Walchand College of Engineering, Sangli

(Government Aided Autonomous Institute)

AY 2024-25

Course Information

Programme	M. Tech. All Branches
Class, Semester	First Year M. Tech., Sem I
Course Code	7IC501
Course Name	Research Methodology
Desired Requisites:	NIL

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	3 Hrs/week	**MSE**	**ISE**	**ESE**	**Total**
Tutorial	---	30	20	50	100
		Credits: 3			

Course Objectives

1	To prepare students for undergoing research, identify and formulate the research problems, state the hypothesis, design a research layout, set a research process and methodology.
2	To enable students to interpret the results, propose theories, suggest possible/alternative solutions, solve, and prove the solution adapted–logically and analytically, conclude the research findings.
3	To impart knowledge to analyze critically the literature and publish research in reputed conferences/ journals.
4	To expose students to research ethics, IPR and Patents

Course Outcomes (CO) with Bloom's Taxonomy Level

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

CO	**Course Outcome Statement/s**	**Bloom's Taxonomy Level**	**Bloom's Taxonomy Description**
CO1	Demonstrate a research solution in each engineering domain using appropriate Engineering research process and research methodology.	II	Apply
CO2	Device feasible solution to a research problem in the respective engineering domain based on economic, social and legal aspects using appropriate research procedures and practices.	III	Analyze
CO3	Compose research publications and dissertation reports efficiently.	VI	Create
CO4	Draft IPR and patent documents, as well as copyright documentation for research work.	VI	Create

Module	**Module Contents**	**Hours**
I	**Engineering Research Process:** Meaning of research problem, Sources of research problem, Criteria and Characteristics of a good research problem, Errors in selecting a research problem, Definition, scope and objectives of research problem. Approaches of investigation of solutions for research	6

	problem, data collection, analysis, interpretation.	
II	**Research Methodology :** Problem statement formulation, resources identification for solution, Experimental and Analytical modeling, Simulations, Numerical and Statistical methods in engineering research. Hypothesis and its testing by different techniques: T-Test, Z-test etc.,	6
III	**Research Methods:** Uni and Multivariate Analysis: ANOVA, Design of Experiments/Taguchi Method, Regression Analysis. Software tools like spreadsheets. Processing and Analysis of Data: Processing Operations, Types of Analysis-Presentation and Interpretation of Data Editing, Classification and Tabulation-Interpretation. Analyse your results and draw conclusions.	7
IV	**Research Practices:** Effective literature studies approaches, critical analysis, Plagiarism, Research ethics, Mendeley - Reference Management Software. Research communication- Effective Technical Writing, Writing a research article for Journal/conference paper, Technical report, Dissertation/ Thesis report writing, Software used for report writing such as word, Latex etc. Presentation techniques for paper/report/seminar. Publishing article in Scopus/SCI/Web of science indexed journal or conference.	7
V	**Intellectual Property Rights (IPR):** Nature of Intellectual Property: Patents, Designs, Trade and Copyright, Ownership of copyright, Term of copyright, Technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property, New developments in IPR, Traditional knowledge, Various Case Studies.	7
VI	**Patents** Patent Rights: Scope of Patent Rights, Various Patent databases, Geographical Indications. Procedure for grants of patents, Patenting under Patent Cooperation Treaty (PCT). Licensing and transfer of technology. Administration of Patent System. Introduction to International Scenario: World Intellectual Property Organization (WIPO), Trade-Related Aspects of Intellectual Property Rights (TRIPs), Patenting under PCT.	6

Textbooks

1	Kothari C. R, "Research Methodology", 5th Edition, New Age International, 2023
2	Melville Stuart and Goddard Wayne, "Research Methodology: An Introduction for Science & Engineering Students" Juta and Company Ltd, 4th edition 2023.
3	Kumar Ranjit, "Research Methodology: A Step-by-Step Guide for beginners", SAGE Publications, , 4th edition 2023.

