Annasaheb Dange College of Engineering and Technology

Ashta - 416301, Dist. : Sangli, Maharashtra

(An Empowered Autonomous Institute)

Established: 1999

F.Y. M. Tech. – Computer Science and Engineering

[Level 6.5, PG Diploma] Semester - I

Sr. No.	Course Category	Course Type	Course Code	Course Name	L	T	P	S	Cr	Evaluation Scheme (Marks)				
										Theory			Laboratory	
										MSE	TA	ESE	CIA	ESE
01	RM	T1	0CERM501	Research Methodology and IPR	3	1	0	2	4	40	20	40	-	-
02	MC	T1	0CEMC502	Mathematical Foundation of Computer Science	3	1	0	2	4	40	20	40	-	-
03	PC	LIT1	0CEPC503	Advanced Data Structures	3	0	2	2	4	40	20	40	50	50
04	PE	LIT1	0CEPE5**	Program Elective - I	3	1	2	2	5	40	20	40	50	50
05	PE	LIT2	0CEPE5**	Program Elective - II	3	1	2	2	5	40	20	40	50	-
06	MA	T2	0CEMA508	English for Research Paper Writing	2	0	0	-	0	-	50	-	-	-
				Total	**17**	**4**	**6**	**-**	**22**					

Legends: L-Lecture, T-Tutorial, P-Practical, S-Self Study, Cr-Credits, MSE - Mid-Semester Examination. CIA-Continuous Internal Assessment, TA - Teachers Assessment, ESE-End-Semester Examination

Minimum Passing Criteria	TA (Theory) : ≥ 8 / 20	MSE + ESE (Theory) : ≥ 32 / 80	TA (Theory) / CIE (Lab) : ≥ 20 / 50	ESE (Lab) : ≥ 20/50

Program Elective- I		Program Elective- II	
0CEPE504	Wireless Sensor Networks	0CEPE506	Quantum Computing
0CEPE505	Intelligent Systems	0CEPE507	GPU Computing

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Established: 1999

F.Y. M. Tech. – Computer Science and Engineering

[Level 6.5, PG Diploma] Semester - II

Sr. No.	Course Category	Course Type	Course Code	Course Name	L	T	P	S	Cr	Evaluation Scheme (Marks)				
										Theory			Laboratory	
										MSE	TA	ESE	CIA	ESE
01	OE	T1	0CEOE5**	Open Elective	3	0	0	2	3	40	20	40	-	-
02	PC	LIT2	0CEPC511	Advanced Algorithms	3	0	2	2	4	40	20	40	50	-
03	PC	LIT1	0CEPC512	Soft Computing	3	1	2	2	5	40	20	40	50	50
04	PE	LIT1	0CEPE5**	Program Elective -III	3	0	2	2	4	40	20	40	50	50
05	PE	LIT2	0CEPE5**	Program Elective - IV	3	0	2	2	4	40	20	40	50	-
06	VS	L2	0CEVS517	Seminar	0	0	4	2	2	-	-	-	50	-
07	MA	T2	0CEMA518	Pedagogy Studies	2	0	0	-	0	-	50	-	-	-
				Total	**17**	**1**	**12**	**-**	**22**					

Legends: L-Lecture, T-Tutorial, P-Practical, S-Self Study, Cr-Credits, MSE - Mid-Semester Examination. CIA-Continuous Internal Assessment, TA - Teachers Assessment, ESE-End-Semester Examination

Minimum Passing Criteria	TA (Theory) : ≥ 8 / 20	MSE + ESE (Theory) : ≥ 32 / 80	TA (Theory) / CIE (Lab) : ≥ 20 / 50	ESE (Lab) : ≥ 20/50

Program Elective- III		Program Elective- IV		Open Elective	
0CEPE513	Deep Learning	0CEPE515	Cloud Computing	0CEOE509	Business Analytics
0CEPE514	Computer Vision	0CEPE516	Digital Forensics	0CEOE510	Operation Research

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ADCET

Exit after **F.Y. M. Tech. – Computer Science and Engineering**

Additional Credits to qualify for PG Diploma

Students has to undergo an 8-week Internship in Domain (related to their Seminar) in order to qualify for PG Diploma (Exit after F. Y. M. Tech – Computer Science and Engineering)

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RM Established:

Annasaheb Dange College of Engineering and Technology
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Department of Computer Science and Engineering

ADCET

Course Information:

Class, Semester	F.Y. M.Tech – Semester I					**Category**	**RM**
Course Code, Course Title	**0CERM501** Research Methodology and IPR					**Type**	**T1**
Prerequisites	-						
Teaching Scheme (per week)	**Lecture**	**Tutorial**	**Practical**	**Self Study**	**Credits**		
	03	01	00	2	04		
Examination Scheme (Marks)	**Theory**	**MSE**	**TA**	**ESE**	**Practical**	**CIA**	**ESE**
		40	20	40		-	-

Course Outcomes (COs) :
Upon successful completion of this course, the student will be able to:

CO1	Formulate the research problem through fundamentals of research and literature review.
CO2	Identify and apply research design principles and make use of data collection and analysis techniques.
CO3	Apply quantitative methods to solve research problem.
CO4	Interpret the research problem into registering IPR and filing patents.

Syllabus:

Module	Contents	Lecture Hours
I	**Introduction to Research** Definitions and Characteristics of Research, Motivation and Objectives, Research Methods vs. Methodology. **Types of Research:** Descriptive vs. Analytical, Applied vs. Fundamental, Quantitative vs. Qualitative, Conceptual vs. Empirical, Concept of Applied and Basic Research Process, Criteria of Good Research.	08
II	**Literature Review:** Objectives of Review of Literature, Importance of Literature Review in Defining a Problem, Primary and Secondary Sources, Reviews, Treatise, Monographs, Patents, Web as a Source, Searching in the Web, Critical Literature Review, Identifying Gap Areas from Literature Review and Research Database, Development of Working Hypothesis	07
III	**Research Design** Basic Principles, Need of Research Design, Features of Good Design, Different Research Designs, Experimental Designs, Research Databases, Development of Models, Developing a Research Plan, Exploration, Description, Diagnosis, and Experimentation. **Data Collection and Analysis:** Primary and Secondary Data, Methods of Data Collection, Sampling Methods, Data Processing and Analysis Strategies and Tools	08
IV	**Quantitative Methods for Problem Solving** Basic Statistical Distributions and their Applications (No Derivations): Binomial, Poisson, Normal and their Applications in Research Studies. Fundamentals of Statistical Analysis and Inference, Multivariate methods, Concepts of Correlation and Regression Analysis, Fundamentals of Time Series Analysis and Spectral Analysis.	08
V	**Intellectual Property Rights (IPR)** Intellectual Property Rights and Patent Law, Drafting of Patents, Patent Types, Commercialization, Copy Right, Royalty, Trade Related aspects of Intellectual Property Rights (TRIPS).	07
VI	**Copyrights and Trademarks** Agreement, Features of the Agreement, Protection of Intellectual Property under TRIPS, Copyright and Related Rights, Trademarks, Geographical indications, Industrial Designs, Patents, Patentable Subject Matter, Rights Conferred, Exceptions, Term of protection, Conditions on Patent Applicants, Process Patents	07
	Total Lecture Hours	45

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List of Tutorial	
Tutorial. No	**Title / Topic of the Tutorial**
1	1. Define research and explain its significance in academic and professional contexts. 2. Differentiate between research methods and research methodology, providing examples of each. 3. Compare and contrast descriptive research with analytical research, highlighting their respective applications. 4. Discuss the criteria that constitute good research. What factors ensure the reliability and validity of research findings?
2	1. What are the primary objectives of conducting a literature review in a research study? 2. Explain the differences between primary and secondary sources. Provide examples of each in the context of research. 3. Describe the process of identifying research gaps through a critical literature review. Why is this process crucial for developing a working hypothesis? 4. How can the web be utilized effectively as a source for literature review? Discuss the advantages and potential pitfalls
3	1. What are the basic principles of research design, and why is a well-structured design essential for a research study? 2. Identify and explain the features of a good research design. How do these features contribute to the overall success of a research project? 3. Discuss the different types of research designs, including experimental designs, and their respective applications. 4. Outline the steps involved in developing a comprehensive research plan, from exploration to experimentation.
4	1. Differentiate between primary and secondary data. Provide examples of situations where each type would be appropriate. 2. Discuss various methods of data collection and the factors influencing the choice of a particular method. 3. Explain the importance of sampling methods in research. What are the key considerations when selecting a sampling technique? 4. Describe the strategies and tools commonly used for data processing and analysis in research studies.
5	1. Provide an overview of basic statistical distributions such as Binomial, Poisson, and Normal, and discuss their applications in research studies. 2. Explain the fundamentals of statistical analysis and inference. How do these concepts aid in interpreting research data? 3. What are multivariate methods, and in what scenarios are they particularly useful in research? 4. Discuss the concepts of correlation and regression analysis. How do they differ, and what insights can they provide in research?

Total Tutorial Sessions	15	Total Tutorial Hours	15

Text Books

1. C.R. Kothari and Gaurav Garg, "Research Methodology: Methods and Techniques", New Age International (P) Ltd., Publishers, Fourth Multi Colour Edition, 2020.
2. S.C. Gupta and V.K. Kapoor, Fundamentals of Mathematical statistics, Sultan Chand & Sons, New Delhi, 12th Revised Edition, 2020.
3. Paolo Brandimarte, Quantitative Methods: An Introduction for Business Management, John Wiley & Sons, 2011
4. Priya Rai, R.K. Sharma, P.K. Jain and Akash Singh, Transforming Dimension of IPR Challenges for New Age Libraries, National Law University Delhi Press, 2015.

References:

1. Garg, B.L., Karadia, R., Agarwal, F. and Agarwal, An introduction to Research Methodology, RBSA Publishers, U.K., 2002.
2. Panneerselvam, R. Research Methodology, PHI Publications, Second edition, 2014.
3. G. Ramamurthy, "Research Methodology", Oxford University Press, Second Editon, 2005.
4. Fink, A., Conducting Research Literature Reviews: From the Internet to Paper, Sage Publications, 5th edition, 2009.

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Course Information:

Class, Semester	F.Y. M.Tech – Semester I						**Category**	**MC**	
Course Code, Course Title	**0CEMC502 and Mathematical foundations of Computer Science**						**Type**	**T1**	
Prerequisites	Basic Mathematical Concepts, Discrete Mathematics								
Teaching Scheme (per week)	**Lecture**	**Tutorial**	**Practical**	**Self Study**	**Credits**				
	03	01	00	2	04				
Examination Scheme (Marks)	**Theory**	**MSE**	**TA**	**ESE**	**Practical**	**CIA**	**ESE**		
		40	20	40		-	-		

Course Outcomes (COs) :
Upon successful completion of this course, the student will be able to:

CO1	**Analyze** uncertainties in real-world applications using probability distributions, statistical methods, the Central Limit Theorem, and probabilistic inequalities.
CO2	**Develop** estimation techniques using sampling methods such as the Method of Moments and Maximum Likelihood Estimation for predictive modeling.
CO3	**Design** multivariate statistical models, including regression, classification, and principal component analysis, while addressing issues like overfitting.
CO4	**Analyze** the computational capabilities and limitations of Turing Machines, decidability, and complexity classes to assess problem solvability in theoretical computer science.
CO5	**Implement** mathematical and statistical techniques in computer science applications, including data mining, computer security, distributed systems, and machine learning.
CO6	**Explore** recent advancements in probability and statistical distributions for modern computing fields such as bioinformatics, soft computing, and computer vision.

