T. Y. B. TECH CSE-DS

SEMESTER-V SYLLABUS

(PATTERN 2023-NEP)

Vision of Department

"Excellence in Data Science to empower the future of technology with holistic development."

Mission of Department

- **M1:** To impart quality education with contemporary industry needs using emerging Machine Learning & Data Science techniques.
- **M2:** To cultivate a research-oriented mindset and comprehensive professional skills.
- **M3:** To equip learners with interdisciplinary skill sets to cater the needs of the industry and society.

Program Specific Outcomes (PSO's)

PSO-1: Apply Data Science techniques to extract valuable insights from real-world data for informed decision-making.

PSO-2: Apply Machine Learning and AI concepts for predictive modelling and intelligent system development.

Program Outcomes (PO's)

At the end of program, students should be able to:

1. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems.

2. **Problem analysis**: Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences.

3. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety and the cultural, social and environmental considerations.

4. **Conduct investigations of complex problems**: Use research-based knowledge and

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

5. **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.

6. **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

7. **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts and demonstrate the knowledge of, and need for sustainable development.

8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

9. **Individual and team work**: Function effectively as an individual and as a member or leader in diverse teams and in multidisciplinary settings.

10. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations and give and receive clear instructions.

11. **Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

12. **Life-long learning**: Recognize the need for and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Contents

Bansilal Ramnath Agarwal Charitable Trust's

Vishwakarma Institute of Information Technology, Pune-48

(An Autonomous Institute affiliated to Savitribai Phule Pune University)

T.Y. B. TECH. (CSE-DS), SEMESTER V (PATTERN 2023)

AY 2025-26

-	Course Name	Teaching Scheme (Hrs/Week)			Assessment Scheme (100-mark scale)										Credits
					ISA					ESA				Total	
		Th	L	T	HA	SCE	PPT	GD	CIE	ESE	PR	OR	TW	100	
CD31231	DESIGN AND ANALYSIS OF ALGORITHM	2	2	-	-	20	-	-	20	40	20	-	-	100	3
CD31232	ARTIFICIAL INTELLIGENCE	2	2	-	-	20	-	-	20	40	20	-	-	100	3
CD31233	COMPUTER NETWORK	2	2	-	-	20	-	-	20	40	-	20	-	100	3
CD31234X	PROGRAM ELECTIVE	3	2	-	20	20	-	-	20	40	-	-	-	100	4
MDM31235	STATISTICAL METHODS IN SIX SIGMA	2	-	1	10	20	-	-	10	-	-	40	20	100	3
	OPEN ELECTIVE -III	2	-	-	20	20	-	-	20	-	-	40	-	100	2
	OPEN ELECTIVE-IV	2	-	-	20	20	-	-	20	-	-	40	-	100	2
CD31235	PROJECT WORK- I	-	4	-	-	-	-	-	-	-	-	-	50	50	2
	TOTAL	15	12	1	70	140	-	-	130	160	40	140	70	750	**22**

PROGRAM ELECTIVES			
Course Code	**Course Name**	**Course Code**	**Course Name**
CD31234A	CLOUD COMPUTING	CD31234B	SOFT COMPUTING
EC131205G	MAINFRAME TECHNOLOGIES		

OPEN ELECTIVE – III			
Course Code	**Course Name**	**Course Code**	**Course Name**
CSOEUA31236A	SOFTWARE TESTING AND QUALITY ASSURANCE	MEOEUA31236D	INDUSTRIAL ENGINEERING
ETOEUA31236C	SUSTAINABLE ENERGY TECHNOLOGY	CVOEUA31236E	PROJECT PLANNING AND MANAGEMENT

OPEN ELECTIVE – IV			
Course Code	**Course Name**	**Course Code**	**Course Name**
CSOEUA31237A	ENGINEERING ECONOMICS AND FINTECH	MEOEUA31237D	PRODUCT DEVELOPMENT
ETOEUA31237C	COMPUTING FOR AGRICULTURE 4.0	CVOEUA31237E	BUSINESS ANALYTICS

BOS Chairman

Dean Academics

Director

CD31231: Design and Analysis of Algorithm

Teaching Scheme	**Examination Scheme**				
Credits: 03 **Lecture (L):** 02 hrs / week **Practical (P):** 02hrs /week	CIE	SCE	ESE	PR	Total
	20	20	40	20	100

Prerequisites: Discrete Mathematics, Data Structures

Course Objectives:

1. Analyze the performance of algorithms using asymptotic notations and complexity measures.
2. Apply various algorithmic techniques such as divide and conquer, greedy, dynamic programming, and backtracking to solve computational problems.
3. Classify problems based on their computational hardness, including concepts of NP-completeness and intractability.
4. Evaluate advanced strategies like approximation, randomized, and natural algorithms for solving hard and intractable problems.
5. Implement multithreaded, distributed, and application-specific algorithms in real-world computing domains like IoT and Data Science.

Course Outcomes:

1. Analyze algorithms for time and space complexities using asymptotic notations.
2. Apply appropriate algorithmic strategies to solve computational problems.
3. Identify intractable problems using the theory of NP-completeness.
4. Solve problems using advanced, parallel, or distributed algorithmic techniques.

Contents

Unit I: Introduction to Algorithms and Basic Strategies (6 Hrs)

Basic Concepts: Analysis of Algorithms, Best, Average and Worst case running times, Asymptotic notations (O, Ω, Θ).
Divide and Conquer strategy: General strategy, Binary Search, Finding Max-Min, Large integer Multiplication
Greedy Method: Principle of optimality, Fractional Knapsack problem, scheduling algorithms-Job scheduling and activity selection problem.
Case Study: Ride Allocation in Taxi Apps (e.g., Uber, Ola)

Unit II: Dynamic Programming, Backtracking and Branch & Bound (6 Hrs)

Dynamic Programming: General Strategy, Single source shortest path, All-pairs shortest path,0/1 Knapsack problem, Traveling Sales person problem, Multistage graphs.
Backtracking: 8 Queen's problem, Graph Coloring.
Branch and Bound: Overview of method, 0/1 Knapsack problem – LC branch and bound Traveling Salesperson Problem.
Case Study: Route Planning in Google Maps

Unit III: NP-Completeness, Approximation and Randomized Algorithms	**(6 Hrs)**
Polynomial and Non-polynomial problems, P and NP classes, NP-complete problems (Vertex cover, 3-SAT), **NP-hard problem** (Hamiltonian cycle). Approximation algorithms for TSP and Max Clique. **Randomized Algorithms:** Sorting, Minimum Cut. **Natural Algorithms:** Genetic Algorithms, Simulated Annealing, Artificial Neural Networks (ANN). **Case Study: Job Assignment in Cloud Computing (e.g., AWS, Azure)**	
Unit IV: Multithreaded, Distributed and Application-oriented Algorithms	**(6 Hrs)**
Multithreaded Algorithms: Performance measures, Parallel loops, Race conditions, Matrix multiplication, Merge sort. **Distributed Algorithms:** BFS, All pair shortest path, Bully algorithm, Dijkstra-Scholten algorithm. **Application Algorithms:** Embedded scheduling, String Matching, Algorithms in IoT and Data Science. **Case Study: Real-Time Data Processing in IoT-Based Smart Agriculture**	

Textbooks:

1. Gilles Brassard, Paul Bratley, 'Fundamentals of Algorithmics', PHI, ISBN 978-81-203-1131-2, 2011
2. Horowitz and Sahani, 'Fundamentals of Computer Algorithms', 2ND Edition, University Press, ISBN: 978-81-7371-6126, 1998.

Reference Books:

1. Thomas H. Cormen et al., 'Introduction to Algorithms', MIT Press, ISBN 978-0-262-03384-8, 2009
2. Fayez Gebali, 'Algorithms and Parallel Computing', Wiley, ISBN 978-0-470-90210-3,2011
3. Michael T. Goodrich and Roberto Tamassia, 'Algorithm Design: Foundations, Analysis and Internet Examples', Wiley, ISBN 978-81-2 -0986-7, 2001
4. Rajeev Motwani and Prabhakar Raghavan, 'Randomized Algorithms', Cambridge University Press, ISBN: 978-0-521-61390-3, 1995
5. Dan Gusfield, 'Algorithms on Strings, Trees and Sequences', Cambridge University Press, ISBN: 0-521-67035-7, 1997
6. Anany Levitin, 'Introduction to the Design and Analysis of Algorithms', Pearson Education,2002

Online Resources:

1. NPTEL Courses
   https://onlinecourses.nptel.ac.in/noc19_cs47/preview
2. Coursera Courses
   https://www.coursera.org/specializations/data-structures-algorithms

List of Experiments
1. Solve the problem of giving change to a customer using the smallest possible number of coins using a greedy strategy. 2. Implement 0/1 Knapsack problem using branch and bound and dynamic programming techniques. 3. Solve the Travelling Salesperson Problem using dynamic programming and compare it with a greedy approach. 4. Solve the Minimum Cut problem in an undirected graph using a randomized algorithm. 5. Implement multithreaded matrix multiplication and analyze the performance. 6. Implement distributed BFS and compare it with a centralized approach. 7. Simulate a basic string matching system using Naive and Rabin-Karp algorithms. 8. Mini Project: Apply algorithmic strategies to a domain-specific problem in IoT or Data Science.