References	
1	Merges Robert, Menell Peter, Lemley Mark, “Intellectual Property in New Technological Age”, ASPEN Publishers, 2018.
2	Ramappa T., “Intellectual Property Rights Under WTO”, S. Chand, 2008
3	Mayall, “Industrial Design”, McGraw Hill, Oct 2021.
4	Halbert, “Resisting Intellectual Property”, Taylor & Francis Ltd ,2020
5	Deepak Chopra and Neena Sondhi, “Research Methodology : Concepts and cases ”, Vikas Publishing House, New Delhi
Useful Links	
1	https://onlinecourses.nptel.ac.in/noc21_ge03/preview- Introduction to reseach
2	https://onlinecourses.swayam2.ac.in/ntr21_ed23/preview - Academic Research & Report Writing
	https://onlinecourses.nptel.ac.in/noc21_ge12/preview - Qualitative Research Methods And Research Writing
5	https://onlinecourses.nptel.ac.in/noc21_hs44/preview - Effective Writing
6	https://www.scopus.com/search/form.uri?display=basic#basic
7	https://webofscienceacademy.clarivate.com/learn
9	https://www.wipo.int/about-wipo/en/
10	https://iprsearch.ipindia.gov.in/publicsearch

CO-PO Mapping						
	Programme Outcomes (PO)					
	1	**2**	3	4	5	6
CO1	2	2	1			
CO2	3	2	2	3	2	2
CO3		3		3	1	
CO4				3	1	
The strength of mapping is to be written as 1: Low, 2: Medium, 3: High Each CO of the course must map to at least one PO.						

Assessment

The assessment is based on MSE, ISE and ESE. MSE shall be typically on modules 1 to 3.
ISE shall be taken throughout the semester in the form of teacher’s assessment. Mode of assessment can be field visit, assignments etc. and is expected to map at least one higher order PO.
ESE shall be on all modules with around 40% weightage on modules 1 to 3 and 60% weightage on modules 4 to 6.
For passing a theory course, Min. 40% marks in (MSE+ISE+ESE) are needed and Min. 40% marks in ESE are needed. (ESE shall be a separate head of passing)

Walchand College of Engineering, Sangli

(Government Aided Autonomous Institute)

AY 2024-25

Course Information	
Programme	M.Tech. (Computer Science and Engineering)
Class, Semester	First Year M. Tech., Sem I
Course Code	7CO501
Course Name	Advanced Data Structures
Desired Requisites:	Data Structures

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	3 Hrs/week	**MSE**	**ISE**	**ESE**	**Total**
Tutorial	-	30	20	50	100
		Credits: 3			

Course Objectives	
1	Able to choose appropriate data structures, understand the ADT/ libraries, and use them to design algorithms for a specific problem.
2	Able to understand the necessary mathematical abstractions to solve problems
3	Familiarity with advanced paradigms and data structure used to solve algorithmic problems.
4	To contribute in choosing appropriate data structures and using them for solving real world problems.

Course Outcomes (CO) with Bloom's Taxonomy Level

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

CO	**Course Outcome Statement/s**	**Bloom's Taxonomy Level**	**Bloom's Taxonomy Description**
CO1	Demonstrate Dictionaries and various hashing techniques	II	Understanding
CO2	Analyze and construct Skip Lists.	IV	Analysing
CO3	Develop and analyze algorithms for red-black trees, B-trees and Splay trees.	IV	Analysing
CO4	Develop algorithms for text processing applications.	III	Applying

Module	**Module Contents**	**Hours**
I	Dictionaries: Definition, Dictionary Abstract Data Type, Implementation of Dictionaries; Hashing: Review of Hashing, Hash Function, Collision Resolution Techniques in Hashing, Separate Chaining, Open Addressing, Linear Probing, Quadratic Probing, Double Hashing, Rehashing, Extendible Hashing, Recent trends in hashing.	7
II	Skip Lists: Need for Randomizing Data Structures and Algorithms, Search and Update Operations on Skip Lists, Probabilistic Analysis of Skip Lists, Deterministic Skip Lists	6
III	Trees: Binary Search Trees, AVL Trees, Red Black Trees, 2-3 Trees, B- Trees, Splay Trees.	6

