Outcomes (Course Skill Set):

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

CO 1. Explain the fundamental syntax of R through readings, practice exercises,

CO 2. Demonstrations of applications of R and writing R code.

CO 3. Apply critical programming language concepts such as data types, iteration,

CO 4. Analyze the different control structures, functions, and Boolean operators by writing R programs

CO 5. Develop R Programs with a variety of data formats using R-Studio

Assessment Details (both CIE and SEE)

Component		**Weightage (%)**	
CIE's	CIE 1 5th week	20	60
	CIE 2 10th week	20	
	CIE 3 15th week	20	
AAT's	AAT-1 10th week	10	
	AAT-2	10	
	AAT-3	20	
Continuous Internal Evaluation Total Marks: 100. Reduced to 50 Marks			
Semester End Examination (SEE) Total Marks: 100. Reduced to 50 Marks			

Textbooks

1. Jones, O., Maillardet. R. and Robinson, A. (2014). Introduction to Scientific Programming and Simulation Using R. Chapman & Hall/CRC, The R Series.

References:

1. Michael J. Crawley, "Statistics: An Introduction using R", Second edition, Wiley,2015

Weblinks and Video Lectures (e-Resources):

1. Wickham, H. & Grolemund, G. (2018). for Data Science. O'Reilly: New York. Available for free at http://r4ds.had.co.nz

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

Demonstration of simple projects

INTRODUCTION TO MACHINE LEARNING

Course Code:	21ISO752	CIE Marks	50
Teaching Hours/Week (L:T:P:S)	3:0:0:0	SEE Marks	50
Total Hours of Pedagogy	40T+20 P	Total Marks	100
Credits	03	Exam Hours	03

Description of the course:

Machine learning (ML) is a form of Artificial intelligence that makes predictions from data. It is a new technological aspect which is used to automate processes like image classification, speech recognition, and market forecasting. A machine learning (ML) developer is an expert on using data to training models.

Prerequisite:

Basic Probability concepts

Course Learning Objectives:

This course will enable students to:

- Explain the basic concepts of various types of machine learning algorithms
- Apply the well posed learning techniques to solve real world .
- Design decision tree models to solve the problem
- Apply Artificial Neural Networks with multilayer perceptron.
- Solve problems by applying simple Reinforcement based learning methods.

Syllabus

Module– I

Introduction: Introduction to machine learning, Types of Machine learning, supervised learning, unsupervised learning, semi supervised learning, reinforcement learning, Batch learning, Online Learning, Instance based learning, Model based learning, Bad and insufficient quality of data, poor quality data, Irrelevant features, Testing, Over fitting andUnder fitting the data

08 hours

Teaching Learning Methodology: Chalk & Talk**,** Python IDE

Module–II

Introduction to Well-Posed Learning problems, Designing a learning system, Perspectives and issues in machine learning, Find-S Algorithm, Candidate eliminationAlgorithm.

08 hours

Teaching Learning Methodology: Chalk & Talk, Python IDE

Module– III

Decision Tree Learning: Introduction, Decision Tree representation, Appropriate problemsfor decision tree learning, The basic decision tree algorithm, C4.5 algorithm, Hypothesis space search in decision tree algorithms, Issues in decision tree learning.

08 hours

Teaching Learning Methodology: Chalk & Talk, Python IDE

Module– IV

Artificial Neural Networks: Introduction, Neural network representation, Problems forneural network learning, Perceptrons, Multiple layer networks and back propagation algorithm, Remarks on the Back propagation Algorithm

08 hours

Teaching Learning Methodology: Chalk & Talk, Python IDE

Module– V

Reinforcement Learning: Introduction, Reinforcement learning problem, Reinforcementlearning problem characteristics, The Learning task, Q Learning ,An Algorithm for Q learning.

08 hours

Teaching Learning Methodology: Chalk & Talk, Python IDE

Course Outcomes:

On completion of this course, the students will be able to:

- Explain the basic concepts of machine learning algorithm and its types.
- Apply the well posed learning techniques and investigate the Machine learning examples
- Design decision tree models to solve the problem
- Apply effectively neural networks for appropriate applications.
- Demonstrate Reinforcement techniques and derive effectively learning rules.