CD31232: ARTIFICIAL INTELLIGENCE

Teaching Scheme	**Examination Scheme**				
Credits: 03 **Lecture (L):** 02 hrs / week **Practical (P):** 02 hr / week	CIE	SCE	ESE	PR	Total
	20	20	40	20	100

Prerequisites: Linear Algebra, Probability and Statistics, Discrete Mathematics

Course Objectives:

1. To understand the various characteristics of intelligent agents.
2. To learn the different search strategies in AI.
3. To learn knowledge representation and working knowledge of reasoning in presence of incomplete and uncertain information.
4. To learn how to represent knowledge in solving AI problems and to introduce the concepts of Expert Systems and Machine Learning.
5. To know about the various applications of AI.
6. To know advancements of AI

Course Outcomes:

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

1. Understand different types of AI Agents and environment.
2. Implement various AI search algorithms.
3. Understand fundamentals of knowledge representation and working knowledge of reasoning in presence of incomplete and uncertain information.
4. Apply knowledge representation, reasoning and machine learning techniques to real world problems and design the Expert Systems.
5. Apply AI techniques for real world application.
6. To understand best practices for scalability, reliability, and security in cloud-based AI and ML solutions.

Contents

Unit I: Introduction to Artificial Intelligence& Intelligent Agents (6 Hrs)

Introduction, Definition, Future of Artificial Intelligence, Characteristics of Intelligent Agents, Typical Intelligent Agents, Environment, Environment Types, Problem Solving Approach to Typical AI problems.

Defining the problem as a State Space Search, Problem Characteristics, Problem solving Methods, Search Strategies: Uninformed - Informed - Heuristics

Constraint Satisfaction Problems, Constraint Propagation, Backtracking and look ahead strategy Search.

Unit II: Search Strategies (6 Hrs)

Uninformed Search Strategies: Breadth-first search, Depth-first search

Informed (Heuristic) Search Strategies: Greedy best first search, Optimal search: A* search, Minimizing the total estimated solution cost

Heuristic search techniques: Heuristic Function, Generate and test, Hill Climbing, Best-First Search, Beam search, Tabu Search.

Unit III: Knowledge Representation and Inference (6 Hrs)

Knowledge representation, Types of knowledge, Structured representation of knowledge, Propositional logic, Predicate logic, First order logic. Rule based expert system, Rules
Inference: Backward chaining, Forward chaining, Rule value approach, Inference engine, Rules.
Knowledge Representation: Conceptual Dependency, Frames, Semantic nets.

Unit IV: Planning & Learning in Expert Systems (6 Hrs)

Planning: Block world problem, Goal Tree, Non-linear planning, Hierarchical planning, Goal stack planning
Definition of learning, Forms of learning, learning by taking advice, Learning in problem solving, Induction learning, Explanation based learning, Formal learning theory, Ensemble learning.
Expert systems - Intelligent System Vs Expert system, Architecture of expert systems, Roles of expert systems, Knowledge Acquisition, Meta Expert systems shells.

Unit V: AI Applications (6 Hrs)

AI in Speech Recognizer, Natural Language Processing, Chatbots, Computer Vision, Role of AI in Industry 4.0 and industry 5.0.
AI in Robotics – Robotic sensors, Agriculture robots, Domestic robots, Delivery robots, Mining robots, Space robots, Robotics in biological sensing, Unmanned Aerial Vehicle – UAV, Forestry.
AI in E-commerce, Education, Manufacturing, Navigation, Healthcare, Gaming, Social media, Security, Lifestyle

Unit VI: Advancements of AI on Cloud Platforms (6 Hrs)

Amazon Web Services (AWS): Amazon SageMaker, Alexa, Lex, and Polly, Conversational gents, Amazon Comprehend, natural language processing, Amazon Rekognition, image and video, Amazon Translate, Amazon Machine Learning, Amazon Transcribe, transcription, Amazon Textract, document analysis.
Microsoft Azure: Microsoft Azure Machine Learning Studio, Azure Machine Learning Service, Azure Cognitive Services Google Cloud Platform (GCP): AI Hub Google Cloud AI Building Blocks

Textbooks:

1. Stuart Russell, Peter Norvig, Artificial Intelligence: A Modern Approach, Prentice Hall, Fourth edition, 2020
2. Artificial Intelligence by Elaine Rich, Kevin Knight and Nair ISBN-978-0- 07008770-5, TMH
3. Artificial Intelligence by Patrick Henry Winston, Addison-Wesley PublishingCompany,ISBN 0-201-53377-4

Reference Books:

1. Artificial Intelligence with Python -Second Edition-Alberto ArtasanchezPrateek Joshi-Packt Publishing Ltd
2. Artificial Intelligence by Saroj Kausik ISBN:- 978-81-315-1099-5, Cengage Learning
3. Artificial Intelligence and Intelligent Systems by Padhy, Oxforfd University Press
4. Deepak Khemani, “A First Course in Artificial Intelligence”, McGraw HillEducation(India), 2013, ISBN : 978-1-25-902998-1

List of NPTEL Courses:

1. https://cse.iitkgp.ac.in/~pallab/artificial_intelligence_autumn_2020/index.html
2. https://onlinecourses.nptel.ac.in/noc22_cs56/preview
3. https://onlinecourses.nptel.ac.in/noc23_ge40/preview

List of Assignments:

Similar problem statements can be floated for each batch by subject in-charge. Implement any 7 of them.

1. Implement DFS, BFS for 8-puzzle problem .
2. Implement constraint satisfaction problem.
3. Perform parsing of family tree using knowledge-base.
4. To Implement A* Algorithm for an application.
5. Implement minmax algorithm for game playing.
6. Implement basic search strategies – 8-Queens Problem
7. Implement Forward Chaining Algorithm
8. Implement backward chaining algorithm
9. Create a Chabot application for any real-world scenario

CD31233: COMPUTER NETWORKS

Teaching Scheme	Examination Scheme				
Credits: 03 **Lecture (L):** 02 hrs / week **Practical (P):** 02 hr / week	CIE	SCE	ESE	OR	Total
	20	20	40	20	100

Prerequisites: Digital Electronics

Course Objectives:

1. To study the fundamentals of networking
2. To understand functionalities of Physical and Data link layer
3. To understand the functionalities of Network Layer
4. To study the various network protocols

Course Outcomes:

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

1. Discuss network design and concepts
2. Explore the functions of OSI layers & TCP/IP protocol stack
3. Break down the functionality of network layer-wise..
4. Use and simulate the various network protocols

Contents

Unit I: Explore the Network **(6 Hrs.)**

LANs, WANs, and the Internet, The Network as a Platform, Network Components, Network connecting devices, IEEE standards. Addressing: Physical & logical Addresses, Port Addresses, Specific Addresses. Rules of Communication: Communication Fundamentals, Rule Establishment, Message Encoding, Message Formatting and Encapsulation, Message Size, Message Timing, Message Delivery options.

Unit II: Physical Layer and Data Link Layer **(6 Hrs.)**

Standard terminologies: Protocols, Protocol Suites, Standard Organization, Benefits of using layered Model, OSI Reference Model, TCP/IP Protocol Model, Data Transfer in the Network: Data Encapsulation and Data Access. Physical Layer Protocols, Network Media, Data Link Layer Protocols, Media Access Control. Types of Errors: Redundancy, Detection Versus Correction, Forward Error Correction Versus Retransmission. Ethernet IEEE standards, Standard Ethernet, Fast Ethernet, Gigabit Ethernet. Ethernet Protocol, LAN Switches, Address Resolution Protocol.

Unit III: Network Layer **(6 Hrs.)**

Introduction to Network Layer Protocols, Introduction to Routing and Routers, IP Addressing: IPv4 Network Addresses, IPv6 Network Addresses, Connectivity Verification.

Addressing Schemes: Classful, classless, Sub netting IP Networks: sub netting an IPv4 Network, Design consideration for IPv6

Unit IV: Routing Essentials (6 Hrs.)
Routing, Router Functions and Configuration (Configuring a Cisco Router), Routing Decisions and Operations, The Routing Table, Static Routing and Default Routing, Dynamic Routing and Protocols, Static vs. Dynamic Routing.