IV	Text Processing: String Operations, Brute-Force Pattern Matching, The Boyer Moore Algorithm, The Knuth-Morris-Pratt Algorithm, Standard Tries, Compressed Tries, Suffix Tries, The Huffman coding algorithm.	6
V	Computational Geometry: 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.	7
VI	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.	7

Textbooks	
1	Mark Allen Weiss, "Data Structures and Algorithm Analysis in JAVA", 3rd Edition, Pearson,2004.
2	M T Goodrich and Roberto Tamassia, Algorithm Design, John Wiley, 2002.

References	
1	Mark Allen Weiss, "Data Structures and Algorithm Analysis in C++, 2ndEdition", Pearson, 2004.
2	Sartaj Sahni, "Data structures, Algorithms and Applications in Java", 2ndEdition, Universities Press,2005

Useful Links	
1	https://www.cise.ufl.edu/~sahni/cop3530/presentations.htm.
2	http://www.nptelvideos.com/java java_video_LectureHours_tutorials.php

CO-PO Mapping

	Programme Outcomes (PO)					
	1	2	3	4	5	6
CO1	3	2				1
CO2	3	1			1	
CO3	3		1			
CO4	3			2		

The strength of mapping is to be written as 1: Low, 2: Medium, 3: High
Each CO of the course must map to at least one PO.

Assessment

The assessment is based on MSE, ISE and ESE. MSE shall be typically on modules 1 to 3. ISE shall be taken throughout the semester in the form of teacher's assessment. Mode of assessment can be field visit, assignments etc. and is expected to map at least one higher order PO. ESE shall be on all modules with around 40% weightage on modules 1 to 3 and 60% weightage on modules 4 to 6. For passing a theory course, Min. 40% marks in (MSE+ISE+ESE) are needed and Min. 40% marks in ESE are needed. (ESE shall be a separate head of passing)

Walchand College of Engineering, Sangli

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AY 2024-25

Course Information					
Programme	M.Tech. (Computer Science and Engineering)				
Class, Semester	First Year M. Tech., Sem I				
Course Code	7CO504				
Course Name	Data Science				
Desired Requisites:	Probability and statistics, python fundamentals, databases				
Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	3 Hrs/week	**MSE**	**ISE**	**ESE**	**Total**
Tutorial	-	30	20	50	100
		Credits: 3			

Course Objectives	
1	To emphasise significance of Data Science in real life.
2	To inculcate selection of statistical and machine learning methods to solve real life problems.
3	To infuse skills required to extract and communicate useful insights from data.
4	To sensitize on ethical issues related to data.

Course Outcomes (CO) with Bloom's Taxonomy Level

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

CO	**Course Outcome Statement/s**	**Bloom's Taxonomy Level**	**Bloom's Taxonomy Description**
CO1	grasp fundamentals of data handling and extracting insights from it and associated ethical considerations.	II	Understanding
CO2	practice data handling and analysis techniques using required tools and libraries to derive meaningful insights from raw data.	III	Applying
CO3	**analyse** datasets and their ethical considerations using fundamental statistical methods and algorithms to solve real-world data science problems.	IV	Analysing
CO4	evaluate effectiveness of statistical methods and algorithms to derive solve real-life problems as well as ethical considerations and responsibilities associated with data science practices.	V	Evaluating

Module	**Module Contents**	**Hours**
I	**Introduction to Data Science** **Overview of Data Science**: Definition, importance, and applications; **Data Science Process**: Steps from data collection to actionable insights; Tools and Technologies; real world case study; Review of statistical methods and python libraries	4
II	**Data manipulation and Exploratory Data Analysis** **Data Collection Methods**: Techniques and sources; **Data Cleaning**: Handling missing values, outliers, and inconsistencies; **Data Transformation**: Normalization, standardization, and encoding; **Descriptive Statistics:** Measures of central tendency, variability, and distribution; **Inferential Statistics:** Hypothesis testing, confidence intervals, and p-values Techniques to summarize and visualize data, **Data Visualization Tools**: Using libraries like Matplotlib and Seaborn	8