Syllabus:

Module	Contents	Lecture Hours
I	**Probability:** Probability mass, density, and cumulative distribution functions, Parametric families of distributions, Expected value, variance, conditional expectation, Applications of the univariate and multivariate Central Limit Theorem, Probabilistic inequalities, Markov chains	08
II	**Sampling**: Random samples, sampling distributions of estimators, Methods of Moments and Maximum Likelihood.	08
III	**Statistical inference:** Statistical inference, Introduction to multivariate statistical models: regression and classification problems, principal components analysis, The problem of overfitting model assessment.	07
IV	**Turing Theory:** Introduction to Turing Machines, Types of Turing Machines, Recursive and Recursive and recursively Enumerable Languages, Church-Turing Thesis and Computability, Decidability and undecidability, Reducibility, Complexity Classes	08
V	**Computer science and engineering applications** Computer science and engineering applications: Data mining, Network protocols, analysis of Web traffic, Computer security, Software engineering, Computer architecture, Operating systems, Distributed systems, Bioinformatics, Machine learning	07
VI	**Recent Trends:** Advances in Computational Theories and Turing Computability, Recent Trends in various distribution functions in mathematical field of computer science for varying fields like bioinformatics, soft computing, and computer vision.	07
	Total Lecture Hours	45

List of Tutorial

S.No	Title / Topic of the Tutorial
1	Probability Distributions and Their Applications
2	Expectation, Variance, and Probabilistic Inequalities

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3	Central Limit Theorem and Its Applications			
4	Sampling Techniques and Estimation Methods			
5	Statistical Inference and Multivariate Models			
6	Graph Theory: Isomorphism, Planar Graphs, and Graph Coloring			
7	Hamiltonian Circuits, Euler Cycles, and Combinatorial Techniques			
8	Applications of Graph Theory in Computer Science and Engineering			
9	Computational Techniques in Statistical Analysis			
10	Recent Trends in Mathematical Applications for Computing			
Total Tutorial Sessions		**15**	**Total Tutorial Hours**	**15**

Text Books

1. Trivedi K., Probability and Statistics with Reliability, Queuing, and Computer Science Applications. Wiley.
2. Introduction to Languages and the theory of computation(John C Martin) The McGraw Hill Companies

References :

1. John Vince, Foundation Mathematics for Computer Science, Springer.
2. Mitzenmacher M. and Upfal E., Probability and Computing: Randomized Algorithms and Probabilistic Analysis, Cambridge University Press.
3. Tucker Alan, Applied Combinatorics, Wiley

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Course Information:

Class, Semester	F.Y. M.Tech – Semester I					**Category**	**PC**
Course Code, Course Title	**0CEPC503 Advanced Data Structures**					**Type**	**LIT1**
Prerequisites	**Data Structures**						
Teaching Scheme (per week)	**Lecture**	**Tutorial**	**Practical**	**Self Study**	**Credits**		
	03	00	02	2	04		
Examination Scheme (Marks)	**Theory**	**MSE**	**TA**	**ESE**	**Practical**	**CIA**	**ESE**
		40	20	40		50	50

Course Outcomes (COs) :
Upon successful completion of this course, the student will be able to:

CO1	**Analyze** various temporal and geometric data structures, to determine their efficiency and applicability in different computational scenarios.
CO2	**Evaluate** advanced tree structures to optimize searching, insertion, and deletion operations in dynamic data environments.
CO3	**Design** efficient solutions for selected graph problems, to address real-world graph-based optimization problems.
CO4	**Develop** efficient hashing techniques and randomized data structures, to enhance data storage and retrieval performance.
CO5	**Construct** string-matching algorithms and dynamic graph structures to solve complex computational problems involving pattern matching and dynamic connectivity.

Syllabus:

Module	Contents	Lecture Hours
I	**Temporal and Geometric data structures** **Temporal data structures** - Persistent data structures - Model and definitions, Partial persistence, Full persistence, Retroactive data structures – Retroactivity, Full retroactivity, Non-oblivious Retroactivity. **Geometric data structures** - One Dimensional Range Searching, Two Dimensional Range Searching, Constructing a Priority Search Tree, Searching a Priority Search Tree, Priority Range Trees, Quad trees, k-D Trees.	09
II	**Advanced Trees** Binary Search Trees, AVL trees, Red-black trees, Splay Trees, Tango Trees	07
III	**Selected Graph Problems** Vertex coloring, edge coloring, Network flows: Max flow – Mincut theorem, Ford-fulkerson Method, Push-relabel method, Random Graph based analysis.	07
IV	**Hashing** Hash Function, Basic Chaining, FKS Perfect Hashing, Linear Probing, Cuckoo Hashing **Skip Lists:** Need for Randomizing Data Structures and Algorithms, Search and Update Operations on Skip Lists, Probabilistic Analysis of Skip Lists, Deterministic Skip Lists	08
V	**String matching** String Operations, Brute-Force Pattern Matching, The Boyer-Moore Algorithm, The Knuth-Morris-Pratt Algorithm, Predecessor Problem, Tries, Trie node structure and its applications, Suffix trees and suffix arrays.	07
VI	**Dynamic Trees and Graph Connectivity** Dynamic trees - Link-cut Trees, Operations on link-cut trees, Dynamic Connectivity, Euler-Tour Trees, Other Dynamic Graph Problems	07
	Total Lecture Hours	45

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List of Experiments	
S.No	**Title / Topic of the Experiment**
1	Implementation of Full Retroactivity in Data Structures.
2	Implement AVL Tree with rotations for insertion and deletion operations
3	Implement Red-Black Tree insertion, deletion, and balancing algorithms.
4	Design and implement algorithms for **vertex coloring** that aim to minimize the number of colors used.
5	Implement the **Ford-Fulkerson algorithm** for calculating the maximum flow in a flow network.
6	Implement the **chaining technique** to handle collisions in a hash table and evaluate its effectiveness in terms of **search**, **insert**, and **delete** operations.
7	Implement linear probing to resolve collisions in a hash table and compare its efficiency with chaining and other collision resolution strategies.
8	Implementation and performance analysis of Brute-Force Pattern Matching
9	Implementation and analysis of Pattern Matching using the Knuth-Morris-Pratt (KMP) Algorithm:
10	Implementation of Link-Cut Trees and Euler-Tour Trees.

Total Practical Sessions	**15**	**Total Practical Hours**	**30**

Text Books

1. Cormen Thomas H., Leiserson Charles E., Rivest Ronald L., Stein Clifford, "Introduction to Algorithms," PHI, Third Edition, 2009
2. Mark de Berg, Otfried Cheong, Marc van Kreveld, Mark Overmars , "Computational Geometry - Algorithms and Applications", Springer, Third Edition, 2014
3. Erik Demaine, Lecture Notes on MIT Courseware

References:

1. O'Rourke Joseph, "Computational Geometry in C", Cambridge University Press
2. Diestel Reinhard, "Graph Theory", Springer-Verlag, 2017
3. Brass Peter, "Advanced Data Structures", Cambridge University Press.

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Course Information:

Class, Semester	F.Y. M.Tech – Semester I					**Category**	**PE**
Course Code, Course Title	**0CEPE504- Wireless Sensor Networks**					**Type**	**LIT1**
Prerequisites	Wireless Communication						
Teaching Scheme (per week)	**Lecture**	**Tutorial**	**Practical**	**Self Study**	**Credits**		
	03	01	02	2	05		
Examination Scheme (Marks)	**Theory**	**MSE**	**TA**	**ESE**	**Practical**	**CIA**	**ESE**
		40	20	40		50	50

Course Outcomes (COs) :
Upon successful completion of this course, the student will be able to:

CO1	Architect sensor networks for various application setups.
CO2	Devise appropriate data dissemination protocols and model links cost.
CO3	Explain of the fundamental concepts of wireless sensor networks and have a basic knowledge of the various protocols at various layers.
CO4	Evaluate the performance of sensor networks and identify bottlenecks.

Syllabus:

Module	Contents	Lecture Hours
I	**Introduction to Wireless Sensor Networks:** Course Information, Introduction to Wireless Sensor Networks: Motivations, Applications, Performance metrics, History and Design factors **Network Architecture:** Traditional layered stack, Cross-layer designs, Sensor Network **Architecture Hardware Platforms:** Motes, Hardware parameters	08
II	**Introduction to ns-3:** Introduction to Network Simulator 3 (ns-3), Description of the ns-3 core module and simulation example.	08
III	**Medium Access Control Protocol design:** Fixed Access, Random Access, WSN protocols: synchronized, duty-cycled **Introduction to Markov Chain:** Discrete time Markov Chain definition, properties, classification and analysis **MAC Protocol Analysis:** Introduction to Asynchronous Duty-Cycled MAC Protocols. X-MAC Protocol: Design and Operation, Performance Metrics and Comparative Analysis.	07
IV	**Security in ad hoc wireless networks**: - Network security requirements, Issues and challenges in security provisioning, Network security attacks, Secure routing protocol - SAR, Security-Aware AODV Protocol Static and dynamic key distribution	07
V	**Routing protocols:** Introduction, MANET protocols **Routing protocols for WSN:** Resource-aware routing, Data-centric, Geographic Routing, Broadcast, Multicast **Opportunistic Routing Analysis:** Analysis of opportunistic routing (Markov Chain) Advanced topics in wireless sensor networks.	10
VI	**ADVANCED TOPICS :** Recent Developments in WSN Standards, Software Platforms and Tools for WSNs, Emerging Applications of WSNs	05
	Total Lecture Hours	45

List of Experiments

S.No	Title / Topic of the Experiment
1	ns-3 Basic Simulation Setup
2	MAC Protocol Performance Comparison
3	Markov Chain Modeling of a MAC Protocol
4	Implementing a Routing Protocol
5	WSN Security: Key Distribution Simulation
6	Energy-Aware Routing
7	IEEE 802.15.4 Simulation

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8	Mote Sensor Data Acquisition			
9	WSN Localization Simulation			
10	Data Aggregation in WSNs			
Total Practical Sessions		**15**	**Total Practical Hours**	**30**

List of Tutorial

S.No	**Title / Topic of the Tutorials**
1	WSN Fundamentals and Applications
2	Getting Started with ns-3
3	Implementing a Basic MAC Protocol in ns-3
4	Markov Chain Analysis for WSNs
5	WSN Routing Protocols: Flooding and Routing
6	WSN Security: Key Distribution
7	Energy Consumption Analysis in ns-3
8	IEEE 802.15.4 Standard
9	WSN Hardware: Mote Programming
10	Data Visualization for WSNs

Total Tutorial Sessions	**15**	**Total Tutorial Hours**	**15**

Text Books

1. W. Dargie and C. Poellabauer , Fundamentals of Wireless Sensor Networks –Theory and Practice", 1st edition, Wiley, 2010
2. KazemSohraby, Daniel Minoli and TaiebZnati, Wireless sensor networks -Technology, Protocols, and Applications, 1st edition, Wiley Interscience, 2007.
3. Takahiro Hara,Vladimir I. Zadorozhny, and Erik Buchmann, Wireless Sensor Network Technologies for the Information Explosion Era, ", 1st edition, springer, 2010
4. C.S.R.Murthy & B.S. Manoj, Ad Hoc wireless Network Architecture & Protocols by, 1st edition, Pearson Education, 2004

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Course Information:

Class, Semester	F.Y. M.Tech – Semester I					**Category**	**PE**
Course Code, Course Title	**0CEPE505-Intelligent Systems**					**Type**	**LIT1**
Prerequisites	Data Structures						
Teaching Scheme (per week)	**Lecture**	**Tutorial**	**Practical**	**Self-Study**	**Credits**		
	03	01	02	2	05		
Examination Scheme (Marks)	**Theory**	**MSE**	**TA**	**ESE**	**Practical**	**CIA**	**ESE**
		40	20	40		50	50

Course Outcomes (COs) :
Upon successful completion of this course, the student will be able to:

CO1	**Analyze** the components and applications of intelligent systems in various domains.
CO2	**Evaluate** different search methods and optimization techniques for problem-solving in intelligent systems.
CO3	**Examine** knowledge representation techniques and logical inference mechanisms for decision-making.
CO4	**Assess** reasoning techniques under uncertainty and compare various learning algorithms.
CO5	**Design** intelligent system models integrating fuzzy logic, genetic algorithms, and neural networks.