Textbooks:

1. S. Tanenbaum : "Computer, Networks", PHI Publication, 4th edition, ISBN: 8178087855. July 2018
2. Fourauzan B., "Data Communications and Networking", 5th Edition, TataMcGraw- Hill, Publications, ISBN-13: 978-1259064753 ISBN-10: 1259064751, July 2017
3. Kurose, Ross, "Computer Networking a Top Down Approach Featuring the Internet", Pearson, ISBN-10: 0132856204, March 2012

Reference Books:

1. Routers and Routing Basics CCNA 2 Companion Guide- Webdell Odom, Rick McDonald.
2. CCNA Routing and Switching 200-125 Official Cert. Guide Library.
3. Cisco CCNA Command Guide- An introductory Guide for complete beginners & Course material

List of Courses:

1. CCNA Module : https://www.netacad.com/courses/ccna-introduction-networks?courseLang=en-US
2. CCNA Module : https://www.netacad.com/courses/ccna-switching-routing-wireless-essentials?courseLang=en-US

List of Assignments:

Similar problem statements can be floated for each batch by subject in-charge.
Implement any 7 of them.

1. Study of basic TCP/IP network commands and utilities (eg: ping, ifconfig, tracert, arp, tcpdump, whois, host, netstat, nslookup, ftp, telnet etc…)
2. Identify MAC and IP addresses (physically as well as using packet tracer tool): Study with example like identify IP addressing schema , ranges used in VIIT campus.
3. Configuration of initial Switch setting: Example will be provided like configure switch for a particular lab.
4. Configure a router (Ethernet & Serial Interface) using router commands including access lists on any network simulator (eg. Packet Tracer)
5. Network design and implementation of small network using Packet Tracer
6. Design a network/VLAN using a packet tracer tool: Example will be provided like VLAN for different departments in same campus.
7. Network analysis as well as packet header study with the help of any protocol analyzer/ packet sniffer. (eg: wireshark)
8. Installation and Configuration of Remote Login Service Telnet/SSH and access it through Telnet/SSH client
9. Installation and Configuration of FTP server and access it through FTP Client
10. Installation and configuration of DHCP Server in Wireless Environment using an Access Point (Packet Tracer)
11. Case Study of existing College network with IP Address Scheme.

MDM31235: Statistical Methods in Six Sigma

Teaching scheme	Examination Scheme					
Credits: 3	ISA				ESA	Total
Lectures (L): 2 Hrs./week	HA	Tutorial	SCE	TW	OR	
Tutorial (T): 1 Hr/week	10	10	20	20	40	100

Prerequisite(s): Manufacturing Processes, Manufacturing Technology, and Metrology and Quality Controls

Course Objectives:

1. To introduce the concept and methodology of Six Sigma for process improvement.
2. To provide knowledge of statistical tools used in Six Sigma projects.
3. To enable students to apply statistical techniques to reduce process variation.
4. To develop skills in data-driven decision making through Six Sigma tools (DMAIC).
5. To prepare students to work as part of Six Sigma teams in real-world scenarios.

Course Outcomes: After successful completion of the course, students will be able to

1. Apply basic and advanced statistical tools for process analysis and improvement.
2. Analyse process performance using control charts, process capability indices, & variation studies.
3. Perform hypothesis testing and regression analysis in Six Sigma projects.
4. Interpret and implement DMAIC methodology with appropriate statistical techniques.
5. Evaluate the effectiveness of improvement strategies using Design of Experiments (DOE) and statistical software.

Contents

Unit-I: Foundation of Quality and Six Sigma principles (6 Hrs.)

Introduction to quality, Total Quality Management (TQM): history, principles, and seven quality control tools, cost of quality, cost of poor quality, voice of customer and stakeholders. Definition, origin and principles of Six Sigma, DMAIC (Define, Measure, Analyze, improvement and control) methodology and role of statistics in Six Sigma

Unit-II: Data Collection and Analysis in Six Sigma (6 Hrs.)

Data collection methods and types of data, measures of central tendency and dispersion, Graphical tools for data analysis: Histograms, Box plots, Pareto Charts, Run charts, Measurement System Analysis (MSA), Gage R&R studies.

Unit-III: Statistical Process Control (6 Hrs.)

Control charts for variables and attributes ($\bar{X}$-R, $\bar{X}$-S, p, np, c, u charts), Acceptance Sampling: Design of Acceptance Sampling Plans for Attributes and Variables, interpretation of control charts and process capability analysis: measures and indices (Cp, Cpk, Pp, Ppk).

Unit-IV: Hypothesis Testing and Experimental Design (6 Hrs.)

Sampling distribution, Central Limit Theorem, Hypothesis testing: Fundamentals- single population test, two population tests. Introduction to Design of Experiment- Randomized Block Design, Factorial Design, Fractional Factorial Design, Taguchi Method: Key Concepts and illustrative application.

Correlation: scatter diagram, correlation coefficient and Regression Analysis: Fitting equations to data and accelerated stability test. ANOVA-one way, two-way and Multivariate Analysis. Design for Six Sigma: DMADV, DMADOV, DFX (Design for excellence), and Team Management.

Textbooks:

1. Allen, Theodore T.. Introduction to Engineering Statistics and Lean Sigma: Statistical Quality Control and Design of Experiments and Systems. United Kingdom: Springer London, 2010 .ISBN:9781849960007, 1849960003
2. Barsalou, Matthew A.. The ASQ Pocket Guide to Statistics for Six Sigma Black Belts. United States, ASQ Quality Press, 2015.ISBN:9780873898935, 0873898931

Reference Books

1. Breyfogle, F. W. (2003). Implementing Six Sigma: Smarter Solutions Using Statistical Methods, Second Edition. United Kingdom: Wiley. ISBN:9780471265726, 0471265721

List of Tutorials:

1. Application of Six Sigma in Semiconductor Manufacturing. (Case study of Motorola)
2. Improving the efficiency of the banking and transaction processes by reducing errors and streamlining operations. (Case study of Bank of America)
3. Six Sigma methodologies in the healthcare industry to optimize processes like MRI scan procedures and diagnostic systems. (Case study of Siemens Company)
4. Six Sigma for Consumer Research and Product Development (Case study of PepsiCo)
5. DMAIC methodology and statistical method implementation in manufacturing. (Case study of General Electrics)
6. Statistical process Control and DOE for quality improvement in manufacturing. (Case study of Toyota)

CD31234A: CLOUD COMPUTING

Teaching Scheme	**Examination Scheme**				
Credits: 04	CIE	SCE	HA	ESE	Total
Lecture (L): 02 hrs / week **Tutorial (P):** 01 hr / week	20	20	20	40	100

Prerequisites: Programming Paradigm Methodology

Course Objectives:

1. Understand the fundamental concepts of cloud computing, networking, storage, and Linux essentials to build a strong foundation for cloud-based solutions.
2. Apply AWS core services, security mechanisms, Infrastructure as Code (IaC), and serverless computing to design and deploy scalable cloud applications.
3. Demonstrate containerization and orchestration with Docker & Kubernetes
4. Design and develop CI/CD pipelines, automation testing, and monitoring tools to optimize software development and operational efficient

Course Outcomes:

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

1. Explain cloud computing, networking, storage, and Linux essentials.
2. Utilize AWS services, security mechanisms, and Infrastructure as Code (IaC) for cloud application deployment.
3. Implement containerization and orchestration using Docker and Kubernetes for efficient cloud-native application management
4. Develop CI/CD pipelines, automation testing, and monitoring solutions to enhance software development and operations
5. Apply cloud security best practices, access control mechanisms, data protection techniques, and compliance tools to ensure secure cloud operations
6. Design and deploy cloud-native applications leveraging microservices, serverless architectures, and explore emerging cloud technologies such as AI/ML and edge computing.

Contents

Unit I: Introduction to Cloud **(6 Hrs)**

Network Fundamentals: The OSI Model, TCP vs UDP, IP addressing & Subnetting, Routing & Firewall.

Storage Fundamentals: Block Storage, Object Storage, File storage, SAN, NAS Linux Introduction and Essential Commands: Introduction, History, Usage, Flavours.

Linux Commands Shell Scripting: Basics, Arithmetic & Logical Operations, Cron, Loops.

Cloud Fundamentals: Introduction to Cloud Computing, Properties of Cloud, Benefits of Using Cloud, Cloud Service Models (IaaS, PaaS, SaaS), Cloud Deployment Models (Public, Private, Hybrid, Multi-Cloud). Case Studies: Configure IP addressing, subnetting, and firewalls in a Linux environment

Unit II: AWS Fundamentals **(6 Hrs)**

AWS Accounts and Security: Overview of AWS Accounts, Creating an AWS Account, Securing an AWS Account, Setting Up a Budget in AWS, Introduction to Identity and Access Management (IAM), Creating Access Keys and Configuring AWS CLI v2 Tools.
AWS Core Services: Introduction to Simple Storage Service (S3), Basics of Virtual Private Cloud (VPC), Introduction to Elastic Compute Cloud (EC2), Load Balancing Concepts, Overview of AWS Systems Manager.
Infrastructure as Code & Serverless Computing: Introduction to Infrastructure as Code with AWS CloudFormation, Basics of AWS Lambda for Serverless Computing.
Case Studies: Develop a **serverless function** using **AWS Lambda** and trigger it using an S3 event.