III	**Supervised Machine Learning** **Regression:** Linear regression, Multiple linear regression, Train, dev and test dataset, **Binary classification:** Logistic regression, Decision tree, **Multi-class classification:** Multiclass, Multi-label paradigms; **Ensemble methods:** Bagging, Boosting, Stacking; **Evaluation:** Performance measures, Bias-variance trade off	8
IV	**Unsupervised Machine Learning** **Anomaly Detection:** Basic techniques for univariate data, kNN, LOF, iForest, **Clustering:** Agglomerative, K-Means, DBSCAN, Fuzzy clustering; Evaluation of unsupervised techniques	7
V	**Advanced topics** **Artificial neural networks**- Introduction, working, activation functions; **Handling unstructured data:** Natural Language Processing Fundamentals; Introduction to big data concepts and tools	6
VI	**Communicating data insights and ethical considerations** **Effective Reporting:** Structuring and writing comprehensive data reports; **Data Storytelling:** Techniques to create compelling narratives with data; **Visualization Best Practices:** Designing clear and impactful charts and graphs; **Presentation Skills:** Delivering findings to technical and non-technical audiences; Privacy, bias, and fairness in data science; Bias and Fairness: Identifying and mitigating bias in data and algorithms; Case Studies	6

Textbooks	
1	Grus, Joel. Data science from scratch: first principles with python. O'Reilly Media, 2019.
2	VanderPlas, Jake. Python data science handbook: Essential tools for working with data. "O'Reilly Media, Inc.", 2016.
References	
1	Robinson, Emily, and Jacqueline Nolis. Build a career in data science. Manning Publications, 2020.
2	O'Neil, Cathy, and Rachel Schutt. Doing data science: Straight talk from the frontline. "O'Reilly Media, Inc.", 2013.
Useful Links	
1	NPTEL course Link
2	https://www.analyticsvidhya.com/

CO-PO Mapping

	Programme Outcomes (PO)					
	1	2	3	4	5	6
CO1	1	1			2	2
CO2	1	1	2	2	1	3
CO3	1	2	3	3	1	3
CO4	1	2	3	3	1	3

The strength of mapping is to be written as 1: Low, 2: Medium, 3: High
Each CO of the course must map to at least one PO.

Assessment
The assessment is based on MSE, ISE and ESE. MSE shall be typically on modules 1 to 3. ISE shall be taken throughout the semester in the form of teacher's assessment. Mode of assessment can be field visit, assignments etc. and is expected to map at least one higher order PO. ESE shall be on all modules with around 40% weightage on modules 1 to 3 and 60% weightage on modules 4 to 6. For passing a theory course, Min. 40% marks in (MSE+ISE+ESE) are needed and Min. 40% marks in ESE are needed. (ESE shall be a separate head of passing)

Walchand College of Engineering, Sangli

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AY 2024-25

Course Information

Programme	M.Tech. (Computer science and engineering)
Class, Semester	First Year M.Tech., Sem I
Course Code	7CO503
Course Name	**Mathematical foundations of Computer Science**
Desired Requisites:	Discrete Mathematics

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	3 Hrs/week	**ISE**	**MSE**	**ESE**	**Total**
Tutorial	-	20	30	50	100
Practical	-	Nil			
Interaction	-	**Credits: 3**			

Course Objectives

1	To introduce the mathematical fundamentals for computer science and engineering.
2	To study various sampling and classification problems.
3	

Course Outcomes (CO) with Bloom's Taxonomy Level

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

CO	Course Outcome Statement/s	Bloom's Taxonomy Level	Bloom's Taxonomy Description
CO1	grasp the fundamental techniques studied in statistics and graph theory to solve problems in domains such as data mining, machine learning, network analysis.	II	understanding
CO2	solve various problems on probability, sampling, statistics, graph theory.	III	applying
CO3	analyse the methods of statistical inference, and the role that sampling distributions play in those methods.	IV	analysing
CO4	evaluate correct and meaningful statistical analysis of simple to moderate complexity.	V	evaluating