Syllabus:

Module	Contents	Lecture Hours
I	Introduction to Intelligent Systems, Definition and characteristics of intelligent systems, Historical evolution of artificial intelligence (AI), Components: perception, reasoning, learning, and Applications in various domains	08
II	Biological foundations to intelligent systems II: Fuzzy logic, knowledge Representation and inference mechanism, genetic algorithm, and fuzzy neural networks	08
III	Search Methods: Basic concepts of graph and tree search. Three simple search methods: breadth-first search, depth-first search, iterative deepening search. Heuristic search methods: best-first search, admissible evaluation functions, hill climbing search. Optimization and search such as stochastic annealing.	07
IV	Knowledge representation and logical inference: Issues in knowledge representation. Structured representation, such as frames, and scripts, semantic networks and conceptual graphs. Formal logic and logical inference. Knowledge-based systems structures, its basic components. Ideas of Blackboard architectures.	08
V	Reasoning under uncertainty and Learning Techniques on uncertainty Reasoning: such as Bayesian reasoning, Certainty factors and Dempster-Shafer Theory of Evidential reasoning, A study of different learning and evolutionary algorithms, such as statistical learning and induction learning.	08
VI	Emerging Trends and Ethical Considerations, Multi-agent systems and swarm intelligence, Explainable AI (XAI) and interpretable models, Ethical issues: bias, fairness, and accountability in AI, Case studies in healthcare, finance, and autonomous systems	06
	Total Lecture Hours	**45**

List of Experiments

S.No	Title / Topic of the Experiment
1	AI-based Chatbot Development – Create a simple rule-based chatbot with decision-making capabilities
2	Simulation of an Intelligent Agent – Implement an intelligent agent that can navigate a virtual environment
3	Implementation of Fuzzy Logic System – Design a fuzzy logic system for an industrial application (e.g., temperature control).
4	Solving an Optimization Problem using Genetic Algorithm – Implement a genetic algorithm for solving an NP-hard problem.

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5	Implementation of Breadth-First and Depth-First Search – Solve a maze navigation problem using BFS and DFS
6	Simulated Annealing for Function Optimization – Optimize a mathematical function using simulated annealing.
7	Creating an Expert System using Rule-Based Reasoning – Implement a basic expert system for medical diagnosis.
8	Implementation of First-Order Logic in AI Applications – Develop a knowledge-based system using Prolog.
9	Bayesian Network for Probabilistic Reasoning – Build a Bayesian network for weather prediction.
10	Supervised Learning Model for Classification – Train and test a supervised learning model on real-world data.
11	Multi-Agent System Simulation – Simulate a cooperative multi-agent system for a warehouse automation scenario
12	Bias Detection in AI Models – Analyze bias in an AI model using fairness metrics.

Total Practical Sessions	**15**	**Total Practical Hours**	**30**

List of Tutorial

S.No	Title / Topic of the Tutorial
1	Case Study on AI Applications – Analyze AI solutions in healthcare, finance, or robotics and compare their effectiveness
2	Comparative Analysis of Intelligent Systems – Examine various intelligent systems (e.g., rule-based, machine learning, deep learning) and their real-world implementations.
3	Fuzzy Logic Implementation in Decision Making – Develop a fuzzy logic-based decision system for an industrial or healthcare application.
4	Genetic Algorithm for Optimization – Solve a real-world problem using a genetic algorithm (e.g., traveling salesman problem).
5	Heuristic Search and Performance Evaluation – Compare best-first search and hill climbing for solving pathfinding problems.
6	Building a Semantic Network for a Knowledge System – Construct a semantic network for a domain-specific knowledge base.
7	Automated Reasoning with Propositional Logic – Solve a real-world problem using propositional logic and inference techniques.
8	Bayesian Networks in Decision Making – Design a Bayesian network for a risk assessment application
9	Implementation of a Machine Learning Model using Inductive Learning – Train an inductive learning algorithm for classification.
10	Explainability in AI Models – Compare black-box and interpretable AI models using SHAP or LIME techniques.
11	Multi-Agent Systems for Problem Solving – Design a multi-agent system for cooperative task execution.

Total Tutorial Sessions	**15**	**Total Tutorial Hours**	**15**

Text Books

1. Luger G.F. and Stubblefield W.A Artificial Intelligence: Structures and strategies for Complex Problem Solving. Pearson Educaton, 6th edition. 2021
2. Russell S. and Norvig P. Artificial Intelligence: A Modern Approach. Prentice-Hall, 4th edition 2020 (US Edition).

References:

1. Inam Ullah Khan and Mariya Ouaissa Artificial Intelligence for Intelligent Systems: Fundamentals, Challenges, and Applications. CRC Press, 1st edition. 2024
2. P. Angelov. Handbook on Computational Intelligence. Publisher: World Scientific, 1st edition 2016.

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Annasaheb Dange College of Engineering and Technology
Ashta - 416301, Dist. : Sangli, Maharashtra
(An Empowered Autonomous Institute)
Department of Computer Science and Engineering
Established: 1999

Course Information:

Class, Semester	F.Y. M.Tech – Semester I					**Category**	**PE**
Course Code, Course Title	**0CEPE506 Quantum Computing**					**Type**	**LIT2**
Prerequisites	-						
Teaching Scheme (per week)	**Lecture**	**Tutorial**	**Practical**	**Self Study**	**Credits**		
	03	01	02	2	05		
Examination Scheme (Marks)	**Theory**	**MSE**	**TA**	**ESE**	**Practical**	**CIA**	**ESE**
		40	20	40		50	

Course Outcomes (COs) :
Upon successful completion of this course, the student will be able to:

CO1	**Analyze** quantum computing principles, including quantum mechanics, qubits, and quantum circuits
CO2	**Evaluate** quantum algorithms such as Deutsch-Jozsa, Bernstein-Vazirani, and Quantum Fourier Transform in terms of efficiency and complexity
CO3	**Implement** quantum search and factorization algorithms like Shor's and Grover's to solve computational problems
CO4	**Design** quantum error correction mechanisms and analyze their role in mitigating quantum noise
CO5	**Develop** quantum programs using Qiskit and explore quantum cryptographic protocols and applications

Syllabus:

Module	Contents	Lecture Hours
I	**Introduction to Quantum Computing**: Motivation for Quantum Computing, Postulates of Quantum Mechanics, Qubits and Quantum States, Bloch Sphere Representation, Quantum Gates: Pauli, Hadamard, Phase, and CNOT, Quantum Circuits and Measurement	08
II	**Quantum Algorithms and Complexity**: Quantum Parallelism and Superposition, Quantum Fourier Transform (QFT), Deutsch-Jozsa Algorithm, Bernstein-Vazirani Algorithm, Simon's Algorithm, Introduction to Quantum Complexity Classes (BQP, QMA, etc.)	08
III	**Shor's and Grover's Algorithms:** Shor's Algorithm for Integer Factorization, Quantum Phase Estimation, Applications of Shor's Algorithm in Cryptanalysis, Grover's Algorithm for Unstructured Search, Performance Comparison with Classical Search, Grover's Algorithm Applications	07
IV	**Quantum Error Correction and Noise:** Need for Quantum Error Correction, Classical vs. Quantum Error Correction, Shor Code and Steane Code, Quantum Decoherence and Noise Models, Quantum Fault Tolerance and Threshold Theorem	07
V	**Quantum Hardware and Programming Quantum Hardware:** Superconducting Qubits, Ion Traps, Photonic Systems, Introduction to Quantum Programming Frameworks (Qiskit, Cirq, PennyLane), Writing Quantum Circuits in Qiskit, Running Quantum Circuits on Simulators and Real Quantum Machines, Quantum Cloud Computing	08
VI	**Advanced Topics and Applications**: Quantum Machine Learning, Quantum Cryptography: BB84 and Quantum Key Distribution, Variational Quantum Algorithms (VQE, QAOA),,Quantum Internet and Future Trends, Ethical and Security Aspects of Quantum Computing	07
	Total Lecture Hours	45

List of Experiments with CO Mapping

S.No	Title / Topic of the Experiment	CO Mapped
1	Implementing Quantum Gates and Circuits in Qiskit	CO1
2	Simulating Deutsch-Jozsa and Bernstein-Vazirani Algorithms	CO2
3	Implementing Quantum Fourier Transform and Analyzing its Complexity	CO2
4	Implementing Shor's Algorithm for Integer Factorization	CO3
5	Implementing Grover's Algorithm for Unstructured Search	CO3
6	Simulating Quantum Error Correction using Shor Code	CO4

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7	Running Quantum Circuits on Real Quantum Hardware using IBM Quantum			CO5
8	Developing and Executing Quantum Cryptographic Protocols (BB84)			CO5
9	Implementing Variational Quantum Algorithms for Optimization Problems			CO5
10	Exploring Quantum Machine Learning using Quantum Neural Networks			CO5
Total Practical Sessions		**15**	**Total Practical Hours**	**30**

List of Tutorials with CO Mapping

S.No	Title / Topic of the Tutorial			CO Mapped
1	Basics of Qubits, Quantum Gates, and Circuit Design			CO1
2	Analyzing Deutsch-Jozsa and Bernstein-Vazirani Algorithms			CO2
3	Implementation and Analysis of Quantum Fourier Transform			CO2
4	Understanding the Working of Shor's Algorithm			CO3
5	Application of Grover's Algorithm in Database Search			CO3
6	Quantum Error Correction Mechanisms			CO4
7	Exploring Qiskit for Quantum Programming			CO5
8	Quantum Cryptography and Security Implications			CO5
Total Tutorial Sessions		**15**	**Total Tutorial Hours**	**15**

Text Books

1. Quantum Information Science – Manenti R., Motta M., 1st Edition, Oxford University Press (2023)
2. Quantum computation and quantum information – Nielsen M. A., and Chuang I. L., 10th Anniversary edition, Cambridge University Press (2010)
3. A Pathak, Elements of Quantum Computation and Quantum Communication, BocaRaton, CRC Press (2015)

References:

1. Quantum Computing for Computer Scientists – Noson S. Yanofsky, Mirco A.Mannucci (Covers quantum programming)
2. Learn Quantum Computing with Python and IBM Quantum Experience – Robert Loredo (Practical Qiskit coding guide)

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Department of Computer Science and Engineering

Established: 1999

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Course Information:

Class, Semester	F.Y. M.Tech – Semester I					**Category**	**PE**
Course Code, Course Title	**0CEPE507 – GPU Computing**					**Type**	**LIT2**
Prerequisites	Basic knowledge of mathematics, Operating System, Computer Organization & Architecture						
Teaching Scheme (per week)	**Lecture**	**Tutorial**	**Practical**	**Self Study**	**Credits**		
	03	01	02	2	5		
Examination Scheme (Marks)	**Theory**	**MSE**	**TA**	**ESE**	**Practical**	**CIA**	**ESE**
		40	20	40		**50**	-

Course Outcomes (COs) :
Upon successful completion of this course, the student will be able to:

CO1	**Apply** fundamental concepts of GPU computing by implementing parallel algorithms using CUDA/OpenCL/OpenACC.
CO2	**Analyze** the impact of different CUDA memory types on the performance of parallel programs, and evaluate memory allocation, copying strategies, and access patterns for efficient GPU computing.
CO3	**Examine** synchronization mechanisms and function execution models in GPU programming.
CO4	**Analyze** GPU debugging, profiling, and asynchronous execution strategies by evaluating performance metrics, stream-based parallelism.
CO5	**Analyze** advanced GPU computing techniques such as dynamic parallelism, unified virtual memory.