Unit III: Docker and Kubernetes (6 Hrs)

Virtualization Fundamentals: Virtualization, Hypervisor, Docker containers, Containers vs VMs. **Docker Introduction**: Docker Engine Architecture, Docker Engine Setup on Linux or windows, Basic Container Operations, interacting with a Running Container, Stopping and Removing a Container, **Docker Image Management:** Docker Image Registry, Removing a Docker Image, Save and Load Images, Docker Engine, **Docker Storage & Volumes**: Understanding Docker Storage and Docker Volumes. Docker Compose: Introduction to Docker Compose, defining and running multi-container applications
Kubernetes: Architecture, Scheduling, Application Lifecycle Management, Security,Helm Introduction. Case Studies: Implement **Kubernetes Deployments, Services, and Ingress Controllers**.

Unit IV: DevOps (6 Hrs)

Introduction to DevOps: DevOps culture and principles, Benefits of DevOps, Comparison with traditional software development methodologies. Continuous Integration and Continuous Delivery (CI/CD): CI/CD pipeline overview, Tools used in CI/CD (Jenkins, GitHub Actions, GitLab CI/CD, CircleCI).
Version Control with Git and GitHub: Basic Git commands (clone, commit, push, pull, merge, branch), Working with Git repositories (local and remote), Collaboration using GitHub (pull requests, issue tracking).
Configuration Management & Infrastructure as Code (IaC): Introduction to configuration management, Tools for automation (Ansible, Puppet, Chef, Terraform)
Case Studies: Set up and use **Git for version control** (clone, commit, push, pull, branching, merging).

Unit V: Cloud Security & Compliance (6 Hrs)

Security in Cloud: Shared Responsibility Model, Cloud Security Best Practices; Identity and Access Control: IAM Policies, MFA, Roles, Federated Access; Data Protection: Encryption at Rest/In Transit, Key Management (AWS KMS); Compliance & Auditing: AWS Artifact, CloudTrail, GDPR, HIPAA, PCI-DSS; Threat Detection: GuardDuty, AWS Inspector, Security Hub.
Case Study: Implement role-based access control in AWS with IAM & configure CloudTrail for activity logging

Unit VI: Cloud-Native Applications & Emerging Trends (6 Hrs)

Cloud-Native Architecture: Microservices, 12-Factor App Principles; Serverless & Event-Driven Architecture: AWS Lambda, SNS, SQS; Containers & Microservices: Service Mesh (Istio), Container Orchestration Trends; Edge & Hybrid Cloud: AWS Outposts, Azure Stack, Edge Use ,DynamoDB

Text Books:

1. Karl Matthias, Sean P. Kane – Docker: Up & Running: Shipping Reliable Containers in Production, O'Reilly Media,.Artificial Intelligence by Elaine Rich, Kevin Knight and Nair ISBN-978-0-07008770-5, 2017, TMH.
2. Rajkumar Buyya, Christian Vecchiola, S. Thamarai Selvi – Mastering Cloud Computing, McGraw Hill, ISBN-13: 978-1-25-902995-0, 2013

Reference Books:

1. David Clinton, Bernard Golden – AWS Certified Solutions Architect Study Guide, Sybex, 2022
2. Michael Hausenblas, Stefan Schimanski – Cloud Native Infrastructure: Patterns for Scalable Infrastructure and Applications in a Dynamic Environment, O'Reilly Media, 2019.

List of NPTEL Courses:

1. https://online-pmo.com/wp-content/Education/Learning%20DevOps.pdf
2. https://git-scm.com/book/en/v2, https://www.techmagic.co/blog/best-application-deployment-strategies
3. https://www.jenkins.io/doc/

List of Assignments:

Similar problem statements can be floated for each batch by subject in-charge. Implement any 7 of them.

1. Execute basic Linux commands (file operations, process management, user management).
2. Write and execute Shell scripts (arithmetic operations, loops, conditional statements)
3. Deploy a Static Website on AWS – Host a website using Amazon S3 and configure public access.
4. Launch and configure an EC2 instance with a web server.
5. Containerization with Docker – Install Docker, create containers, manage images, and use volumes.
6. Kubernetes Deployment – Set up a Kubernetes cluster and deploy a sample application.
7. Configuration Management with Ansible – Write a playbook to deploy a web server.
8. CI/CD Pipeline with Jenkins – Automate application deployment using GitHub and Jenkins.
9. Automating Infrastructure Deployment – A company needs to deploy multiple virtual machines and networking components on AWS. Use Terraform or CloudFormation to automate the deployment and explain the advantages of Infrastructure as Code (IaC).
10. Building a Secure Web Application – Develop and deploy a secure web application using AWS EC2, S3, and a load balancer. Implement IAM roles and policies for access control.
11. Serverless Application Development – Design a serverless application using AWS Lambda, API Gateway, and DynamoDB for an event-driven use case (e.g., online quiz, real-time chat, or notification system)
12. Containerized Microservices Deployment – Convert a monolithic application into containerized microservices using Docker and deploy it on Kubernetes. Evaluate the benefits of containerization
13. CI/CD Pipeline for Application Deployment – Set up a CI/CD pipeline using Jenkins, GitHub Actions, or GitLab CI/CD to automate application deployment. Integrate unit testing and deployment strategies.
14. Monitoring and Logging in Cloud Environments – Implement a monitoring solution using Prometheus and Grafana or AWS CloudWatch for a cloud-based application. Analyze logs and set up alerts.
15. Optimizing Cloud Costs for an Enterprise – A company experiences high cloud costs. Analyze their AWS billing and suggest optimizations using auto-scaling, reserved instances, and cost monitoring tools

CMUA32204A: SOFT COMPUTING

Teaching Scheme	**Examination Scheme**				
Credits: 04	CIE	HA	SCE	ESE	Total
Lecture (L): 02 hrs / week **Tutorial (P):** 01 hr / week	20	20	20	40	100

Prerequisites :Linear Algebra, Data Structure, Machine Learning

Course Objective(s):

1. To introduce the fundamental principles of soft computing and its differences from hard computing techniques.
2. To provide in-depth knowledge of neural networks, fuzzy logic, and evolutionary algorithms for intelligent problem-solving.
3. To explore the biological inspiration and mathematical modeling of artificial neurons and fuzzy sets.
4. To enable students to understand and apply optimization techniques for modeling, analyzing, and solving complex engineering and decision-making problems..
5. To provide a foundational understanding of genetic algorithms, focusing on their architecture, operators, and role in evolutionary optimization.
6. To expose students to swarm intelligence algorithms such as PSO, ACO, GWO, and WOA and their real-world applications.

Course Outcomes(s):

Upon completion of course, students will be able to:

1. Learn soft computing techniques and their applications.
2. Analyze various neural network architectures.
3. Define the fuzzy systems.
4. Understand the genetic algorithm concepts and their applications.
5. Identify and select a suitable Soft Computing technology to solve the problem; construct a solution and implement a Soft Computing solution.

Contents

Unit I: Introduction to Soft Computing
(6 Hrs)

Introduction, the need for Soft Computing. Comparison between Hard Computing and Soft Computing, Overview of Soft Computing techniques and tools – Fuzzy Logic, Neural Networks,

Agents and Environments, Structure of Agent, Types of Agents, Some applications of soft computing techniques and Evolutionary Algorithms. Characteristics of Soft Computing systems. Intelligent Agents: Agents and Environments, Structure of Agent, Types of Agents, Some applications of soft computing techniques

Unit-II : Neural Networks (6 Hrs)

Biological and Artificial Neurons**:**Structure of a biological neuron,Nerve structure and synapse,Artificial neuron: basic model,Mathematical representation of a neuron,Activation Functions:Threshold,Sigmoid,Tanh,ReLU and variants,Importance and selection of activation functions, Neural Network Architectures:Single-layer feed forward network,Multilayer feedforward network (MLP),Recurrent neural networks (RNN),Functional differences and use-cases, Learning Techniques in Neural Networks,Supervised learning,Unsupervised learning,Reinforcement learning, Perceptron and Convergence Rule, Structure of perceptron,Perceptron learning rule, Convergence theorem and limitations,Linearly separable problems, Perceptron Models:Single-layer perceptron,Limitations of single-layer networks,Extension to multilayer perceptron.Multilayer Perceptron (MLP) and Backpropagation,Applications of Neural Networks

Unit -III : Fuzzy Logic (6 Hrs)

Fuzzy Set Theory: Introduction to fuzzy sets, difference between fuzzy sets and crisp sets, crisp and fuzzy relations, basic fuzzy set operations and membership functions. Fuzzy Logic: Basics of fuzzy logic, fuzzy rules, fuzzy reasoning, and fuzzy operations. Fuzzy Inference System: fuzzification, rule evaluation, defuzzification, and use of fuzzy controllers in simple systems.