Module	**Module Contents**	**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	6

II	**Sampling** Random samples, sampling distributions of estimators, Methods of Moments and Maximum Likelihood	7
III	**Statistical inference** Statistical inference, Introduction to multivariate statistical models: regression and classification problems, principal components analysis, The problem of overfitting model assessment.	7
IV	**Graph Theory** Graph Theory: Isomorphism, Planar graphs, graph coloring, Hamiltonian circuits and Euler cycles. Permutations and Combinations with and without repetition. Specialized techniques to solve combinatorial enumeration problems	7
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.	6
VI	**Recent Trends** Recent Trends in various distribution functions in mathematical field of computer science for varying fields like bioinformatics, soft computing, and computer vision.	6

Text Books	
1	Trivedi K., Probability and Statistics with Reliability, Queuing, and Computer Science Applications. Wiley.
2	Ronald Walpole, Probability and Statistics for Engineers and Scientists, Pearson, ISBN-13: 978-0321629111

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, Wile

Useful Links	
1	

CO-PO Mapping						
	Programme Outcomes (PO)					
CO	**1**	**2**	**3**	**4**	**5**	**6**
CO1	1	1	1	1		1
CO2	1	1	1	1		1
CO3	1		1	1		1
CO4	1		1	1		1

The strength of mapping is to be written as 1,2,3; Here, 1: Low, 2: Medium, 3: High Each CO of the course must map to at least one PO.

Assessment
The assessment is based on MSE, ISE and ESE. MSE shall be typically on modules 1 to 3. ISE shall be taken throughout the semester in the form of teacher's assessment. Mode of assessment can be field visit, assignments etc. and is expected to map at least one higher order PO. ESE shall be on all modules with around 40% weightage on modules 1 to 3 and 60% weightage on modules 4 to 6. For passing a theory course, Min. 40% marks in (MSE+ISE+ESE) are needed and Min. 40% marks in ESE are needed. (ESE shall be a separate head of passing)

Walchand College of Engineering, Sangli

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AY 2024-25

Course Information	
Programme	M.Tech. (Computer Science and Engineering)
Class, Semester	First Year M. Tech., Sem I
Course Code	7CO551
Course Name	Advanced Data Structures Lab
Desired Requisites:	UG level course in Data Structures Lab

Teaching Scheme		**Examination Scheme (Marks)**			
Practical	2 Hrs/ Week	**LA1**	**LA2**	**Lab ESE**	**Total**
Interaction	-	30	30	40	100
		Credits: 1			

Course Objectives	
1	The fundamental design, analysis, and implementation of basic data structures.
2	Basic concepts in the specification and analysis of programs.
3	Principles for good program design, especially the uses of data abstraction.
4	Significance of algorithms in the computer field

Course Outcomes (CO) with Bloom's Taxonomy Level

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

CO	**Course Outcome Statement/s**	**Bloom's Taxonomy Level**	**Bloom's Taxonomy Description**
CO1	Basic ability to analyze algorithms and to determine algorithm correctness and time efficiency class.	III	Apply
CO2	Master a variety of advanced abstract data type (ADT) and data structures and their impel mentation's.	IV	Analyze
CO3	Develop and analyze algorithms for red-black trees, B-trees and Splay trees	V	Evaluate
CO4	Identify suitable data structures and develop algorithms for computational geometry problems.	V	Evaluate