Syllabus:

Module	Contents	Lecture Hours
I	**Introduction** History, Graphics Processors, Graphics Processing Units, GPGPUs. Clock speeds, CPU / GPU comparisons, Heterogeneity, Accelerators, Parallel programming, CUDA OpenCL / OpenACC, Hello World Computation Kernels, Launch parameters, Thread hierarchy, Warps / Wavefronts, Thread blocks / Workgroups, Streaming multiprocessors, 1D / 2D / 3D thread mapping, Device properties, Simple Programs	07
II	**Memory** Memory hierarchy, DRAM / global, local / shared, private / local, textures, Constant Memory, Pointers, Parameter Passing, Arrays and dynamic Memory, Multi-dimensional Arrays, Memory Allocation, Memory copying across devices, Programs with matrices, Performance evaluation with different memories	08
III	**Synchronization** Memory Consistency, Barriers (local versus global), Atomics, Memory fence. Prefix sum, Reduction. Programs for concurrent Data Structures such as Worklists, Linked-lists. Synchronization across CPU and GPU **Functions:** Device functions, Host functions, Kernels functions, Using libraries (such as Thrust), and developing libraries	08
IV	**Support and Streams** Debugging GPU Programs. Profiling, Profile tools, Performance aspects **Streams:** Asynchronous processing, tasks, Task-dependence, Overlapped data transfers, Default Stream, Synchronization with streams. Events, Event-based Synchronization - Overlapping data transfer and kernel execution, pitfalls.	07
V	**Case Studies** Image Processing, Graph algorithms, Simulations, Deep Learning	07
VI	**Advanced Topics** Dynamic parallelism, Unified Virtual Memory, Multi-GPU processing, Peer access, Heterogeneous processing	08
	Total Lecture Hours	45

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List of Experiments	
S.No	**Title / Topic of the Experiment**
1	• Implement CUDA code to compute the squares of the first N integers. Implement Producer consumer problem.
2	Implement matrix multiplication on the CPU and GPU(without using shared memory), and compare their relative performances in terms of GFlop/s and report your performance results
3	Implement the 1-D convolution kernel and compare the performance with and without shared memory
4	Implement 2-D convolution with data in shared memory. Also, analyze the reduction in bandwidth from use of shared memory in 2-D convolution.
5	Implement code for histogramming without atomic operations and experiment with it to find out the fraction of times that it gives incorrect results and report it.
6	Implement reduction to find the sum or maximum of an array using atomic operations on global memory. Optimize this with shared memory and compare performance.
7	Implement parallel reduction for finding the sum or maximum of an array using GPU threads.

8	• Implement parallel sorting, such as radix sort or bitonic sort, using GPU programming.
	• Implement Non-Serial Polyadic Dynamic Programming with GPU Parallelization.
	  • **Evaluate memory usage** (global memory vs. shared memory) and access patterns.
	  • **Analyze scaling behaviour** for both larger problem sizes and GPU resource utilization

9	Perform FFT on a signal using GPU libraries (e.g., cuFFT) and analyze the speedup.
10	Train a simple neural network on a GPU and compare the training time with CPU-based training.
Total Practical Sessions	**15** **Total Practical Hours** **30**

List of Tutorials		
Q.No	**Title / Topic of the Tutorial**	
	Tutorial No 1	
1	• A **CPU** has a clock speed of **3.5 GHz** and can execute **4 instructions per cycle** with **8 cores**. • A **GPU** has a clock speed of **1.5 GHz**, but each Streaming Multiprocessor (SM) has **128 cores**, and the GPU has **40 SMs**. • Compare the total theoretical FLOPS (Floating Point Operations Per Second) for both.	
2	• Consider a **2D matrix multiplication** kernel where we process a **1024 × 1024** matrix. • We configure **thread blocks** of size **16 × 16** • How many thread blocks do we need	
3	• A warp in CUDA contains **32 threads**. • Consider a **block of 256 threads**. • How many warps are needed to execute the block.	
4	• Suppose we have a **3D grid of 64 × 32 × 16**. • Each thread block has a **thread configuration of (8, 8, 8)**. • How many thread blocks and total threads are launched.	

5	• A **NVIDIA A100 GPU** has:
	  ○ **80 Streaming Multiprocessors (SMs)**
	  ○ **128 CUDA cores per SM**
	  ○ **Clock Speed: 1.41 GHz**	

	Tutorial No.2	
1	A **GPU** has the following approximate memory access latencies: • **Registers**: **1 cycle** • **Shared Memory**: **20–30 cycles**	

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	• **Global Memory (DRAM): 400–600 cycles** If a kernel performs **100 memory accesses**, where: • **50%** are to **global memory** • **30%** are to **shared memory** **20%** are to **registers**
2	Implement parallel reduction for finding the sum or maximum of an array using GPU threads.
3	A **global memory access** takes **500 cycles**, while a **constant memory access** takes **10 cycles** if **cached**.If a kernel performs **1,000 accesses** to a constant value, what is the performance gain if we use **constant memory** instead of global memory
4	Memory Allocation & Copying – Data Transfer TimeA **512 MB matrix** is copied from CPU to GPU. • **PCIe bandwidth = 16 GB/s** How long does the memory transfer take
5	A kernel performing **100 million texture fetches** sees the following latencies: • **Global Memory Fetch: 500 cycles** • **Texture Memory (cached): 50 cycles** How much faster is texture memory
	Tutorial No.3
1	Given an array **A = [1, 2, 3, 4]**, multiple threads update A[0] by adding their thread index. **__global__ void race_condition(int *A) {** **A[0] += threadIdx.x;** **}** **Compute the possible incorrect results** if 4 threads (threadIdx.x = 0,1,2,3) run without synchronization.
2	. A global variable X = 0 is modified by Thread 0, but Thread 1 reads it immediately. **__global__ void memory_consistency(int *X) {** **if (threadIdx.x == 0) X[0] = 42;** **if (threadIdx.x == 1) printf("%d\n", X[0]);** **}** What could Thread 1 print if __threadfence() is not used
3	Given X = 5, multiple threads perform **__global__ void atomic_op(int *X) {** **atomicAdd(X, 2);** **}** If **4 threads** execute this kernel, what is X
4	Explain the role of cudaDeviceSynchronize() in CPU-GPU synchronization?

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5	. Given A = [1, 2, 3, 4], each thread **doubles its element** in shared memory before storing it back.
	__global__ void shared_memory_example(int *A) {
	__shared__ int temp[4];
	int tid = threadIdx.x;
	temp[tid] = A[tid];
	__syncthreads(); // Barrier 1
	temp[tid] *= 2;
	__syncthreads(); // Barrier 2
	A[tid] = temp[tid];
	}
	Compute the final output.	

	Tutorial No.4	
1	Case study on Image Processing (Image Convolution Using CUDA, Histogram Equalization for Image Enhancement, Edge Detection Using Sobel Filter).	
2	Case study on **Graph Algorithms** (Parallel Graph Traversal Using CUDA (Breadth-First Search)).	
3	Case study on **Simulations** (Large-Scale Simulations (N-Body Simulation)).	
4	Case study on **Deep Learning** (Deep Learning Acceleration with CUDA (CNN Training)).	
	Tutorial No.5	
1	What is dynamic parallelism in CUDA? Suppose you have 1024 elements to process, but only elements with values > 50 need additional computation. If each element has a 30% chance of being > 50, how many kernel launches will happen with dynamic parallelism?	
2	What is Unified Virtual Memory? If copying data between host and device takes 5ms, and a GPU kernel runs for 2ms, what is the speedup using UVM if memory transfers are avoided?	
3	What is beterogeneous computing? A CPU processes a task in 20ms, while a GPU processes the same task in 4ms. If the CPU handles 30% of the workload and the GPU 70%, what is the overall runtime?	
4	A profiler shows your kernel spends 60% of its time on memory transfers and 40% on computation. If optimizations reduce memory transfer time by 50%, what is the new total execution time?	
5	A kernel processes 1 million elements. Memory access takes 300 ns/element, while computation takes 100 ns/element. You optimize memory access with shared memory, reducing memory latency by 50%. • What is the total initial kernel time? • What is the new kernel time after optimization? What percentage speedup did you achieve?	
6	You have a computational workload that takes 10 seconds on a single GPU. When using 2 GPUs, you observe a 1.8× speedup instead of the ideal 2× due to communication overhead. You try with 4 GPUs, but the speedup drops to 3.2×. • What is the communication overhead for 2 GPUs? • What is the communication overhead for 4 GPUs? How much of the workload is inherently serial?	

Total Tutorial Sessions	**15**	**Total Tutorial Hours**	**15**

Text Books

1. Peter.S.Pachego, Introduction to parallel programming, First, Morgan Kaufimall, 2011
2. Michael J Quiann, Parallel Programming in C with MPI and Open MP, ---, Tata McGraw Hill, 2006
3. Prof.Somanath Roy, HIGH PERFORMANCE COMPUTING FOR SCIENTISTS AND ENGINEERS, ---, NPTEL, 2020

References:

1. Ananth Grama, George Karypis, Vipin Kumar & Anshul Gupta, Introduction to Parallel Computing , Second, Pearson Education Limited, 2003
2. Shane cook, CUDA Programming :A Developer's Guide to parallel Computing with GPUs, First, Elsevier Inc, 2013

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Course Information:

Class, Semester	F.Y. M.Tech – Semester I						**Category**	**MA**	
Course Code, Course Title	**0CEMA508** - English for Research Paper Writing						**Type**	**T2**	
Prerequisites	-								
Teaching Scheme (per week)	**Lecture**		**Tutorial**		**Practical**	**Self Study**		**Credits**	
	02		00		00	-		0	
Examination Scheme (Marks)	**Theory**	**MSE**	**TA**	**ESE**	**Practical**	**CIA**		**ESE**	
		-	**50**	-		-		-	

Course Outcomes (COs) :
Upon successful completion of this course, the student will be able to:

CO1	**Apply** foundational academic English principles, including clarity, objectivity, and formal tone, to improve research writing quality.
CO2	**Analyze** research papers using advanced reading strategies such as skimming, scanning, and critical evaluation to identify arguments, methodologies, and findings.
CO3	**Evaluate** research writing style by structuring sentences and paragraphs effectively, using link words for cohesion, and avoiding redundancy.
CO4	**Demonstrate** proficiency in research vocabulary and grammar by using discipline-specific terminology, complex sentence structures, and appropriate verb tense consistency.
CO5	**Create** ethically sound research documents by leveraging AI tools for citation management, ensuring plagiarism-free writing, and adhering to academic conventions.

Syllabus:

Module	Contents	Lecture Hours
I	**Foundations Of Academic English In Research** Academic English - Map (Message-Audience-Purpose) - Language Proficiency For Writing - Key Language Aspects - Clarity And Precision - Objectivity - Formal Tone - Integrating References - Following Academic Conventions	05
II	**Effective Writing Style For Research Papers** Word Order - Sentences And Paragraphs - Link Words For Cohesion - Avoiding Redundancy / Repetition - Breaking Up Long Sentences - Structuring Paragraphs - Paraphrasing Skills – Framing Title And Sub-Headings	05
III	**Advanced Reading Skills For Researchers** Reading Academic Texts - Critical Reading Strategies - Skimming And Scanning - Primary Research Article Vs. Review Article - Reading An Abstract - Analysing Research Articles - Identifying Arguments - Classifying Methodologies - Evaluating Findings - Making Notes	05
IV	**Research Vocabulary Development** Formulaic Expressions - Synonyms And Nuances - Academic Phrase Bank - Discipline-Specific Vocabulary - Formal Expressions And Idioms - Language For Describing Results - Commonly Misused Words - Effective Use Of Adjectives And Adverbs	06
V	**Grammar Refinement For Research Writing** Advanced Punctuation Usage - Grammar For Clarity - Complex Sentence Structures - Active-Passive Voice - Subject-Verb Agreement - Proper Use Of Modifiers - Avoiding Ambiguous Pronoun References - Verb Tense Consistency - Conditional Sentences	05
VI	**Technology And Language For Research** Digital Literacy And Critical Evaluation Of Online Content - Technology And Role Of Ai In Research Writing – Assistance In Generating Citations And References - Plagiarism And Ethical Considerations – Tools And Awareness – Fair Practices	04
	Total Lecture Hours	30

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Text Books
1. Bailey. S. 2015. Academic Writing: A Handbook for International Students. London and New York: Routledge. 2. Craswell, G. 2004. Writing for Academic Success. Sage Publications. 3. Wallwork, Adrian. 2015. English for Academic Research: Grammar, Usage and Style, Springer, New York 4. English for Writing Research Papers, Springer, New York.
References:
1. Creme, P. & M. Lea. 2008. Writing at University: A guide for students. Open University Press. 2. Oshima, A. & Hogue, A. 2005. Writing Academic English, Addison-Wesley, New York 3. Swales, J. & C. Feak. 2012. Academic Writing for Graduate Students: Essential Skills and Tasks. Michigan University Press.