Unit -IV Optimization (6 Hrs)

Overview of Optimization: Introduction to optimization and its importance in engineering problems. Basics of optimization terminology – design variables, constraints, objective function, and problem formulation. Classical Optimization Methods: Introduction to classical methods, single-variable optimization, multi-variable optimization, and constrained optimization techniques. Optimization Techniques: Optimality criteria, Overview of direct search methods and Simplex search methods

Unit - V Genetic Algorithms (6 Hrs)

Concept of genetics and evolution – application of evolutionary principles to probabilistic search – basic genetic algorithm framework – GA operators: encoding, selection, crossover,mutation – solving single-objective optimization problems using GAs – introduction to real-world applications

Unit VI Swarm Intelligence (6 Hrs)

Swarm Intelligence: Introduction to Bio-Inspired Optimization Techniques. Particle Swarm Optimization (PSO): Concept, properties, algorithm formulation, pseudo-code, parameters, premature convergence, real-valued and binary PSO.Ant Colony Optimization (ACO): Concept, formulation, pseudo-code. Applications of PSO and ACO.Grey Wolf Optimization (GWO) and Whale Optimization Algorithm (WOA): Formulation and pseudo-code

List of Assignment

1. Implement fuzzy set operations using C/C++/Java language.
2. Implement fuzzy relational operations using C/C++/Java language

3. Write a program to solve a single objective function problem using Grey wolf optimization technique.
4. Write a program to solve a single objective function problem using CSA optimization technique.
5. Write a program to simulate the working nature of Ant Colony Optimization.
6. Solve some mathematical data based problems using the steps of PSO.

Text books:

1. S. N. Sivanandam and S. N.Deepa, Principles of soft computing – John Wiley & Sons, 2007.
2. Timothy J. Ross, Fuzzy Logic with engineering applications , John Wiley & Sons, 2016.

Reference Books:

1. N. K. Sinha and M. M. Gupta, Soft Computing & Intelligent Systems: Theory & Applications- Academic Press /Elsevier. 2009.
2. Simon Haykin, Neural Network- A Comprehensive Foundation- Prentice Hall International, Inc.1998
3. R. Eberhart and Y. Shi, Computational Intelligence: Concepts to Implementation, Morgan Kaufman/Elsevier, 2007.
4. Driankov D., Hellendoorn H. and Reinfrank M., An Introduction to Fuzzy Control- Narosa Pub., 2001.

List of NPTEL / MOOC Courses:

1. Introduction To Soft Computing By Prof. Debasis Samanta | IIT Kharagpur, https://onlinecourses.nptel.ac.in/noc22_cs54/preview
2. NOC:Introduction to Soft Computing, IIT Kharagpur Prof. Debasis Samanta https://nptel.ac.in/courses/106105173
3. NPTEL Video Course : NOC:Introduction to Soft Computing http://www.digimat.in/nptel/courses/video/106105173/L01.html
4. Optimization Theory and Algorithms , By Prof. Uday Khankhoje | IIT Madras https://onlinecourses.nptel.ac.in/noc24_ee122/preview

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Vishwakarma Institute of Information Technology, Pune-48

(OPEN ELECTIVE-III)

CSOEUA31236A Software Testing and Quality Assurance

Teaching Scheme	Examination Scheme						
Credits: 2	CIE	HA	SCE	ESE	OR	TW	TOTAL
Lecture's/Week(L): 2 Hrs/week	20	20	20	--	40	---	100
Practical/Week(P): --------							
Tutorial/Week(T): ----------							

Prerequisites: Software Engineering.

Course Objectives:

- To explore the historical evolution of Quality Assurance (QA) from its origins in manufacturing to its modern role in software development, emphasizing key milestones such as Statistical Quality Control, Total Quality Management, and the digital transformation of QA practices
- To introduce the basics of software engineering, development life cycles, and software testing methods.
- To teach the process of planning, executing, and managing software tests, including how to gather test requirements, create test plans, execute tests, and handle defects.
- To introduce Agile Testing and explain how it differs from traditional testing methods like Waterfall, with a focus on Scrum-based testing practices and the Agile Testing Quadrants.

Course Outcomes:

After studying this course, students will be able to:

- Students will be able to trace the development of QA from manufacturing processes to contemporary software frameworks, explain the significance of each historical phase, and identify how QA principles are applied in current digital environments.
- Students will understand how software is built, the steps involved, and how testing ensures software works correctly and safely.

- Students will be able to create and manage test plans, execute manual tests, log defects, and generate key reports throughout the software testing life cycle.
- Students will understand Agile testing principles, compare Agile and Waterfall testing approaches, and identify the types of tests used in Agile environments

Unit I : Prelude to Software Testing	**6 Hrs**

How Quality Assurance Evolved – From Manufacturing to Software, The Birthplace of QA – Manufacturing
Rise of Statistical Quality Control QA Became Critical during 1940s Total Quality Management (TQM)
Rise of Software Development Software Testing Becoming a Role The Modern Era The Digital Shift – QA at Full Speed Conclusion: From Factories to Frameworks

Unit II : Introduction to Software Testing	**6 Hrs**

What is Software Engineering, Software Development Life Cycle (SDLC)
Methodologies: Waterfall, Iterative, V-Model, Agile (DevOps, Develops) Roles in a SDLC Team
What is Testing? Why is it needed (Objective)Differences: QA vs QC Principles of Software Testing White Box & Black Box Testing Types by approaches: Static (GAP analysis) vs Dynamic Testing, Shift Left & Shift Right Testing, Exploratory Testing, Compatibility Testing, Usability testing, UX/UI testing, Interoperability testing, Multi Device testing (Mobile), Cross Browser testing. Testing Types by Objective: Functional Testing, Manual Testing. Automated Testing, Non-Functional Testing (NFT) Performance Testing, Security Testing ETL & Data Migration Testing, Software Testing Life Cycle (STLC) in Waterfall model, Software Testing Life Cycle (STLC) in Agile Methodology

Unit III : Software Testing Life Cycle (STLC) in Waterfall model	**6 Hrs**

Test Requirement gathering Test Strategy & Test Plan Artefacts Signoffs Test ware components & Usage Module, Function, Sub-function, Test Case, Test Condition & Test Scenario Test Data Types: Synthetic & migrated data Techniques: Equivalence Partitioning, Boundary Value Analysis, Decision Table Testing, State Transition Testing Requirement Traceability Matrix (RTM) Test execution run plan GAP Analysis (Static Testing) Artefacts Signoffs Manual Test Execution & Test log creation Test execution status report Defect log & report Defect Life Cycle Defect Management Process & Workflows Defect categorization: Severity, Priority Defect Management Tools Test execution summary report Defect summary report

Unit IV : Software Testing Life Cycle (STLC) in Agile Methodology	**6 Hrs**

What is Agile Testing? Difference from traditional testing (Waterfall/Sequential) Scrum-Based Testing
Overview of the Agile Testing Quadrants Unit Tests / Component Tests Functional Tests / Acceptance Tests Non-functional Tests (Performance, Security) Exploratory & Usability Testing
Waterfall vs Agile: A Drawing Parallels Process & Approach - Comparative View

Textbooks:

1. **"Foundations of Software Testing: ISTQB Certification"** *By Rex Black, Erik van Veenendaal, and Dorothy Graham*
2. **"Software Testing: Principles and Practices"** *By Srinivasan Desikan and Gopalaswamy Ramesh*
3. **"Software Testing Techniques"** *By Boris Beizer*
4. **"Lessons Learned in Software Testing: A Context-Driven Approach"** *By Cem Kaner, James Bach, and Bret Pettichord*

Reference Books:

1. **"Software Engineering: A Practitioner's Approach"** *By Roger S. Pressman and Bruce R. Maxim*
2. **"Introduction to Software Testing"** *By Paul Ammann and Jeff Offutt*
3. **"Software Quality Assurance: From Theory to Implementation** *"By Daniel Galin*

Home Assignments	
1	Create a comparison chart between at least three SDLC models (Waterfall, Iterative, Agile), highlighting their phases, pros and cons, and suitable use cases.
2	Write a brief report explaining the differences between Quality Assurance (QA) and Quality Control (QC), with real-world examples from both manufacturing and software.
3	Identify 3 examples each of functional and non-functional testing in a web-based application. Briefly describe how they are tested and their purpose.
4	Choose **two test design techniques** (e.g., Boundary Value Analysis, Decision Table Testing) and create test cases for a sample login form or ATM withdrawal function.
5	Create a sample RTM using a simple feature set (e.g., online shopping cart). Map requirements to test scenarios and test cases.
6	Draw and explain the Agile Testing Quadrants. Provide examples of tests that fall into each quadrant (e.g., Unit tests in Q1, Usability tests in Q4).
7	Describe the defect life cycle stages. Then, list at least **4 example defects** and assign appropriate severity and priority levels with justifications.
8	Write manual test cases for a simple app (like a calculator or login screen), execute them, and document the **test log**, **execution status report**, and **defect log**.
9	Create a personal **tester's portfolio** that includes: A mock test plan Sample test cases (for any app of your choice) Defect reports Screenshots or mockups Use tools like Canva or PowerPoint to creatively present your work.
10	Choose a real e-commerce site (like Amazon or Flipkart) and: ● Perform usability testing Document compatibility issues (across browsers or devices) Suggest UI/UX improvements Present findings in a short report or slide deck.