List of Experiments / Lab Activities/Topics

Implement the following using C/C++/Java

1. Write a program to perform the following operations on singly linked list. I) Creation ii) Insertion iii) Deletion iv) Traversal.
2. Write a program to perform the following operations on doubly linked list. I) Creation ii) Insertion iii) Deletion iv) Traversal in both ways
3. Write a program that implements stack (its operations) using i) Arrays ii) linked list
4. Write a programs that implements Queue (its operations) using i) Arrays ii) linked list
5. Write C program that implements the Quick sort method to sort a given list of integers in ascending order.
6. Write C program that implement the Merge sort method to sort a given list of integers in ascending order.
7. Write C program that implement the SHELL sort method to sort a given list of integers in ascending order. (ex. WALCHAND COLLEGE OF ENGINEERING SANGLI 2023 Batch)
8. Write a program to perform the following: i) Creating a Binary Tree of integers ii) Traversing the above binary tree in preorder, inorder and postorder.
9. Write a C program to perform the following: i) Creating a AVL Tree of integers ii) Traversing the above binary tree in preorder, inorder and postorder.
10. Write a C program that uses functions to perform the following: i) Creating a SplayTree of integers ii) Traversing the above binary tree in preorder, inorder and postorder.
11. Write a C program to perform the following: i) Creating a B-Tree of integers ii) Traversing the above binary tree in preorder, inorder and postorder.
12. Write a program that implements Kruskals algorithm using a disjoint set data structure. The program takes as input a file (data.txt), in which each line either represents a vertex or an edge. For the edge lines, the first integer on that line representing the starting vertex, the second the ending vertex, and the third the weigh of the edge. Use this file to construct, line by line, the graph upon which Kruskal‟s algorithm will be run (do NOT hardcode this graph!).
13. Write a program to simulate various graph traversing algorithms.
14. Write a program to find the minimal spanning tree of a graph using the Prim‟s algorithm. The program should be able to read in the weight matrix of a graph and produce the minimal spanning tree Generate weight matrices (using a random number generator) with a large number of nodes and estimate the time complexity of the algorithm.
15. Write a program to find the closest pair of points using a divide and conquer strategy. Use the random number generator to generate a large number of points in a unit square as input to the algorithm. Test the correctness of the algorithm by using a brute force method.
16. Use dynamic programming to find the optimal binary search tree for a given set of numbers together with their probabilities. Remember that the numbers may be generated in any order, so, a presorting step is also required.

Textbooks	
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, 2008
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, 2000
3	Brass Peter, *Advanced Data Structures*, Cambridge University Press.
Useful Links	
1	NPTEL Videos of 'Data Structures and Algorithms' Course: Link
2	Data Structures with Visualization: Link
3	Lecture Videos from Erik Demaine from MIT: Link

CO-PO Mapping						
	Programme Outcomes (PO)					
	1	2	3	4	5	6
CO1			2			
CO2	3					2
CO3		2		2	1	
CO4			2			2
The strength of mapping is to be written as 1,2,3; where, 1: Low, 2: Medium, 3: High Each CO of the course must map to at least one PO, and preferably to only one PO.						

Assessment				
There are three components of lab assessment, LA1, LA2 and Lab ESE. IMP: Lab ESE is a separate head of passing (min 40 %), LA1+LA2 should be min 40%				
Assessment	**Based on**	**Conducted by**	**Typical Schedule**	**Marks**
LA1	Lab activities, attendance, journal	Lab Course Faculty	During Week 1 to Week 8 Marks Submission at the end of Week 8	30
LA2	Lab activities, attendance, journal	Lab Course Faculty	During Week 9 to Week 16 Marks Submission at the end of Week 16	30
Lab ESE	Lab activities, journal/ performance	Lab Course Faculty and External Examiner as applicable	During Week 18 to Week 19 Marks Submission at the end of Week 19	40
Week 1 indicates starting week of a semester. Lab activities/Lab performance shall include performing experiments, mini-project, presentations, drawings, programming, and other suitable activities, as per the nature and requirement of the lab course. The experimental lab shall have typically 8-10 experiments and related activities if any.				