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Course Information:

Class, Semester	F.Y. M.Tech – Semester II					**Category**	**OE**
Course Code, Course Title	**0CEOE509 Business Analytics**					**Type**	**T1**
Prerequisites	Basic mathematics, Machine learning						
Teaching Scheme (per week)	**Lecture**	**Tutorial**	**Practical**	**Self Study**	**Credits**		
	03	00	00	2	03		
Examination Scheme (Marks)	**Theory**	**MSE**	**TA**	**ESE**	**Practical**	**CIA**	**ESE**
		40	20	40		-	-

Course Outcomes (COs) :
Upon successful completion of this course, the student will be able to:

CO1	**Assess** the role of data science and business analytics within an organization.
CO2	**Design** a data integration pipeline for transforming diverse data into a unified enterprise data warehouse for strategic analytics.
CO3	**Determine** appropriate business analytics models and apply descriptive analytics tools.
CO4	**Develop** predictive analytics models/tools to gain insight from data for business decision-making.
CO5	**Develop** prescriptive analytics models/tools to gain insight from data for decision-making purposes.
CO6	**Use** software like R, Excel, and SPSS for model development and output interpretation.

Syllabus:

Module	Contents	Lecture Hours
I	Introduction to Data Science Overview of tools in Data Science – Data Science Methodology: Data Requirements – Data Understanding – Data Preparation – Data Modeling – Model Evaluation –Model Deployment – Model Feedback	07
II	Introduction to Business analytics Overview of the strategic impact of BAI across key industries-Analytics 3.0-the nature of analytical competition- Competing on Analytics with Internal and external Processes- A Road Map to Enhanced Analytical Capabilities- Managing Analytical People- The Architecture of Business Intelligence -Essential Practice Skills for High-Impact Analytics Projects.	09
III	Descriptive Analytics Data Visualization and Analytics- Charts (Bars-Pie-Line-Scatter-Map-Bubble-Box & Whisker-Tree map - Heat Map-Circle and Area) -Worksheet, Dashboard and Story Board creation	07
IV	Predictive Analytics Introduction, Real-World Applications (Marketing, Finance, Healthcare), Data Preprocessing, Linear Regression, Cluster, CART and Neural Network model,	08
V	Prescriptive Analytics Introduction, Applications in Business (Supply Chain, Finance, Marketing), Linear optimization, Integer optimization, Non-linear programming and Simulation	07
VI	Contemporary Issues Guest lecture by industry experts on Emerging trends in business analytics and intelligence	07
	Total Lecture Hours	45

Text Books

1. Sharda R, Delen D, Turban E, Aronson J, Liang T. P, (2014), Business Intelligence and Analytics: Systems for Decision Support, 10th edition, Pearson Education.
2. Powell S. G, Baker K. R, (2014), Management Science: The Art of Modeling with Spreadsheets, (W/Cd), 4thedition, John Wiley & Sons..

References:

1. Linoff G. S, Berry M. J, (2011), Data mining techniques: for marketing, sales, and customer relationship

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management, 3rd edition, John Wiley & Sons.
2. Frank B, Green B, Harris T, Van De Vanter K, (2010), Business Intelligence Strategy: A Practical Guide for Achieving BI Excellence, MC Press.
3. Hair, J. F, Black W. C, Babin B. J, Anderson R. E, Tatham R. L, (2009), Multivariate data analysis, 7th edition, Pearson education.

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Course Information:

Class, Semester	F.Y. M.Tech – Semester II					**Category**	**OE**
Course Code, Course Title	**0CEOE510** Operation Research					**Type**	**T1**
Prerequisites	-						
Teaching Scheme (per week)	**Lecture**	**Tutorial**	**Practical**	**Self Study**	**Credits**		
	03	00	00	2	03		
Examination Scheme (Marks)	**Theory**	**MSE**	**TA**	**ESE**	**Practical**	**CIA**	**ESE**
		40	20	40			

Course Outcomes (COs) :
Upon successful completion of this course, the student will be able to:

CO1	Apply LP techniques in manufacturing and service sectors.
CO2	Provide comprehensive knowledge about different techniques of Operations Research.
CO3	Apply Network Flow techniques and Project Scheduling techniques in real time Projects.
CO4	Apply Job Sequencing techniques in Manufacturing and service sectors.
CO5	Interpret the results obtained from software

Syllabus:

Module	Contents	Lecture Hours
I	**Basics of Linear Algebra** Matrices, Rank of a matrix, Euclidean Space, Linear Dependence of Vectors, Spanning set & basis, Representation of a matrix in terms of vectors, System of Linear Equations, Basic Solution, Basic feasible Solution. Structure of a Linear Programming (LP) Model, General form of a LP model, Model Formulation & Graphical Method of Solution, Simplex Method (Maximization case), Big M	08.
II	**Linear Programming** Formulation of linear programming problems, Graphical method for solving linear programming problems with two variables, Simplex method for solving linear programming problems, Duality in linear programming	08.
III	**Network Analysis** Network Flows: Problems, Shortest Paths, Spanning Tree, Maximum Flow, Network Simplex Method PERT/CPM networks - project scheduling with uncertain activity times - the critical path calculation.	07.
IV	**Job Sequencing** Sequencing: Sequencing of 'n' jobs and '2' machines - 'n' jobs and '3', M machines –Processing two jobs through M machines.	08.
V	**Application using software** Solving operation research problems using Excel-Solver and TORA Software.	08.
VI	**Contemporary Issues** Guest lecture by industry experts on contemporary operational analytics tools used by corporates in decision making	06.
	Total Lecture Hours	**45**

Text Books

1. Wayne L. Winston and S. Christian Albright (2008). Practical Management Science, 3rd ed., South-Western College Pub
2. Hamdy Taha, (2003), Operations Research – 7 th edition, Prentice Hall India

References:

1. Kanti Swarup, P.K. Gupta & Man mohan, (2005), Operations Research, Sultan Chand & Sons
2. S.D.Sharma & Kedar Nath, (2004), Operations Research, , Ram Nath & Co.
3. V.K.Kapoor, (2002), Operations research Techniques for Management, Sultan Chand & Son

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Course Information:

Class, Semester	F.Y. M.Tech – Semester II					**Category**	**PC**
Course Code, Course Title	**0CEPC511 Advanced Algorithms**					**Type**	**LIT2**
Prerequisites	Advanced Data Structures						
Teaching Scheme (per week)	**Lecture**	**Tutorial**	**Practical**	**Self Study**	**Credits**		
	03	00	02	2	04		
Examination Scheme (Marks)	**Theory**	**MSE**	**TA**	**ESE**	**Practical**	**CIA**	**ESE**
		40	20	40		50	-

Course Outcomes (COs) :
Upon successful completion of this course, the student will be able to:

CO1	**Analyze** the efficiency of fundamental graph algorithms, including BFS, DFS, Topological Sorting, Strongly Connected Components, and Minimum Spanning Trees using Kruskal's and Prim's algorithms.
CO2	**Evaluate** single-source shortest path algorithms such as Bellman-Ford, Dijkstra's, and shortest paths in Directed Acyclic Graphs, along with their correctness proofs
CO3	**Apply** all-pairs shortest path algorithms, maximum flow techniques, and bipartite matching methods to solve real-world network optimization problems
CO4	**Design** multithreaded algorithms for computational problems, including matrix operations, sorting, and solving systems of linear equations
CO5	**Assess** NP-completeness, computational geometry problems, and approximation algorithms by formulating reductions and verifying problem complexity

Syllabus:

Module	Contents	Lecture Hours
I	**Elementary Graph Algorithms and MST** Representation of Graphs, BFS and DFS, Topological Sort, Strongly Connected Components Growing a Minimum Spanning Tree, Algorithms of Kruskal and Prim.	08 Hrs.
II	**Single Source Shortest Path Algorithms** Bellman-Ford Algorithm, SSSP in Directed Acyclic Graphs, Dijkstra's Algorithm, Difference Constraints and Shortest Paths, Proofs of Shortest-paths Properties	08 Hrs.
III	**APSP and Maximum Flow** Shortest Paths and Matrix Multiplication, Floyd-Warshall Algorithm, Johnson's Algorithm for Sparse Graphs Flow Networks, Ford-Fulkerson Method, Maximum Bipartite Matching, Push-relable algorithms	07 Hrs.
IV	**Multithreaded Algorithms and Matrix Operations** Dynamic Multithreading fundamentals, Multithreaded Matrix Multiplication, Multithreaded merge sort Solving systems of linear equations, Inverting matrices, Symmetric positive-definite matrices and least-squares approximation	08 Hrs.
V	**Computational Geometry and NP-Completeness** Line-segment properties, determining whether any pair of segments intersects, Finding the convex hull, Finding the closest pair of points Polynomial time, Polynomial-time verification, NP-completeness and reducibility, NP-completeness proofs, NP-complete problems	08 Hrs.
VI	**Approximation Algorithms** The vertex-cover problem, The traveling-salesman problem, The set-covering problem, Randomization and linear programming, The subset-sum problem	06 Hrs.
	Total Lecture Hours	**45 Hrs**

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List of Experiments	
S.No	**Title / Topic of the Experiment**
1	Implement BFS and DFS for a given graph and analyze their time complexity. (CO1)
2	Implement Kruskal's and Prim's algorithms to construct a Minimum Spanning Tree and compare their efficiency. (CO1)
3	Develop a program to find the shortest path using Dijkstra's and Bellman-Ford algorithms and analyze their correctness. (CO2)
4	Implement Floyd-Warshall and Johnson's algorithms for all-pairs shortest paths and compare their performance. (CO3)
5	Implement the Ford-Fulkerson algorithm to compute the maximum flow in a given network. (CO3)
6	Design and implement a multithreaded matrix multiplication algorithm using dynamic multithreading. (CO4)
7	Develop a multithreaded merge sort algorithm and analyze its performance. (CO4)
8	Implement the Convex Hull algorithm using Graham's scan or Jarvis's March and analyze its efficiency. (CO5)
9	Verify NP-completeness by reducing the Vertex Cover problem to a known NP-complete problem. (CO5)
10	Implement an approximation algorithm for the Traveling Salesman Problem and analyze its approximation ratio. (CO5)

Total Practical Sessions	**15**	**Total Practical Hours**	**30**

Text Books

1. Thomas H. Corman et al, "Introduction to Algorithms", PHI Learning pvt. Ltd, Third Edition

References:

1. E. Horowitz, Sartaj Sahani et al," Fundamentals of Computer Algorithms", Universities Press, Second Edition

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Annasaheb Dange College of Engineering and Technology
Ashta - 416301, Dist. : Sangli, Maharashtra
(An Empowered Autonomous Institute)
Department of Computer Science and Engineering

Established: 1999

Course Information:

Class, Semester	F.Y. M.Tech – **Semester II**	**Category**	**PC**
Course Code, Course Title	**0CEPC512- Soft Computing**	**Type**	**LIT1**
Prerequisites	Basic calculus (derivatives) Basic linear algebra (matrices, vectors) Basic probability and statistics Programming experience in Python/Mat lab/Octave		

Teaching Scheme (per week)	**Lecture**	**Tutorial**	**Practical**	**Self Study**	**Credits**
	03	01	02	2	05