Text Books:

1. Tom M Mitchell, "Machine Learning", McGraw-Hill, 1997
2. Rudolph Russell, Machine Learning Step by step guide to implement machinelearning algorithms with python

Reference Books:

1. Aaron Courville, Ian Goodfellow, and Yoshua Bengio, Deep Learning, MIT Press,2015, ISBN:9780262035613
2. Christopher Bishop, Pattern recognition and machine learning. Himalaya PublishingHouse. ISBN: 98345789
3. Course material available on Swayam platform and NPTEL, for the course on Introduction to Machine Learning, conducted by Prof. Sudeshna Sarkar, IIT Kharagpur
4. Ethem Alpaydın, Introduction to Machine Learning, MIT press 4th edition ISBN: 9780262043793.
5. C Agarwal, Machine Learning for Text, Pearson Education - 2006 (2 & 4). ISBN – 15:34519801.

E-RESOURCES:

- http://www.infocobuild.com/education/audio-video-courses/electronics/PatternRecognitionApplication-IIT-Kharagpur/lecture-27.html
- https://cs.stanford.edu/people/eroberts/courses/soco/projects/neural-networks/Sources/index.html
- https://onlinecourses.nptel.ac.in/noc19_ee53/preview

- https://onlinecourses.nptel.ac.in/noc22_ge04/preview
- http://www.digimat.in/nptel/courses/video/117105084/L35.

CO-PO Mapping:

PO's/CO's	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	3	2	2	3	-	-	-	-	-	-	2	3	2	3
CO2	3	3	2	2	3	-	-	-	-	-	-	1	3	2	3
CO3	3	3	2	2	3	-	-	-	-	-	-	2	3	2	2
CO4	3	3	3	3	3	-	-	-	-	-	-	2	3	2	3
CO5	3	2	2	2	3	-	-	-	-	-	-	1	3	2	2
Avg	**3**	**2.8**	**2.2**	**2.2**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**1.6**	**3**	**2**	**2.6**

DIGITAL MARKETING

Course Code	**21ISO753**	**CIE Marks**	**50**
TeachingHours/Week (L:T:P:S) (3:0:2:0)	**Credits (3:0:0:0)**	**SEE Marks**	**50**
Total Hours of Pedagogy	**40 Hours Theory + 20 Hours Tutorial**	**Total Marks**	**100**
Credits	**03**	**Exam Hours**	**03**

Course Objectives:

This course will enable students to:

CLO1: Comprehend business advantages of digital marketing and its importance for marketing success and to develop a digital marketing plan.

CLO2: Learn Website and SEO optimization techniques and also, to outline Google Ad Words campaigns.

CLO13: Acquire knowledge of Google Analytics for measuring effects of digital marketing and to getinsights of future trends that will affect the development of digital marketing.

CLO4: Learn to use various social media platforms in order to create, manage and evaluate digitalmarketing efficiently.

CLO5: Recognize strategies used for email marketing, resource planning and budgeting.

Module-1

Introduction to Digital Marketing:

Definition of digital marketing, challenges and benefits of digital marketing,**,** Digital vs. Real Marketing, Digital Marketing Channels, Creating initial digital marketing plan, Content management, SWOT analysis, Target group analysis.

08 Hours

Module-2

Search Engine Optimization

SEO Optimization and its types, Writing the SEO content, Web design, Optimization of Web sites, Google AdWords- creating accounts, Google AdWords- types, Introduction to CRM, CRM platform, CRM models.

08 Hours

Module-3

Introduction of Social Media Marketing

Charaterstics of successful social media marketer, social media marketing plan, Creating a Facebook page, Visual identity of a Facebook page Types of publications, Business opportunities and Instagram options, Optimizationof Instagram profiles, Integrating Instagram with a Web Site and other social networks.

08 Hours

Module-4

LinkedIn and You-tube marketing

Business tools on LinkedIn, Creating campaigns on LinkedIn, Analyzing visitation on LinkedIn, Creating business Accounts on YouTube, YouTube Advertising, YouTube Analytics.

08 Hours

Module-5

Email Marketing:

E-mail marketing, E-mail marketing plan, E-mail marketing campaign analysis, Keeping up with conversions, Digital Marketing Budgeting- resource planning - cost estimating - cost budgeting - cost control.

08 Hours

Course outcomes:

Students will be able to:

CO1: Examine the importance of digital marketing and create suitable plans for marketing success.

CO2: Analyze customer relationships across all digital channels and build better customer relationships.

CO3: Develop a digital marketing plan, starting from SWOT analysis and there by defining a target group.