Walchand College of Engineering, Sangli

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AY 2024-25

Course Information	
Programme	M.Tech. (Computer Science and Engineering)
Class, Semester	First Year M. Tech., Sem I
Course Code	7CO554
Course Name	Data Science Lab
Desired Requisites:	Python

Teaching Scheme		**Examination Scheme (Marks)**			
Practical	2Hrs/ Week	**LA1**	**LA2**	**Lab ESE**	**Total**
Interaction		30	30	40	100
		Credits: 1			

Course Objectives	
1	To emphasise significance of Data Science in real life.
2	To inculcate selection of statistical and machine learning methods to solve real life problems.
3	To infuse skills required to extract and communicate useful insights from data.

Course Outcomes (CO) with Bloom's Taxonomy Level

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

CO	**Course Outcome Statement/s**	**Bloom's Taxonomy Level**	**Bloom's Taxonomy Description**
CO1	practice data handling, analysis techniques and ethical considerations using required tools and libraries to derive meaningful insights from raw data.	III	Applying
CO2	**scrutinize** datasets and their ethical considerations using fundamental statistical methods and algorithms to solve real-world data science problems.	IV	Analysing
CO3	gauge effectiveness of statistical methods and algorithms to derive solve real-life problems as well as ethical considerations and responsibilities associated with data science practices.	V	Evaluating
CO4	formulate a data science problem statement and build a narrative report.	VI	Creating

List of Experiments / Lab Activities/Topics

List of Lab Activities:

1. Use python libraries to load data and compute basic statistics.
2. Exploratory Data Analysis: Perform EDA on any open dataset available in Python/Kaggle.
3. Data visualization: Using various plots such as Scatter plot, bar graph, histogram, box plot, explore the relationship between attributes of a dataset using python or t-SNE.
4. Use and evaluate linear/multiple regression on any open dataset. Report RMSE and R-squared value.
5. Use and evaluate logistic regression on any suitable dataset. Report accuracy and F - score.
6. Use and evaluate decision tree on any suitable dataset. Report accuracy and F - score.
7. Use and evaluate Random Forest and XGBoost. Report accuracy and F - score.
8. Use and evaluate anomaly detection algorithms for anomaly detection.
9. Use and evaluate Agglomerative clustering, K- means and DBSCAN.
10. Observe effect of dimensionality reduction by implementing a ML model with and without PCA.
11. Use and evaluate artificial neural networks for classification problem.
12. Create interactive dashboards using Power BI or Tableau.
13. Prepare and deliver a presentation of a data project by creating compelling narratives using data visualizations.
14. Formulate a data science problem statement and build a narrative report.
15. Analyse case studies to identify ethical dilemmas. Discuss potential solutions and best practices

Textbooks	
1	Grus, Joel. Data science from scratch: first principles with python. O'Reilly Media, 2019.
2	VanderPlas, Jake. Python data science handbook: Essential tools for working with data. "O'Reilly Media, Inc.", 2016.

References	
1	Robinson, Emily, and Jacqueline Nolis. Build a career in data science. Manning Publications, 2020.
2	O'Neil, Cathy, and Rachel Schutt. Doing data science: Straight talk from the frontline. "O'Reilly Media, Inc.", 2013.

Useful Links	
1	https://www.analyticsvidhya.com/
2	https://www.w3schools.com/datascience/

CO-PO Mapping						
	Programme Outcomes (PO)					
	1	2	3	4	5	6
CO1	2	1	1	1	2	2
CO2	2	1	2	2	1	3
CO3	2	2	3	3	1	3
CO4	2	2	2	2	1	2
The strength of mapping is to be written as 1,2,3; where, 1: Low, 2: Medium, 3: High Each CO of the course must map to at least one PO, and preferably to only one PO.						