Examination Scheme (Marks)	**Theory**	**MSE**	**TA**	**ESE**	**Practical**	**CIA**	**ESE**
		40	20	40		50	50

Course Outcomes (COs) :
Upon successful completion of this course, the student will be able to:

CO1	**Analyze** the principles of soft computing techniques and compare them with conventional computing methods (K4)
CO2	**Develop** fuzzy logic-based decision-making systems for handling uncertainty in real-world applications. (K6)
CO3	**Implement** artificial neural network models for pattern recognition and classification tasks. (K6)
CO4	**Evaluate** evolutionary computing algorithms, such as Genetic Algorithms and Swarm Intelligence, for problem-solving. (K5)
CO5	**Integrate** hybrid soft computing techniques (Neuro-Fuzzy, GA-ANN) to enhance machine learning models and optimize computational processes. (K6)

Syllabus:

Module	**Contents**	**Lecture Hours**
I	**Introduction to Soft Computing (Fundamentals):** Evolution of Computing: Soft Computing Constituents, From Conventional AI to Computational Intelligence, Characteristics of Neuro Computing and Soft Computing, Difference between Hard Computing and Soft Computing, Concepts of Learning and Adaptation	**07**
II	**Fuzzy Logic and Applications:** Basic Concepts of Fuzzy Sets and Membership Functions, Rough Sets, Fuzzy Rough Sets,Fuzzy Rules and Fuzzy Inference Systems (Mamdani & Sugeno), Fuzzy Decision-Making and Control Systems, Fuzzy Clustering Algorithms (Fuzzy C-Means),	**08**
III	**Artificial Neural Networks (ANNs):** Introduction to Neural Networks and Perceptron Models, Multi-Layer Perceptron (MLP) and Backpropagation Algorithm, Radial Basis Function Networks, Applications of Neural Networks in Pattern Recognition	**08**
IV	**Evolutionary Computing:** Fundamentals of Evolutionary Computation, Genetic Algorithms (GA): Operators, Selection, Crossover, Mutation, Particle Swarm Optimization (PSO), Ant Colony Optimization (ACO) and Applications,	**08**
V	**Introduction to Soft Computing (Fundamentals):** Evolution of Computing: Soft Computing Constituents, From Conventional AI to Computational Intelligence, Characteristics of Neuro Computing and Soft Computing, Difference between Hard Computing and Soft Computing, Concepts of Learning and Adaptation	**07**
VI	**Fuzzy Logic and Applications:** Basic Concepts of Fuzzy Sets and Membership Functions, Rough Sets, Fuzzy Rough Sets,Fuzzy Rules and Fuzzy Inference Systems (Mamdani & Sugeno), Fuzzy Decision-Making and Control Systems, Fuzzy Clustering Algorithms (Fuzzy C-Means),	**07**
	Total Lecture Hours	**45 Hrs**

List of Experiments with CO Mapping

S.No	**Title / Topic of the Experiment**
1	**Introduction to Soft Computing Tools** • Setup MATLAB/Python environments

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	• Implement basic mathematical functions related to soft computing
2	**Fuzzy Logic Implementation** • Design fuzzy sets and membership functions • Implement a **Fuzzy Inference System (FIS)** using MATLAB/Python
3	**Artificial Neural Network (ANN) Basics** • Implement a simple **Perceptron Model** for AND, OR, XOR functions • Train a **Multi-Layer Perceptron (MLP)** using Backpropagation
4	**Neural Network for Classification** • Implement a **Feedforward Neural Network (FNN)** using Tensor Flow/ Keras • Train a model for **handwritten digit recognition (MNIST dataset)**
5	**Genetic Algorithms (GA) Implementation** • Implement **Selection, Crossover, and Mutation** operators • Solve an **optimization problem** using GA
6	**Particle Swarm Optimization (PSO)** • Implement **PSO algorithm** for function optimization • Compare results with Genetic Algorithm
7	**Ant Colony Optimization (ACO)** • Solve the **Traveling Salesman Problem (TSP)** using ACO • Analyze convergence behavior
8	**Neuro-Fuzzy Systems** • Implement a **Neuro-Fuzzy Inference System (NFIS)** • Train an Adaptive Neuro-Fuzzy Inference System (ANFIS)
9	**Hybrid Intelligent System Development** • Integrate **Fuzzy Logic, Neural Networks, and Evolutionary Algorithms** • Develop an intelligent **fault detection system**
10	**Reinforcement Learning in Soft Computing** • Implement a basic **Q-learning model** • Train an agent using **Deep Q-Network (DQN)**
11	**Case Study and Mini Project** • Develop a **real-world application** using soft computing techniques • Examples: **Medical Diagnosis, Stock Price Prediction, or Robotics**

Total Practical Sessions	**15**	**Total Practical Hours**	**30**

List of Tutorial

S.No	Title / Topic of the Tutorial
1	Fundamentals of Soft Computing • Difference between **Soft Computing and Hard Computing** • Applications and advantages of **Soft Computing**
2	Fuzzy Logic Basics • Solve numerical problems on **Fuzzy Sets and Membership Functions** • Design a **Fuzzy Inference System (FIS)**
3	Fuzzy Logic-Based Classification • Case study: **Fuzzy-Based Traffic Signal Control** • Design **Fuzzy Rules for Air Conditioning System**
4	Artificial Neural Networks (ANN) Basics • Derive **activation functions (Sigmoid, ReLU, Softmax, etc.)** • Solve a problem using **Backpropagation Algorithm**
5	Neural Networks for Pattern Recognition • Handwritten digit recognition using **MLP** • Comparison of **ANN and Traditional Machine Learning**
6	Optimization Using Genetic Algorithms • Solve **Knapsack Problem** using GA • Compare GA with **Brute Force and Greedy Algorithms**
7	Evolutionary Algorithms and Their Applications • Discuss **Particle Swarm Optimization (PSO) vs Genetic Algorithm (GA)**

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	• Solve **Optimization Problems Using PSO**
8	Ant Colony Optimization (ACO) for Routing Problems • Design an ACO-based **Shortest Path Algorithm** • Compare ACO with **Dijkstra's Algorithm**
9	Neuro-Fuzzy Systems • Explain **Adaptive Neuro-Fuzzy Inference System (ANFIS)** • Solve **Time Series Prediction Using Neuro-Fuzzy Model**
10	Hybrid Systems & Case Studies • Discuss case studies in **Healthcare, Robotics, and Finance** • Design a **Hybrid Intelligent Model for a Real-World Problem**

Total Tutorial Sessions	**15**	**Total Tutorial Hours**	**15**

Text Books

1. S. Rajasekaran, G.A. Vijayalakshmi Pai, Neural Networks, Fuzzy Logic, and Genetic Algorithms: Synthesis and Applications **ISBN-13:** 978-8120321861, 1st Edition, Prentice Hall of India, 2003
2. S.N. Sivanandam, S.N. Deepa, Principles of Soft ComputingvSBN-13: 978-8126577132, 3rd Edition, Wiley India, 2018,
3. J.S.R. Jang, C.T. Sun, E. Mizutani, Neuro-Fuzzy and Soft Computing: A Computational Approach to Learning and Machine Intelligence **ISBN-13:** 978-0132610667, 1st Edition, Prentice Hall, 1997

References:

1. David E. Goldberg, Genetic Algorithms in Search, Optimization and Machine Learning **ISBN-13:** 978-, 0201157673, 1st Edition, Manning Publications, 1989
2. Simon Haykin, Neural Networks and Learning Machines **ISBN-13:** 978-0131471399, 3rd edition, Prentice Hall , 2008
3. Timothy J. Ross, Fuzzy Logic with Engineering Applications **ISBN-13:** 978-1119235866, 4th edition, wiely, 2016
4. Andries P. Engelbrecht, Computational Intelligence: An Introduction **ISBN-13:** 978-0470035610, 2nd edition, wiely, 2007
5. James A. Freeman, David M. Skapura, Neural Networks: Algorithms, Applications, and Programming Techniques **ISBN-13:** 978-0201513769, 1st edition Addision wesely, 1991

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Department of Computer Science and Engineering
Established: 1999

Course Information:

Class, Semester	F.Y. M.Tech – Semester II	**Category**	**PE**
Course Code, Course Title	**0CEPE513- Deep Learning**	**Type**	**LIT1**
Prerequisites	Machine Learning Basic calculus (derivatives) Basic linear algebra (matrices, vectors) Basic probability and statistics Programming experience in Python		

Teaching Scheme (per week)	**Lecture**	**Tutorial**	**Practical**	**Self Study**	**Credits**
	03	00	02	2	04

Examination Scheme (Marks)	**Theory**	**MSE**	**TA**	**ESE**	**Practical**	**CIA**	**ESE**
		40	20	40		50	50

Course Outcomes (COs) :
Upon successful completion of this course, the student will be able to:

CO1	Formulate deep learning architectures for complex real-world problems.
CO2	Evaluate the performance and limitations of deep learning models using advanced metrics.
CO3	Develop optimized deep learning models using techniques like NAS, pruning, and quantization.
CO4	Synthesize state-of-the-art techniques in generative AI, self-supervised learning, and federated learning.
CO5	Investigate emerging trends and research challenges in deep learning for innovative applications.

Syllabus:

Module	**Contents**	**Lecture Hours**
I	**Foundations of Deep Learning:** MLP, Activation Functions, Back propagation, **Loss Functions & Regularization Techniques**: L1/L2, Dropout, Batch Normalization, **Optimization Strategies**: SGD, Adam, RMSProp, Adaptive Learning Rates, **Universal Approximation Theorem & Deep Learning Limitations**	**07**
II	**Deep Neural Networks & Optimization:** Deep Architectures & Layer Design, Hyper parameter Tuning & Automated Machine Learning (AutoML), **Neural Architecture Search (NAS)**: Evolutionary Algorithms, Reinforcement Learning-based NAS, Gradient-Free Optimization Techniques, Graph Neural Networks (GNNs) & Their Applications	**08**
III	**Convolutional Neural Networks (CNNs) & Vision Models: Advanced CNN Architectures**: ResNet, DenseNet, EfficientNet, **Self-Attention in Vision**: Vision Transformers (ViT), Swin Transformer, Object Detection (YOLOv8, DETR) & Image Segmentation (U-Net, SAM), 3D CNNs & Video Processing Models, Adversarial Attacks & Robustness in CNNs	**08**
IV	**Sequence Modeling with RNNs, LSTMs & Transformers:** Limitations of RNNs and LSTMs, Attention Mechanism & Self-Attention, Transformers: BERT, GPT-4, LLaMA, Efficient Transformer Variants: ALBERT, T5, Reformer, Multimodal Deep Learning (CLIP, DALL-E)	**08**
V	**Advanced Deep Learning Techniques: Generative AI & Diffusion Models:** GANs, Variational Autoencoders (VAE), **Stable Diffusion, Self-Supervised Learning:** SimCLR, MoCo, BYOL, Energy-Based Models & Boltzmann Machines, Meta-Learning & Few-Shot Learning, Quantum Machine Learning with Deep Networks	**07**
VI	**Explainability, Privacy, and Federated Learning : Explainable AI (XAI)**: SHAP, LIME, Grad-CAM, **Federated Learning & Privacy-Preserving DL**: Federated Averaging, Differential Privacy, **Edge AI & TinyML**: Model Compression, Pruning, Quantization, **Neurosymbolic AI & Hybrid Models, Future Trends in Deep Learning Research**	**07**
	Total Lecture Hours	**45**

List of Experiments

S.No	**Title / Topic of the Experiment**
1	a) Build a multi-layer perceptron (MLP) using TensorFlow/PyTorch.