CO4: Apply social media channels to achieve maximum benefit for the business by using web analytics.

CO5: Develop different ways for the integration of marketing plans taking into consideration the available resources and budget.

Suggested Learning Resources:

Text Books:

1. Digital Marketing strategy implementation and practice. Sixth edition, Dave Chaffey and Fiona Ellis-Chadwick, pearson
2. Digital Marketing all in one for dummies by Stephanie Diamond, 6th edition.

Referenc Books:

1. The beginners guide to Digital Marketing(2015)Digital Marketer(pdf) DamiahbRyan & Calvin Jones, "understanding Digital Marketing: Marketing Strategies for engaging the Digital generation", KoganPageLimited, 1st edition, 2009, ISBN-978-0749453893.

E-resources:

1. https://www.digitalmarketer.com/digital-marketing/
2. https://www.tutorialspoint.com/digital-marketing/index.htm
3. https://www.javapoint.com/digital-marketing/

CO-PO Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3
CO1	2	1	1	-	-	2		2	2	3	1	2	2	-	-
CO2	1	1	1	-	-	1		2	2	3	1	2	2	-	-
CO3	2	1	2	-	-	2		2	2	3	1	2	2	-	-
CO4	2	1	2	-	-	2		2	2	3	1	2	2	-	-
C05	2	1	2	-	-	2		2	2	3	1	2	2	-	-
AV G	**1.8**	**1**	**2**	-	-	**1.8**		**2**	**2**	**3**	**1**	**2**	**2**	-	-

DATA SCIENCE AND VISUALIZATION

Course Code	**21ISO754**	**CIE Marks**	**50**
Teaching Hours/Week (L:T:P: S)	**3:0:0:0**	**SEE Marks**	**50**
Total Hours of Pedagogy	**40**	**Total Marks**	**100**
Credits	**03**	**Exam Hours**	**03**

Prerequisite: This course introduces students to data analysis and visualization in the field of exploratory data science using Python.

Course Objective:

1. To introduce the fundamental concepts of data science.
2. To Learn different approaches in the design of data visualization systems
3. To analysis and solve problems of data visualization systems.
4. To evaluate the effectiveness of visualizations for specific data, task, and user types.
5. To use the existing visualization paradigms, techniques, and tools

Teaching-Learning Process (General Instructions)

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

1. Lecturer method (L) need not to be only a traditional lecture method, but alternativeeffective teaching methods could be adopted to attain the outcomes.
2. Use of Video/Animation to explain functioning of various concepts.
3. Encourage collaborative (Group Learning) Learning in the class.
4. Ask at least three HOT (Higher order Thinking) questions in the class, which promotescritical thinking.
5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, andanalyze information rather than simply recall it.
6. Introduce Topics in manifold representations.
7. Show the different ways to solve the same problem with different circuits/logic andencourage the students to come up with their own creative ways to solve them.
8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.

Module - I

Introduction: Introduction to Data Science, Exploratory Data Analysis and Data Science Process. Motivation for using Python for Data Analysis, Introduction of Python shell iPython and Jupyter Notebook.

Essential Python Libraries: NumPy, pandas, matplotlib, SciPy, scikit-learn, statsmodels

08 Hours

Module - II

Getting Started with Pandas: Arrays and vectorized conputation, Introduction to pandas Data Structures, Essential Functionality, Summarizing and Computing Descriptive Statistics. Data Loading, Storage and File Formats. Reading and Writing Data in Text Format, Web Scraping, Binary Data Formats, Interacting with Web APIs, Interacting with Databases Data Cleaning and Preparation.

Handling Missing Data, Data Transformation, String Manipulation**.**

08 Hours

Module - III

Data Wrangling: Hierarchical Indexing, Combining and Merging Data Sets Reshaping and Pivoting. **Data Visualization matplotlib**: Basics of matplotlib, plotting with pandas and seaborn, other pythonvisualization tools.

08 Hours

Module - IV

Data Aggregation and Group operations: Group by Mechanics, Data aggregation, General split-apply-combine, Pivot tables and cross tabulation.

Time Series Data Analysis: Date and Time Data Types and Tools, Time series Basics, date Ranges, Frequencies and Shifting, Time Zone Handling, Periods and Periods Arithmetic, Resampling and Frequency conversion, Moving Window Functions.