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(OPEN ELECTIVE-III)

ETOEUA31236C: Sustainable Energy Technology

Teaching Scheme (Hrs/Week)			Assessment Scheme (100-mark scale)										Credits
			ISA (40 Marks)					ESA (60 marks)				Total	
Theory	Lab	Tut	HA	SCE	PPT	GD	CIE	ESE	PR Exam	OR	TW	100	
2	0	0	20		20		20				40	100	2

Prerequisite: Readers/students are expected to know the following concepts –

1. Fundamentals of calculus and algebra for energy system calculations.
2. Familiarity with fundamental concepts in Electrical and Electronics Engineering.
3. Basic knowledge of Physics and Chemistry at the 12th-grade level.

Course objectives:

1. Understand the global energy scenario, the impact of fossil fuels, and the need for renewable energy (Unit I).
2. Explore the working principles, design aspects, and components of hydropower and wind energy systems (Unit II).
3. Gain knowledge of solar energy systems, including thermal and photovoltaic technologies and their performance parameters (Unit III).
4. Evaluate the potential and sustainability of bioenergy, biofuels, geothermal energy, and energy storage systems with the help of relevant case studies (Unit IV + PPT).

Course Outcomes: Upon completion of the course, students will be able to

1. Describe the global energy scenario and environmental impacts of fossil fuel usage, and identify the scope of renewable energy technologies. (Understand)
2. Analyze the working and performance of hydropower and wind energy systems, including design and component selection. (Analyze)
3. Evaluate the efficiency and structure of solar thermal and photovoltaic systems and differentiate between various solar technologies (Evaluate)
4. Assess the sustainability and technology of bioenergy, geothermal systems, and energy storage solutions through real-life case studies. (Evaluate/Apply)

Unit I: Introduction and Fundamental Concepts

Introduction and Fundamental Concepts, Energy Scenario in Modern World, Fossil Fuels, Climate Change Impacts and Overview of Renewable energy Technology

Unit II: Hydropower and Wind **Energy**

Introduction to Hydro Power, The Fundamentals of various Turbine working principle, Hydroturbine Selection Principle, Pumped Hydro Storage, Worked Out Examples of HydroPower, Introduction to Wind Energy, Wind Speed and Power Analysis, Design of Wind Turbine, Wind Turbine Parts and Performance

Unit III: Solar Energy and Solar Photovoltaic Systems

Introduction to Solar Energy, Solar Thermal Energy Systems, Solar Water Heaters, Introduction to Solar Photovoltaic Systems, Solar Photovoltaic Technology, Structure of a Solar Cell and its Electrical Properties, Solar Cell Efficiency, Types of solar cells

Unit IV: Bioenergy, Biofuels and Geothermal Energy

Introduction to Bioenergy and Biofuels, Biofuel Feedstocks, Bioenergy Technology and Sustainability, Introduction of Geothermal Energy, Different types of Geothermal power systems, Introduction of Energy storage system

PPT: Case studies on different types of sustainable energy technologies.

Text Books:

1. Efstathios E. Michaelides, "Energy, the Environment, and the Sustainability," 1st edition, CRC Press

Reference Books:

- **Renewable Energy: Power for a Sustainable Future**

Author: Godfrey Boyle
Publisher: Oxford University Press

- **Solar Engineering of Thermal Processes**

Authors: John A. Duffie and William A. Beckman
Publisher: Wiley

- **Wind Energy Explained: Theory, Design and Application**

Authors: James F. Manwell, Jon G. McGowan, Anthony L. Rogers
Publisher: Wiley

We shall be following the **NPTEL course on Sustainable Energy Technology** as a reference and guideline for the structure and content of this subject. The course offers a comprehensive overview of various sustainable energy sources and storage technologies. Students are encouraged to refer to the introductory details of the course using the following link available on YouTube at: https://www.youtube.com/watch?v=HNjwoe4mSkE&list=PLyqSpQzTE6M-ZgdjYukayF6QevPv7WE-r.

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Vishwakarma Institute of Information Technology, Pune-48
(OPEN ELECTIVE-III)
Open Elective-II NDUSTRIAL ENGINEERING (IOEUA32185C)

Teaching Scheme
Credits: 3
Lectures: 3 Hrs./week

Examination Scheme
Formative Assessment: 50 Marks
Summative Assessment: 50 Marks

Prerequisite: NIL

Course Objectives:

- To introduce the concepts, principles and framework of contents of Industrial Engineering.
- To acquaint the students with various productivity enhancement techniques.
- To acquaint the students with different aspects of Production Planning and Control and Facility Design.
- To introduce the concepts of various cost accounting and financial management practices as applied in industries
- To acquaint the students with different aspects of Human Resource activities and Industrial Safety rules.
- To acquaint students with different aspect of simulation modeling for various industrial engineering\applications.

Course Outcomes:

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

1. Apply the Industrial Engineering conceptsto solve industrial problems.
2. Understand, analyze and implement different concepts in method study so as to reduce the cost.
3. Design and Develop different aspects of work system and facilities to improve effectiveness of production processes.
4. Apply Industrial safety standards and financial management practices to take financial decision.
5. Undertake project work based on modeling & simulation area.

Unit I: Introduction to Industrial Engineering and Productivity

Definition and Role of Industrial Engineering, Types of production systems and organization structure, Functions of management. Measurement of productivity: Factors affecting the productivity, Productivity Models and Index (Numerical), Productivity improvement techniques.

Unit II: Methods Study

Work Study: Definition, objective and scope of work-study, Human factors in work-study.
Method Study: Definition, objective and scope of method study, work content, activity recording and

exam aids.
Charts to record movements: Operation process charts, flow process charts, travel chart, two-handed chart and multiple activity charts.
Principles of Motion Economy: Classification of movements, SIMO chart, and micro motion study. Definition and installation of the improved method, brief concept about synthetic motion studies. Introduction to Value Engineering and Value Analysis.

Unit III: Work System Design

Work Measurements: Definition, objectives and uses, Work measurement techniques.
Work Sampling: Need, confidence levels, sample size determinations, random observation, conducting study with the simple problems.
Time Study: Definition, time study equipment, selection of job, steps in time study. Breaking jobs into elements, recording information, Rating and standard rating, standard performance, scales of rating, factors affecting rate of working, allowances and standard time determination.
Introduction to PMTS, MTMand MOST.

Unit IV: Production Planning and Control

Introduction: Types of production systems, Need and functions of PPC, Aggregate production planning. Capacity Planning, ERP: Modules, Master Production Schedule, MRP and MRP-II.
Forecasting Techniques: Causal and time series models, moving average, exponential smoothing, trend and seasonality (Numerical), Demand Control strategies (MTO, MTA, MTS).
Introduction to Supply Chain Management: Basic terminologies.

Unit V:Facility Design

Plant Location: Need and factors influencing plant location, Plant Layout: Objectives, principles, types of plant layouts.
Introduction to Assembly Line Balancing and Layout parameters to evaluate.
Material Handling systems: Objectives, relation with plant layout, principles. Types and purpose of different material handling equipment, Selection of material handling equipment.
Inventory control and Management: Types of inventories, Need of inventories, terminology, costs, Inventory Models: Basic production models, (with and without shortage and discount), ABC, VED Analysis.

Unit VI: Engineering Economy, Human Resource and Industrial Safety

Introduction to Costing: Elements of Cost, Break-Even Analysis (Numerical). Introduction to Debit and Credit Note, Financial Statements (Profit and loss account and Balance Sheet), Techniques for Evaluation of capital investments.
Human Resource Development: Functions: Manpower Planning, Recruitment, Selection, Training. Concept of KRA (Key Result Areas), Performance Appraisal (Self, Superior, Peer, 360º). Industrial Safety: Safety Organization, Safety Program

Text Books:

1. M Mahajan, Industrial Engineering and Production Management, Dhanpat Rai and Co.
2. O. P. Khanna, Industrial engineering and management, Dhanpat Rai publication
3. Martend Telsang, Industrial Engineering, S. Chand Publication.
4. Banga and Sharma, Industrial Organization& Engineering Economics, Khanna publication

Reference Books :

1. Introduction to Work Study by ILO, ISBN 988-81-204-1818-2, Oxford & IBH Publishing Company, New Delhi, Second Indian Adaptation, 2008.
2.H. B. Maynard, K Jell, Maynard ‘s Industrial Engineering Hand Book, McGraw Hill Education.
3.Askin, Design and Analysis of Lean Production System, Wiley, India
4.Zandin K.B., Most Work Measurement Systems, ISBN 0824809535, CRCPress,2002
5.Martin Murry, SAP ERP: Functionality and Technical Configuration, SAP Press; 3rdNew edition (2010).
6.Barnes, Motion and time Study design and Measurement of Work, Wiley India
7.Raid Al-Aomar, Adwerd J Williams, Onur M. Uigen ‘Process Simulation using WITNESS’, Wiley

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TY - Open Elective II - Project Planning and Management

Course code: CVOEUA31236E

Teaching Scheme	Examination Scheme				
Credits: 2 Lecture (L): 2 hrs./week Tutorial (T): NA Practical (P): NA	CIE	HA	SCE	Project Development	Total
	20	20	20	40	100

Course Objective(s):

- To impart knowledge of functions of project management and project life cycle.
- To construct CPM, PERT network for a project.
- To introduce students to financial management in the project
- To introduce students to MIS and process of project Performance Evaluation and closeout.