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	b) Compare activation functions: ReLU, Sigmoid, Tanh.
2	a) Implement different optimizers: SGD, Adam, RMSProp. b) Apply dropout, batch normalization, and L1/L2 regularization.
3	a) Perform hyperparameter tuning using Grid Search, Bayesian Optimization, and AutoKeras. b) Experiment with learning rate schedules.
4	a) Implement NAS using reinforcement learning and evolutionary algorithms. b) Compare manually designed vs NAS-generated architectures.
5	a) Train a CNN on **CIFAR-10** using architectures like **LeNet, ResNet, EfficientNet**. b) Use data augmentation for performance improvement.
6	a) Implement **YOLOv8 or Faster R-CNN** for object detection. b) Train **U-Net or Mask R-CNN** for image segmentation tasks.
7	a) Train an **LSTM/GRU-based model** for sentiment analysis on **IMDB dataset.** b) Compare performance with simple RNNs.
8	a) Use **Hugging Face's Transformers** library to fine-tune BERT for **text classification**. b) Experiment with transfer learning using **pre-trained models.**
9	a) Implement a **DCGAN or CycleGAN** to generate synthetic images. b) Experiment with different generator-discriminator architectures.
10	a) Implement **SimCLR or MoCo** for contrastive learning. b) Train a model without labeled data and fine-tune for classification.
11	a) Apply **SHAP, LIME, Grad-CAM** to explain CNN and NLP models. b) Analyze feature importance in predictions.,
12	a) Train a **deep learning model across multiple devices** using **Google's Flower Framework**. b) Experiment with differential privacy techniques.
13	a) Apply **pruning, quantization, and knowledge distillation** to reduce model size. b) Compare accuracy vs efficiency trade-offs. c) Implement Federated Averaging with Differential Privacy in Deep Learning
Total Practical Sessions	**15** **Total Practical Hours** **30**

Text Books

1. Ian Goodfellow, Deep Learning **ISBN**: 978-0262035613, 1st edition, The MIT Press,2016
2. Rajalingappaa Shanmugamani, Deep Learning for Computer Vision **ISBN**: 978-1788295628, 1st edition, packet publishing, 2018
3. Lewis Tunstall, Leandro von Werra, Thomas Wolf, Natural Language Processing with Transformers **ISBN**: 978-1098136789, 1st edition, OReilly Media, 2022
4. Jakub Langr, Vladimir Bok, GANs in Action: Deep Learning with Generative Adversarial Networks, 1st edition, Manning Publications, 2019
5. Christoph Molnar, Interpretable Machine Learning, 2nd Edition, Leanpub, 2022

References:

1. Francois Chollet, Deep Learning with Python 1st Edition Manning Publications 2017
2. Reza BosaghZadeh, BharathRamsundar, Tensor Flow for Deep Learning, 2018
3. Golub, G.,H., and Van Loan,C.,F, Matrix Computations, JHU Press, 2013
4. Aurélien Géron, Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow, O'Reilly Media,
5. Qiang Yang, Yang Liu, Yong Cheng, Federated Learning: A Comprehensive Overview of Applications, Challenges, and Future Directions **ISBN**: 978-1681736976, 1st edition, Morgan & Claypool Publish, 2019

Online Resources:

1. https://www.deeplearning.ai/courses/deep-learning-specialization/
2. https://archive.nptel.ac.in/courses/106/106/106106184/
3. https://onlinecourses.nptel.ac.in/noc21_cs05/preview
4. CS231n: Convolutional Neural Networks for Visual Recognition (Stanford)

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Department of Computer Science and Engineering
Established: 1999

Course Information:

Class, Semester	F.Y. M.Tech – Semester II						**Category**	**PE**	
Course Code, Course Title	**0CEPE514 Computer Vision**						**Type**	**LIT1**	
Prerequisites	Fundamentals of Digital Image Processing								
Teaching Scheme (per week)	**Lecture**	**Tutorial**	**Practical**	**Self Study**	**Credits**				
	03	00	02	2	04				
Examination Scheme (Marks)	**Theory**	**MSE**	**TA**	**ESE**	**Practical**	**CIA**	**ESE**		
		40	20	40		50	50		

Course Outcomes (COs) :
Upon successful completion of this course, the student will be able to:

CO1	**Analyze** color image processing techniques, including color models, transformations, and segmentation, to enhance image quality and feature extraction.
CO2	**Evaluate** texture analysis methods using statistical and wavelet-based descriptors to characterize and distinguish image patterns.
CO3	**Apply** representation and description techniques, such as boundary, regional, and relational descriptors, to effectively model and interpret image structures.
CO4	**Design** object recognition and image restoration models using statistical, neural network-based, and optimization techniques for pattern classification and noise reduction.
CO5	**Develop** algorithms for moving object detection, tracking, and 3D vision applications using state-of-the-art methodologies and research findings.
CO6	

Syllabus:

Module	Contents	Lecture Hours
I	**Color Image Processing**: Color Fundamentals, Color models, Gray level to color transformations, Basics of Color Image Processing, Color Transformations, Smoothing and Sharpening, Color Segmentation	07
II	**Texture Analysis:** Definition, Types of texture, Texel's, Texture analysis concept and categories, Approaches to texture analysis, Statistics, Texture descriptors - statistical - Auto-correlation, co-occurrence matrices and features, edge density and direction, local binary partition, Law's texture energy measures, Wavelets and texture analysis.	08
III	**Representation & Description** Representation, Boundary Descriptors, Regional Descriptors, Use of Principal Components for description, Relational Descriptors.	08
IV	**Object Recognition & Restoration**: **Object Recognition:** Object Detection Vs recognition, Patterns and Pattern Classes, Knowledge Representation, Statistical Pattern Recognition, Neural Nets, Syntactic Pattern Recognition, Optimization Techniques in Recognition. **Restoration:** Image Restoration Model, Noise Models, Restoration using spatial filtering, Reduction using frequency domain filtering	08
V	**Moving Object Detection and Tracking** Introduction, Background Modeling, Connected Component Labeling, Shadow Detection, Single Object Tracking, Discrete Kalman Filtering, Particle-filter based tracking, Mean-shift tracking, Segmentation tracking via graph cuts.	07
VI	**3D Vision** Introduction to 3D imaging and its applications. Study of any Research Paper(s) based on the current trends in 3D imaging or any case study.	07
	Total Lecture Hours	45

List of Experiment

S.No	Title / Topic of the Experiment

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1	Implement color transformations and apply smoothing and sharpening techniques to a given image.
2	Perform color segmentation on a given image using a selected color model (e.g., RGB or HSV)
3	Analyze textures in an image using co-occurrence matrices, edge density, and local binary patterns.
4	Compute and analyze boundary and regional descriptors for object representation in an image.
5	Use PCA to reduce the dimensionality of image data and evaluate its impact on feature representation.
6	Implement statistical pattern recognition techniques for object detection and recognition.
7	Restore an image degraded by noise using spatial domain filtering techniques
8	Detect and label moving objects in a video using background modeling and shadow detection techniques
9	Implement a Kalman filter-based single-object tracking algorithm.
10	Perform a case study or experiment involving 3D imaging techniques, such as depth map generation or stereo vision.

Total Practical Sessions	**15**	**Total Practical Hours**	**30**

Text Books

1. Gonzalez R. C., Woods R. E., "Digital Image Processing", PHI, Second Edition. 2002
2. Sonka Milan, Vaclav Hlavac, Boyle, "Digital Image Processing and Computer Vision", Cengage Learning, Third edition, 2013

References:

1. S. Jayaraman, S. Esakkirajan, T. Veerkumar, "Digital Image Processing", Tata McGraw Hill, Third edition, 2010
2. D. A. Forsyth, J. Ponce, "Computer Vision – A Modern approach", Pearson Education, Prentice Hall, 2005
3. Linda Shapiro, George C. Stockman, "Computer Vision", Prentice Hall, 2000

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Course Information:

Class, Semester	F.Y. M.Tech – Semester II	**Category**	**PE**
Course Code, Course Title	**0CEPE515-Cloud Computing**	**Type**	**LIT2**
Prerequisites	Programming languages, Database management skills, Linux, Proficiency in SQL		

Teaching Scheme (per week)	**Lecture**	**Tutorial**	**Practical**	**Self Study**	**Credits**
	03	00	02	2	04

Examination Scheme (Marks)	**Theory**	**MSE**	**TA**	**ESE**	**Practical**	**CIA**	**ESE**
		40	20	40		50	-

Course Outcomes (COs) :
Upon successful completion of this course, the student will be able to:

CO1	**Analyze** various computing paradigms and assess the evolution and benefits of cloud computing.
CO2	**Evaluate** cloud computing architectures, service models (IaaS, PaaS, SaaS), and deployment models for different use cases.
CO3	**Examine** virtualization techniques, resource provisioning, and storage mechanisms in Infrastructure as a Service (IaaS) and Platform as a Service (PaaS).
CO4	**Assess** service management strategies, including scalability, SLAs, and data processing techniques in cloud environments.
CO5	**Design** secure and compliant cloud solutions by integrating ethical principles, data security measures, and regulatory frameworks (GDPR, HIPAA).
CO6	

Syllabus:

Module	**Contents**	**Lecture Hours**
I	Overview of Computing Paradigm Recent trends in Computing Grid Computing, Cluster Computing, Distributed Computing, Utility Computing, and Cloud Computing. Introduction to Cloud Computing Cloud Computing (NIST Model) Introduction to Cloud Computing, Benefits of Cloud Computing.	**08**
II	Cloud Computing Architecture Cloud computing stack Comparison with traditional computing architecture (client/server), Services provided at various levels, How Cloud Computing Works, Role of Networks in Cloud computing, protocols used, Role of Web services Service Models (XaaS) Infrastructure as a Service (IaaS), Platform as a Service (PaaS), Software as a Service (SaaS) Deployment Models Public cloud, Private cloud, Hybrid cloud, Community cloud. .	**08**
III	Infrastructure as a Service (IaaS) IaaS, virtualization, Different approaches to virtualization, Machine Image, Virtual Machine (VM) Resource Virtualization Server, Storage, Network Virtual Machine (resource) provisioning and manageability, storage as a service, Data storage in cloud computing (storage as a service). Platform as a Service (PaaS) PaaS, Service Oriented Architecture (SOA) Cloud Platform and Management Computation Storage, SaaS, Web services.	**07**
IV	Service Management in Cloud Computing Service Level Agreements (SLAs), Comparing Scaling Hardware: Traditional vs. Cloud, Economics of scaling: Benefitting enormously Managing Data Looking at Data, Scalability & Cloud Services Database & Data Stores in Cloud Large Scale Data Processing	**07**
V	Cloud Security Infrastructure Security Network level security, Host level security, Application-level security Data security and Storage Data privacy and security Issues, Access Control, Trust, Reputation, Risk, Authentication in cloud computing, Client access in cloud.	**07**
VI	Ethics Compliance and Legal Regulations in cloud computing **Ethical Issues in Cloud Computing:** Privacy and confidentiality concerns, Data ownership and user rights, Ethical responsibility of cloud providers. **Compliance in Cloud Computing**: Importance of compliance for organizations, Role of compliance in data security and privacy. **Compliance Standards and Regulations**: GDPR (General Data Protection Regulation), HIPAA	**08**

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	(Health Insurance Portability and Accountability Act) , CCPA (California Consumer Privacy Act), LGPD(General Data Protection Law) and DPDPA (Digital Personal Data Protection Act)	
	Total Lecture Hours	**45**

List of Experiment

S.No	Title / Topic of the Experiment
1	Install Virtual box/VMware Workstation with different flavors of Linux or windows OS on top ofwindows7 or 8.
2	Install a C compiler in the virtual machine created using virtual box and execute Simple Programs
3	Install Google App Engine. Create hello world app and other simple web applications using python/java
4	Use GAE launcher to launch the web applications
5	Simulate a cloud scenario using CloudSim and run a scheduling algorithm that is not presenting CloudSim
6	Find a procedure to transfer the files from one virtual machine to another virtual machine.
7	Find a procedure to launch virtual machine using trystack (Online Open stack Demo Version)
8	Install Hadoop single node cluster and run simple applications like wordcount

Total Practical Sessions	**15**	**Total Practical Hours**	**30**

Text Books

1. Cloud Computing Bible, Barrie Sosinsky, Wiley-India, 2010.
2. Cloud Computing: Principles and Paradigms, Editors: Rajkumar
3. Buyya, James Broberg, Andrzej M. Goscinski, Wile, 2011.