08 Hours

Module - V

Advanced Pandas: Categorical Data, Advanced Group By Use, Techniques for Method Chaining

08 Hours

Teaching-Learning Process for allmodules	Chalk and board, Active Learning, PPT Based presentation, Video

Course outcomes:

On successful completion of the course, the students will be able to :

1. Apply data analysis tools in the pandas library to solve real world problems.
2. Demonstrate the working of Load, clean, transform, merge and reshape operations on data.
3. Create informative visualization and summarize data sets.
4. Analyze and manipulate time series data.
5. Solve real world data analysis problems.

Assessment Details (both CIE and SEE)

Component		**Weightage (%)**	
CIE's	CIE 1 5th week	20	60
	CIE 2 10th week	20	
	CIE 3 15th week	20	
AAT's	AAT-1 10th week	10	
	AAT-2	10	
	AAT-3	20	
Continuous Internal Evaluation Total Marks: 100. Reduced to 50 Marks			
Semester End Examination (SEE) Total Marks: 100. Reduced to 50 Marks			

Text Books:

1. Bart Baesens, Analytics in a Big Data World, Wiley publications, 2014.
2. Gareth James, Daniela Witten, Trevor Hatie, Roberst Tibhirani , An Introduction to StatisticalLearning-with Applications in R, Springer series in statistics, 2017.
3. Jared P. Lander, R for Everyone, Addison Wesley Data & Analytics Series, Pearson, 2014.

Reference Books:

1. McKinney, W. (2017). Python for Data Analysis: Data Wrangling with Pandas, NumPy and IPython. 2nd edition. O'Reilly Media.
2. O'Neil, C, & Schutt, R. (2013). Doing Data Science: Straight Talk from the Frontline O'Reilly Media.

PROJECT WORK					
Course Code	**L:T:P:S**	**Credits**	**Exam Marks**	**Exam Duration**	**Course Type**
21ISP76	**0 : 0 : 20 :0**	**10**	**CIE: 50 SEE: 50**	**03 Hours**	

COURSE PLAN

(To be submitted before commencement of semester)

Course Teacher/s: Dr Rajkumar	**Academic Year: 2024 - 25**
Lab. Instructors (if applicable):	**Date of Commencement of Class: 26-09-2024**

Guidelines:

1. Preparation of detailed design for the project Implementation of the sub-modules and their integration. Testing and validation.
2. Preparation and publication of implementation paper. Preparation and submission of Major Project report.
3. In-house project teams should meet their Guides weekly and update about the progress of the projects, whereas the industry project students meet their Guides once in fifteen days.
4. CIE evaluation: Carried out twice in a semester by an internal panel comprising of Internal Guideand three other faculty members of the department.
5. SEE evaluation: Conducted at the end of the eighth semester by both internal guide and an externalexaminer from other institutions.

Evaluation is based on the demonstration of the working project by the team, project report andpublication.

Course Outcomes

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

1. Review the current state of Art and trends in their area of interest in current technologies and identify a suitable problem in their chosen subject domain.
2. Apply strategies, algorithms, and techniques to develop the project based on the problem statement identified.
3. Analyze the literature/documents for the techniques to be used for the project
4. Design and development of the solutions for the problem identified using appropriate tools and methods.
5. Demonstrate the working of implemented idea with power point and prepare the report on work conducted.

Work effectively in a team and use good project management practices and defend the projectwork.

CO-PO-PSO Mapping:

PO'S	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	-	-	-	-	-	-	-				-	2	2	-
CO2	-	3	-									-	2	2	2
CO3	-	-	3	2	3	-						-	2	-	2
CO4	-	-		-		-	-			3		-	-	-	-
CO5	-	-		-		-	-	3	3		3	3	-	-	-
Average	**-**	**3**	**3**	2	3	3	3	3	3	3	3	**3**	**2**	2	**2**

COURSE EVALUATION SCHEME:

Component		Weightage		
CIE		50	100	Total Marks200
	CIE-II	50		
SEE	Final Exam	100	100	

Rubrics for Project Evaluation:

Criteria	Exemplary	Proficient	Partially Proficient	Max Points
Planning	**Marks 2** **Project schedule**: Progress, milestones and deliverables withrealistic estimates of thetime (Gant chart). **Identify resources:** (hardware and software) required to accomplish the Development effort. **Cost estimates** of hardware and software	**Marks 1.5** **Project schedule**:Progres milestones anddeliverable (Gantchart). **Identify resources:** (hardware and software) required to accomplish the development effort. **Cost estimates** of hardware and software	**Marks 0-1** **Project schedule**:Progress milestonesanddeliverables a notplanned accordingly. **Identify resources:** (hardware and software) required to accomplish the development effort. **Cost estimates** of hardware and software	**2**
Detailed Design	**Marks** 4-5 Design is as per problem formulation. Architectural design/ System design: identifying the sub-systems. Abstract specification of the sub- systems, Interface design. Carefully chosen a methodology or approach that is well- suited to the formulated problem.	**Marks** 3-3.5 Design is as per problem formulation. Architectural design/ System design: identifying the sub-systems. Abstract specification of the sub-systems, Interface design	**Marks** 1-2.5 Design does not target the problem formulation optimally. Architectural design/ System design: identifying the sub-systems. Abstract specification of the sub-systems, Interface design	**5**
Implementation	**Marks** 9-10 Completed implementation for all set objectives as per the design and specification; justifying latest tools and techniques used. Implementation of methodology/approaches/ technique is innovative and is specific to the needs of the project and robust to cater to future enhancements. Showed competency in developing the system and fulfilled the objectives in the given timeline.	**Marks** 7-8 Completed implementation for all set objectives as per the design and specification; justifying latest tools and techniques used. Implementation of methodology/approac hes/ technique is specific to the needs of the project and robust to cater to future enhancements. Showed competency in developing the system and fulfilled the objectives in the given timeline	**Marks** 1-6 Completed implementation for all set objectives as per the design and specification: justifying latest tools and techniques used. Did not adhereto the given timeline	**10**

Testing and Validation	**Marks** 4 Data interpretation, integration, analysis and test results interpretation communicated clearly. Included high quality charts, tables, graphs, images, etc. to assist in interpreting the results and closes with a strong conclusion	**Marks** 3 Data interpretation, integration, analysis and test results interpretation communicated clearly. Included high quality charts, tables, graphs, images, etc. to assist in interpreting the results	**Marks** 1-2 Data interpretation, integration, analysis and test results lacks clarity	**4**
Publication of Implementati on Paper	**Marks** 4 Prepared and received acceptance for Implementation Paper	**Marks** 3 Prepared ImplementationPaper	**Marks** 0 Not Prepared Implementation Paper	**4**
Report	**Marks** 4 Clear and Effective writing and adherence to appropriate report format. All figures, graphs, charts, and drawings are accurate, consistent with the text, and ofgood quality. They enhance understanding of the text. All are labelled correctly	**Marks** 3 Writing that is clear and effective for most part and minor errors in adherence to appropriate report format ,All figures, graphs, charts, and drawings are accurate, consistent with the text, and of good quality. They enhance understanding of the text. All are labelled correctly	**Marks** 1-2 Unclear and ineffective writing and multiple errors in adherence to appropriate report format. All figures, graphs, charts, and drawings are accurate, consistent with the text, and of good quality. They enhance understanding of the text. All are labelled correctly	**4**
Oral communicati on	**Marks** 9-10 Clear and effective communication. Presentation includes appropriate contents and is clearly organized. Presentation highlights key ideas and closes with a strong conclusion. Answer questions/queries professionally	**Marks** 6-8 Communication is clear. Presentation includes appropriate contents and is clearly organized. Presentation highlights key ideas and closes with a strong conclusion. Answer questions/queries professionally	**Marks** 1-5 Unclear Presentation includes appropriate contents and is clearly organized. Presentation highlights key ideas and closes with a strong conclusion. Answer questions/queries professionally	**10**
Group Participati on	**Marks** 5 Did a full share of the work or more and volunteers to help others. Provided many good ideas; inspired others; clearly communicated ideas and needs. Completed assigned work ahead of time	**Marks** 4 Did almost as much work as others. Participated in discussions; on some occasions, made suggestions. Completed assigned workon time	**Marks** 1-3 Did less work than others. Listened mainly; Rarely spoke up, and ideas were off the mark. Needed much reminding; submission was late	**5**
Ethics	**Marks** 4 Upholds the standards of honesty and integrity Addressed the societal and environmental issues and responsibilities	**Marks** 3 Upholds the standards of honesty and integrity Addressed few societal and environmental issues	**Marks** 1-2 Upholds the standards of honesty and integrity	**4**
Peer Review		**Marks** 2 Peer evaluation by team members		**2**
Total				**50**

Note: CIE II rubrics same as CIE I.