Course Outcomes:

Upon completion of the course, students will be able to

1. Understand what a Project is, Essential of Project Management.
2. Learn and Apply project planning and controlling techniques.
3. Understand the importance of financial aspect and economic in the project
4. Understand the use of MIS and process of project Performance Evaluation.

Section A

Basics of Project Management

Introduction to Project Management, Functions of project management, Project Life Cycle and Stages of Project.

Organization Strategy, Project Analysis and Project selection, Project Management Organization structure and organization culture, Project Definition, Activities, Work Breakdown structure.

Project Planning and controlling

Project time and cost estimation, Time Management. Developing Project Plan; Network Analysis using PERT/ CPM technique.

Resource Management and Cost Management: Resource levelling, Scheduling and allocating project resources and costs.

Reducing Project duration - Crashing project activities to speed up a project.

Section B

Financial Aspects and Engineering Economics:
Capital investments: importance and difficulties, means of finance, working capital requirements, project cash flow projections and statements, project balance sheet, profit loss account statements.
Introduction to Engineering economics, time value of money, types of costs, interests, present worth comparisons, equivalent annual worth contributions, rate of return calculations, Break even analysis, economic order quantity, Effect of inflation.

MIS and Project Evaluation
Introduction to Management Information systems (MIS) Overview, Definition. MIS and decision support systems, Information resources, Management subsystems of MIS. Role of ERP in materials management – material resource information systems
Project Evaluation, Project progress and Performance Management Project Closure, and Project Oversight. Familiarization with Project Management software (e.g., MS Project®)

Textbooks:
1. K Nagrajan, "Project Management",New age International Ltd.
2. Ahuja H.N, "Project Management", John Wiely, New York.
3. Rory Burkey, "Project Management-Planning and Control", 4th ed.—Wiley,India.
4. Project Management: A Managerial Approach, Meredith, J.R. and Mantel, S.J., Wiley, PMBOK® Guidelines Book
5. K. K. Chitkara, "Construction Project Management", Tata McGraw Hill Education Pvt. Ltd.
6. Panneerselvam R, "Engineering Economics" Delhi, PHI learning Pvt. Ltd.
7.Bedworth David D, "Engineering Economics" Tata McGraw Hill Education Pvt. Ltd.

Reference Books:
1. Bruce Barkley, "Project Risk Management", McGraw-Hill, 2004

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CSOEUA31237A: Open Elective –IV
Engineering Economics and FinTech

Teaching Scheme

Credits : 2
Lectures : 2 Hrs/week

Examination Scheme

Continuous Evaluation(CE): 20 Marks
Home Assignment (HA): 20 Marks
Skills & Competency Exam(SCE): 20 Marks
Oral Examination(OR): 40 Marks

Prerequisites:	
•	NA
Course Objectives:	
•	Economic development and related issues
•	To explain the Indian banking structure and terms like GDP, inflation
•	To introduce Cash Flow analysis and Taxes
•	To introduce FinTech and it's sub sectors
•	To explain the classification of various models of FinTech.
Course Outcomes:	
	After completion of the course, student will be able to
1.	Illustrate the fundamental concepts in engineering economics
2.	Illustrate the terms like GDP, inflation, and Indian banking structure
3.	Comprehend what FinTech is and the sub sectors that comprise it.
4.	Classify various models of the Fintech along with it's innovations

Unit I: Introduction to Economics (6h)
Introduction to Economics- Flow in an economy, Concept of Engineering Economics – Engineering efficiency, Economic efficiency, Scope of engineering economics – Element of costs, Marginal cost, Marginal Revenue, Sunk cost, Opportunity cost, Time Value of Money, Law of supply and demand
Unit II: Banking and Trades (6h)
Indian Economics – basic features, natural resources, population size and composition, national income concepts, microeconomics of India, Indian Banking, Role of Reserve bank of India, International Economy, inflation, GDP, Financial Analysis, Ratios, financial Institutions, Finance Commissions.
Unit-III: Introduction to FinTech (6h)

Introduction, Financial Services and Fintech: Introduction, Changing Environment, Customer Centricity, Digital Transformation, Definition of Fintech, History of Fintech, Fintech stages, An Overview of Fintech Initiatives Around the World, Ecosystems, Downsides of Disruptive Fintech Initiatives.		
Unit-IV: Model and Classifications (6h)		
Introduction, Classification, Five Ws and one H of FinTech, The organization and its elements, The V4 business model framework, A Business Model, A Business Model for Fintech. Business Model Canvas (BMC) for FinTech, BMC CASE Study. FinTech Innovations, Types of Innovations: Product or Services, Process, Organization		
Text Books :		
	1	B. Nicoletti, The Future of FinTech, 1st ed. Palgrave Macmillan, 2017
	2	Krugman, International Economics, Pearson Education.
	3	Thursen Gerald, Engineering Economics, Prentice Hall.
Reference Books		
	1	Accenture. (2015). The future of Fintech and banking: Digitally disrupted or reimagined? Accenture Research, 1–12
	2	Dietz M., Khanna S., Olanrewaju T., and Rajgopal K. (2015). Cutting through the fintech noise: Markers of success, imperatives for banks. Practice, G. B. (Ed.), 1–18. McKinsey and Company. Retrieved from http://www.mckinsey.com/ industries/financial-services/our-insights/cutting-through-the-noise round financial -technology.
	3	"What is FinTech and why does it matter to all entrepreneurs?". *Hot Topics. July 2014*.retrieved December 9, 2014

ETOEUA31237C : Computing for Agriculture 4.0 (Pattern 2023)
(Open Elective –IV)

Teaching Scheme	Examination Scheme				
Credits: 2	HA	CIE	SCE	TW	Total
Lecture (L): 2 hrs./week Practical(P): 0 hrs/week	20	20	20	40	100

Prerequisite: Readers/students should have completed the following courses:

- Digital System
- Sensors
- Microcontrollers Applications

Course Objectives:

- To explore the integration of computing technologies with modern agricultural practices.
- To understand how IoT, AI, and Machine Learning can revolutionize agricultural productivity.
- To introduce the concepts of Agriculture 4.0 and smart farming techniques.
- To analyze case studies demonstrating real-world applications in the agri-tech domain..

Course Outcomes:

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

1. Understand the foundations of Agriculture 4.0 and the role of computing technologies in smart agriculture.
2. Apply IoT-based solutions for real-time monitoring, automation, and precision farming.
3. Analyze how AI and machine learning algorithms support predictive modeling in crop management, disease detection, and yield optimization.
4. Evaluate real-world industry case studies that demonstrate the practical deployment of digital agriculture solutions.

Unit- I: Introduction to Agriculture 4.0 and Smart Farming (6 Hours)

Evolution from traditional to digital agriculture, Overview of Agriculture 4.0 and key enablers, Introduction to smart farming, digital twins, and cyber-physical systems in agri-tech, Role of computing and data analytics in modern agriculture, Sustainable farming and climate-smart agriculture

Unit –II: IoT Applications in Agriculture (6 Hours)

Fundamentals of IoT architecture and sensor networks, Soil monitoring, smart irrigation, and greenhouse automation, Livestock monitoring and supply chain tracking, Low-power communication protocols (LoRa, ZigBee, NB-IoT), Integration of IoT with cloud and edge computing platforms

Unit III: AI and Machine Learning in Agriculture(6 Hours)

AI-based crop disease detection and classification, ML algorithms for yield prediction and weather forecasting, Precision agriculture using computer vision and drones, Natural language interfaces for farmer interaction, Tools: TensorFlow, Keras, OpenCV, IBM Watson for Agri

Unit IV: Agriculture Industry 4.0 Case Studies and Emerging Trends (6 Hours)

Case studies from India (e.g., Fasal, DeHaat, CropIn, AgNext), Global examples: John Deere, Climate FieldView, IBM Watson Decision Platform for Agriculture, Agri-tech startups, government initiatives (eNAM, AgriStack), Digital marketplaces, data interoperability, and ethics in agri data, Future trends: blockchain in agri-supply chain, robotics in farming

Text Books:

- "Smart Agriculture: An Approach Towards Better Agriculture Management", Dr. R.B. Patel, Dr. A.K. Nayak, Springer"
- "Artificial Intelligence in Agriculture", Jeng-Shyang Pan, S. K. Nayak, B. B. Das, Springer
- "Machine Learning in Precision Agriculture: Applications and Tools", Khan Amanat Ullah, Academic Press

Reference Books:

· "Agriculture 5.0: AI, IoT and Big Data for Next Generation Farming", Prof. Sandeep Kautish, Wiley

· "Precision Agriculture for Sustainability and Environmental Protection", Margaret Oliver, Thomas Bishop, Routledge
· "Digital Technologies and the Environment in Agriculture", John E. Pratley, CSIRO Publishing
· "IoT and Data Analytics in Smart Agriculture", Mukesh Saraswat, Springer

Bansilal Ramnath Agarwal Charitable Trust's

Vishwakarma Institute of Information Technology, Pune-48

Product Development (MEOEUA31237D)

Teaching scheme	Examination Scheme									
Credits: 2 Lectures (L): 2 Hrs./week	ISA						ESA			Total
	HA	TW	SCE	PPT	GD	CIE	ESE	PR	OR	
	10	20	20			10	40			100

Prerequisite: Basic Engineering Science , Material Science, Engineering Metallurgy, Manufacturing processes, Machine Design, Computer Aided Engineering

Course objective:

1. Make the student conversant with techniques for particular phases of product development.
2. Identify Customer needs, satisfaction and commercialization of product.
3. Evaluate Forward and Reverse Engineering and its role in designing a product.
4. Recognize different techniques used for design for manufacturing.

Course Outcomes: Upon completion of the course, students will be able to

1. Design product as per customer needs and satisfaction.
2. Apply engineering, scientific, and mathematical principles to execute a design from concept to finished product.
3. Analyze methods and processes of Forward and Reverse engineering
4. Analyze methods of Design for manufacturing and analysis.

Unit I - Introduction to Product Design

Definition of product design, Essential Factors for product design, Modern approaches to product design, Characteristics of Successful Product Development, Innovative Thinking, Challenges to Product Development, product development versus product design, Product through project and operations.

Unit II - Product development

Technical Questioning, Technology Forecasting and S Curve, Customer Needs and Satisfaction, Types of customer need, Customer need model, Tools for gathering Customer Needs.
Product development process- Identification of customer needs- customer requirements, product development process flows, Product specifications, concept development and concept generation, concept selection, concept screening, concept scoring, concept testing. Interdisciplinary approach in product development.

Unit III – Reverse Engineering

Introduction of reverse engineering, Product Teardown Process, Tear Down Methods, Force Flow Diagrams, Measurement and Experimentation, Applications of Product Teardown, Benchmarking Approach and Detailed Procedure, Tools Used in Benchmarking.

Unit IV - Design for X

Design for manufacture, Design for assembly, Design for robustness, Design for safety, Design for reliability, Design for environment, Design for piece part production, manufacturing cost analysis. Local, Regional and Global issues, product life cycle management, basic life cycle assessment - basic method,

Design Failure mode effect analysis.
Text Books:
1.Product Design-Techniques in Reverse Engineering and New Product Development, Kevin Otto, Kristion Wood, Pearson Education, ISBN 978-81-7758-821-7. 2. Karl T.U. And Steven D.E., Product Design and Development, McGraw Hill, Ed 2000 3. K. Chitale; R.C. Gupta, Product Design and Manufacturing, Prentice Hall India.
Reference Books :
1. Dieter George E., Engineering Design McGraw Hill Pub. Company, 2000 **2.** Grieves, Michael, Product Lifecycle Management McGraw Hill Bralla, James G., Handbook of Product Design for Manufacturing, McGraw Hill Pub

Prepared by- Dr.S.C.Shamkuwar

Bansilal Ramnath Agarwal Charitable Trust's
Vishwakarma Institute of Information Technology, Pune-48
(An Autonomous Institute Affiliated to Savitribai Phule Pune University)
Department of Civil Engineering

Open Elective Business Analytics (CVOEUA31237E)

Teaching Scheme		Examination Scheme
Credits : 2 **Theory: 2 hrs./week** **Practical: Nil**		**HW 20 Marks, CIE 20 Marks, SCE 20 Marks, CP 40 Marks**

Prerequisite course(s): Database Management System, MS-Excel

Course Objectives:

1. To study and understand the importance of Business Analytics and need of data Visualisation for
Business Analytics
2. To study and understand the different components of analytics landscape and project cycle aligned with these components
3. To study and understand different data transformations, data modelling steps and visualize the data on the data models

Course Outcomes: At the end of the course the students will be able to:

1. Describe the importance of Business Analytics and need of data visualisation and analysis for Business.
2. Identify, describe, relate to the concepts of different components of analytics landscape and project cycle aligned with these components.
3. Design and develop different data transformations, data models, analyse and visualize the data.
4. Design and develop custom calculations based on business requirements and understand Tableau Products.

Unit-I: Introduction to Analytics and Data Visualization

Introduction to Analytics: What is Analytics? Need of Analytics, Types of Analytics, Role of Analytics in Business
Data Sources: Data Collection, Transactions Entry, Organizational Systems, Data Sources and Data Source Categories, Issues in Data and Need of Data Preparation
Power BI Desktop: Need of visualisation, Different Visualisation tools, Why Microsoft Power BI? Installation and configuration of Power BI Desktop, Setup of required connector
Data Visualization: What are KPIs? Dashboards, Reports and Scorecards, Types of Dashboards, Slicers and Filters, Setting interactivity, Drilldowns and Drill-through, Formatting your visualizations, Best practices of visualizations

Unit II: Data & Analytics Landscape and Project Cycle

Understanding Data and Databases: What is a database? What is a DBMS? What is SQL? What are tables? Organization of tables in databases, Types of Data, Database Keys, Relationships between tables, Joins and Unions, Type of Data: Structured, Unstructured and Semi-structured
BI Architecture: BI Architecture, Data Security and Governance, Administration
BI Project Lifecycle: Requirements Understanding, Data Understanding, Data Integration and Data warehouse, Reporting and Analysis, Dashboard development, Deployment, Documenting, Project Team and Roles, Challenges in Projects
Data Integration and Data Warehouses: What is Data Integration? Need of Data Integration, ETL, what is Data Warehouse? Need of Data Warehouse, Facts and Dimensions Star Schema and Snowflake Schema, Data Marts.

Unit III: Data Preparation and Data Modelling

Need of Data Preparations: What is Data Preparation? Joining data, Appending Data, New Calculations, Removing Inconsistencies, Transposing
Data Transformation [Basics]: Merging and Appending Data, Filtering, Cleaning Data, Fixing Errors, Transforming Data, Aggregating Data
Data Modelling: Setting Relationships, Creating Data Models
Data Transformations [Advanced]: Split data, Handling inconsistent data, Conditional Column, Custom column

Unit IV: Calculations, Power BI Deployment and Industry Analytics Landscape

Calculations: Introduction to DAX, Calculated Column, Calculated Measures, M-Query calculations, YTD, QTD, MTD calculations
Power BI Deployment: Overview of Power BI Service, Publishing reports to Power BI Service, Understanding the Power BI Service User Interface, Creating Dashboards in Power BI Service, Subscriptions, Comments and Data Driven Alerts, authoring reports within Power BI Service, sharing dashboards across your organization,
Power BI Mobile: Creating Dashboards for Mobiles, using dashboards and reports using Mobile App.
Tableau Overview: Introduction to Tableau, Tableau Products, Tableau architecture, Installation and Setup of Tableau Desktop, Visualizing with Tableau, Tableau online and Tableau server, Publish and share reports on Tableau online.

Assignments:
1. Write the two assignments from each unit.

Text Books :

1. Business Intelligence Guidebook: From Data Integration To Analytics" by Rick Sherman, Elsevier Inc.
2.Successful Business Intelligence, Second Edition: Unlock The Value Of BI & Big Data" by Cindi Howson, McGraw Hill Edition
3. Data Analytics For Beginners: Your Ultimate Guide To Learn And Master Data Analysis. GetYour Business Intelligence Right – Accelerate Growth And Close More Sales" by Victor Finch
4. Data Strategy: How To Profit From A World Of Big Data, Analytics And The Internet Of Things by Bernard Marr, Koganpage Publicaitons, Auva Press

Reference Books:

1. Performance Dashboards – Measuring, Monitoring, And Managing Your Business" by Wayne Eckerson, John Wiley & Sons, Inc
2. Business Intelligence Roadmap: The Complete Project Lifecycle For Decision-Support Applications" by Larissa T. Moss & Shaku Atre, Addison-Wesley information Technology Series
3. “Artificial Intelligence: Building Intelligent Systems” by Dr. Parag Kulkarni, Dr. Prachi Joshi, PHI publication (for understanding of concepts)