References:

1. Cloud Computing: Principles, Systems and Applications, Editors: Nikos Antonopoulos, Lee Gillam, Springer, 2012.

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Course Information:

Class, Semester	F.Y. M.Tech – Semester II						**Category**	**PE**	
Course Code, Course Title	**0CEPE516 and Digital Forensics**						**Type**	**LIT2**	
Prerequisites	Computer and networking skills, Analytical skills Critical thinking, Ability to discover and interpret data.								
Teaching Scheme (per week)	**Lecture**	**Tutorial**		**Practical**		**Self Study**		**Credits**	
	03	00		02		2		04	
Examination Scheme (Marks)	**Theory**	**MSE**	**TA**	**ESE**	**Practical**		**CIA**	**ESE**	
		40	20	40			50	-	

Course Outcomes (COs) :
Upon successful completion of this course, the student will be able to:

CO1	**Analyze** core concepts of digital forensics, including computer crimes, forensic benefits, evidence handling, and legal considerations.
CO2	**Design** investigation procedures from incident response to data collection using specialized forensic workstations and software tools.
CO3	**Apply** advanced data acquisition techniques, select appropriate storage formats, validate acquisitions, and preserve digital evidence for legal admissibility.
CO4	**Manage** digital crime scenes by securing evidence, generating hash values, and maintaining chain of custody.
CO5	**Evaluate** forensic tools to detect hidden or obfuscated data, test software reliability and perform remote and distributed acquisitions.
CO6	**Conduct** forensic investigations of email-based crimes using specialized tools to trace and reconstruct digital communications.

Syllabus:

Module	Contents	Lecture Hours
I	Fundamentals of Computer Forensics and Legal Aspects: Computer forensics fundamentals, Benefits of forensics, computer crimes, computer forensics evidence and courts, legal concerns and private issues.	08
II	Digital Investigation Procedures and Tools: Understanding Computing Investigations – Procedure for corporate High-Tech investigations, understanding data recovery work station and software, conducting and investigations.	08
III	Data Acquisition and Evidence Preservation: Data acquisition understanding storage formats and digital evidence, determining the best acquisition method, acquisition tools, validating data acquisitions, performing RAID data acquisitions, remote network acquisition tools, other forensics acquisitions tools.	07
IV	Crime Scene Management and Evidence Handling: Processing crimes and incident scenes, securing a computer incident or crime, seizing digital evidence at scene, storing digital evidence, obtaining digital hash, reviewing case.	08
V	Forensic Tools, Data Hiding, and Email Investigations: Current computer forensics tools- software, hardware tools, validating and testing forensic software, addressing data-hiding techniques, performing remote acquisitions,	07
VI	Recent Trends in Digital Forensics: **Emerging Threats,** Cloud **and Virtual Forensics, Blockchain and Cryptocurrency Forensics ,AI and Machine Learning in Forensics, Dark Web Investigations, Legal and Ethical Considerations**	07
	Total Lecture Hours	45

List of Experiments

S.No	Title / Topic of the Experiment

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1	Perform email analysis using the tools like Exchange EDB viewer, MBOX viewer and View user mailboxes and public folders, Filter the mailbox data based on various criteria, Search for particular items in user mailboxes and public folders
2	Perform Browser history analysis and get the downloaded content, history, saved logins, searches, websites visited etc using Foxton Forensics tool, Dumpzilla.
3	Perform mobile analysis in the form of retrieving call logs, SMS log, all contacts list using the forensics tool like SAFT)
4	Perform Registry analysis and get boot time logging using process monitor tool
5	Perform Disk imaging and cloning the using the X-way Forensics tools
6	Perform Data Analysis i.e History about open file and folder, and view folder actions using Lastview activity tool
7	Perform Network analysis using the Network Miner tool.
8	Perform information for incident response using the crowd Response tool
9	Perform File type detection using Autopsy tool
10	Perform Memory capture and analysis using the Live RAM capture or any forensic tool

Total Practical Sessions	**15**	**Total Practical Hours**	**30**

Text Books

1. Warren G. Kruse II and Jay G. Heiser, "Computer Forensics: Incident Response Essentials", Addison Wesley, 2002.
2. Nelson, B, Phillips, A, Enfinger, F, Stuart, C., "Guide to Computer Forensics and Investigations, 2nd ed., Thomson Course Technology, 2006, ISBN: 0-619-21706-5.
3. The Basics of Digital Forensics: The Primer for Getting Started in Digital Forensics by John Sammons (ISBN10: 1597496618)
4. Guide to Computer Forensics and Investigations by Bill Nelson, Amelia Phillips, Christopher Steuart (ISBN10: 1435498836)

References:

1. Vacca, J, Computer Forensics, Computer Crime Scene Investigation, 2nd Ed, Charles River Media, 2005, ISBN: 1-58450-389.

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Annasaheb Dange College of Engineering and Technology
Ashta - 416301, Dist. : Sangli, Maharashtra
(An Empowered Autonomous Institute)
Department of Computer Science and Engineering

Established: 1999

Course Information:

Class, Semester	F.Y. M.Tech – Semester II					**Category**	**VS**
Course Code, Course Title	0CEMA517 Seminar					**Type**	**L2**
Prerequisites	---						
Teaching Scheme (per week)	**Lecture**	**Tutorial**	**Practical**	**Self Study**		**Credits**	
	0	0	4	2		2	
Examination Scheme (Marks)	**Theory**	**MSE**	**TA**	**ESE**	**Practical**	**CIA**	**ESE**
		-	-	-		50	-

Course Outcomes (COs) :
Upon successful completion of this course, the student will be able to:

CO1	Identify and articulate a relevant research problem in the chosen specialization.
CO2	Conduct a comprehensive literature survey using reputed journals, conferences, and databases.
CO3	Apply critical thinking to compare and evaluate existing solutions.
CO4	Prepare a well-structured technical report using appropriate citation styles.
CO5	Deliver an effective oral presentation with clarity, confidence, and audience engagement.

Syllabus:

In the M.Tech Seminar course for Semester II (2 credits, 4 hours/week), each student must select a seminar topic relevant to their specialization area and aligned with current research trends. The topic should be approved by the assigned seminar guide or faculty coordinator. Students are expected to carry out an in-depth literature review using reputed databases such as IEEE Xplore, SpringerLink, ScienceDirect, ACM Digital Library, Scopus, and Web of Science, identifying at least 15–20 significant research papers, with an emphasis on recent works from the last five years. The literature review should critically analyze existing work, identify research gaps, and highlight possible future directions, with proper citation management using tools like Mendeley, Zotero, or EndNote.

Each student is required to prepare a detailed seminar report of approximately 20–25 pages, following a structured format that includes the title page, certificate, abstract, keywords, introduction, literature review, analysis and discussion of research gaps, conclusion and future scope, and a properly formatted reference list in IEEE or APA style. All figures, tables, and numbering must be consistent, with captions as per academic standards, and the plagiarism level must not exceed 15%.

Students must also prepare a PowerPoint presentation comprising 15–20 well-structured slides, ensuring clarity, minimal text, appropriate visuals, and a logical flow from introduction to conclusion. The seminar should be delivered within 15–20 minutes, followed by a Q&A session. Students should demonstrate confidence, maintain audience engagement, and handle questions professionally, avoiding direct reading from slides.

Evaluation will be based on topic relevance and abstract submission (10%), quality of literature review (20%), technical report (20%), oral presentation (30%), and final corrected report submission (20%). The timeline for deliverables will include topic and abstract submission within the first two weeks of the semester, submission of the draft report and mid-semester presentation by Week 8, and the final presentation with corrected report by the end of the semester.

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Established: 1999	**Annasaheb Dange College of Engineering and Technology** **Ashta - 416301, Dist. : Sangli, Maharashtra** (An Empowered Autonomous Institute) **Department of Computer Science and Engineering**	adcet

Course Information:

Class, Semester	F.Y. M.Tech – Semester II						**Category**	**MA**	
Course Code, Course Title	0CEMA518 Pedagogy Studies						**Type**	**T2**	
Prerequisites	---								
Teaching Scheme (per week)	**Lecture**	**Tutorial**		**Practical**		**Self Study**		**Credits**	
	02	00		00		-		00	
Examination Scheme (Marks)	**Theory**	**MSE**	**TA**	**ESE**	**Practical**		**CIA**	**ESE**	
		-	**50**	-			-	-	

Course Outcomes (COs) :

Upon successful completion of this course, the student will be able to:

CO1	Develop a well-structured curriculum that aligns with learning objectives, industry needs, and emerging trends in computer science
CO2	Utilize active learning techniques, project-based learning, flipped classrooms, and other modern pedagogical approaches to engage students effectively
CO3	Design and implement various assessment strategies to measure learning outcomes, including formative and summative assessments
CO4	Integrate digital tools, learning management systems (LMS), and AI-driven methodologies to enhance student engagement and personalized learning
CO5	Adapt teaching methods to cater to students with different learning styles, backgrounds, and abilities
CO6	

Syllabus:

Module	Contents	Lecture Hours
I	**Foundations of Pedagogy in Engineering:** Introduction to Pedagogy, Learning Theories: Behaviorism, Cognitivism, Constructivism, Bloom's Taxonomy and Outcome-Based Education (OBE) , Learning Styles and Student-Centered Teaching	03
II	**Curriculum Development and Innovative Teaching Strategies:** Principles of Curriculum Design and Development, Defining Learning Outcomes, Course Objectives & Program Outcomes, Industry-Oriented & Interdisciplinary Curriculum Design, Accreditation Standards (e.g., NBA, ABET) Active Learning: Problem-Based, Project-Based & Inquiry-Based Learning, Flipped Classroom Approach, Collaborative and Peer Learning Methods, Teaching Coding, Algorithms, and Problem-Solving Skills	07
III	**Assessment and Evaluation:** Formative and Summative Assessment Techniques, Rubrics, Quizzes, and Automated Grading Systems, Outcome-Based Education (OBE) and Continuous Evaluation, Use of AI and Machine Learning for Personalized Assessment	05
IV	**Technology Enhanced Learning**: Learning Management Systems (LMS) – Moodle, Blackboard, Google Classroom, Role of AI, VR and Gamification in Computer Science Education, Online and Hybrid Learning Models, Open Educational Resources (OER) and Massive Open Online Courses (MOOCs)	05
V	**Research and Ethical Teaching practices**: Educational Research Methods and Data-Driven Decision Making, Writing Research Papers on Pedagogical Innovations, Ethical Considerations in Teaching and Research, Collaborative Learning and Knowledge Sharing in Academic Communities, Addressing Diversity and Inclusion in Engineering Education Ethical Responsibilities of an Educator, Promoting Academic Integrity and Plagiarism Awareness, Gender Sensitization and Accessibility in Education	07
VI	**Future Trends:** AI-Based Personalized Learning Systems, Integration of Industry 4.0 Technologies in Education, Role of EdTech Startups and Digital Learning Platforms, Preparing for Lifelong Learning and Continuous Professional Development	03
	Total Lecture Hours	30

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Text Books

1. "Teaching and Learning STEM: A Practical Guide" – Richard M. Felder & Rebecca Brent
2. "How Learning Works: Seven Research-Based Principles for Smart Teaching" – Susan A. Ambrose et al.
3. "E-Learning and the Science of Instruction: Proven Guidelines for Consumers and Designers of Multimedia Learning" – Ruth Colvin Clark & Richard E. Mayer
4. "Flipped Learning: Gateway to Student Engagement" – Jonathan Bergmann & Aaron Sams

References:

1. "The Art of Teaching Computer Science" – Jens Bennedsen & Michael E. Caspersen
2. "Minds on Fire: How Role-Immersion Games Transform College" – Mark C. Carnes

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