Assessment				
There are three components of lab assessment, LA1, LA2 and Lab ESE. IMP: Lab ESE is a separate head of passing (min 40 %), LA1+LA2 should be min 40%				
Assessment	**Based on**	**Conducted by**	**Typical Schedule**	**Marks**
LA1	Lab activities, attendance, journal	Lab Course Faculty	During Week 1 to Week 8 Marks Submission at the end of Week 8	30
LA2	Lab activities, attendance, journal	Lab Course Faculty	During Week 9 to Week 16 Marks Submission at the end of Week 16	30
Lab ESE	Lab activities, journal/ performance	Lab Course Faculty and External Examiner as applicable	During Week 18 to Week 19 Marks Submission at the end of Week 19	40
Week 1 indicates starting week of a semester. Lab activities/Lab performance shall include performing experiments, mini-project, presentations, drawings, programming, and other suitable activities, as per the nature and requirement of the lab course. The experimental lab shall have typically 8-10 experiments and related activities if any.				

Walchand College of Engineering, Sangli

(Government Aided Autonomous Institute)

AY 2024-25

Course Information	
Programme	M.Tech. (Computer Science and Engineering)
Class, Semester	First Year M. Tech., Sem I
Course Code	7CO553
Course Name	Presentation and Technical Report Writing
Desired Requisites:	

Teaching Scheme		**Examination Scheme (Marks)**			
Practical	2 Hrs/ Week	**LA1**	**LA2**	**Lab ESE**	**Total**
Interaction	-	30	30	40	100
		Credits: 1			

Course Objectives	
1	Develop the ability to work independently on a chosen topic.
2	Foster creative thinking in the process of technical report writing.
3	Enhance skills in producing high-quality technical reports.
4	Improve effectiveness in delivering technical presentations.

Course Outcomes (CO) with Bloom's Taxonomy Level

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

CO	**Course Outcome Statement/s**	**Bloom's Taxonomy Level**	**Bloom's Taxonomy Description**
CO1	Explain the characteristics of technical and business writing.	II	Understanding
CO2	Use various materials to create effective visual presentations for documents, such as instructions, descriptions, and research reports	III	Applying
CO3	Produce clear, concise, and accurate documents related to technology and workplace writing.	III	Applying
CO4	Evaluate the effectiveness and clarity of technical and business documents.	V	Evaluating

List of Experiments / Lab Activities/Topics

List of Lab Activities:

This course introduces students to the discipline of technical communication. Preparation of visuals to supplement text, workplace communication, descriptions of mechanisms, explanations of processes, and writing reports are the major topics included.
This course is designed for students enrolled in technical degree programs for making them industry ready.

Textbooks	
1	Suitable books based on the contents of the topic.
References	
1	Suitable books based on the contents of the selected topic and research papers from reputed national and international journals and conferences.
Useful Links	
1	As per the need of the topic of report and presentation

CO-PO Mapping						
	Programme Outcomes (PO)					
	1	2	3	4	5	6
CO1		3	1			
CO2		3	1			
CO3		3	1			
CO4				2	1	1
The strength of mapping is to be written as 1,2,3; where, 1: Low, 2: Medium, 3: High Each CO of the course must map to at least one PO, and preferably to only one PO.						

Assessment				
There are three components of lab assessment, LA1, LA2 and Lab ESE. IMP: Lab ESE is a separate head of passing (min 40 %), LA1+LA2 should be min 40%				
Assessment	**Based on**	**Conducted by**	**Typical Schedule**	**Marks**
LA1	Lab activities, attendance, journal	Lab Course Faculty	During Week 1 to Week 8 Marks Submission at the end of Week 8	30
LA2	Lab activities, attendance, journal	Lab Course Faculty	During Week 9 to Week 16 Marks Submission at the end of Week 16	30
Lab ESE	Lab activities, journal/ performance	Lab Course Faculty and External Examiner as applicable	During Week 18 to Week 19 Marks Submission at the end of Week 19	40
Week 1 indicates starting week of a semester. Lab activities/Lab performance shall include performing experiments, mini-project, presentations, drawings, programming, and other suitable activities, as per the nature and requirement of the lab course. The experimental lab shall have typically 8-10 experiments and related activities if any.				

Walchand College of Engineering, Sangli

(Government Aided Autonomous Institute)

AY 2024-25

Course Information	
Programme	M.Tech. (Computer Science and Engineering)
Class, Semester	First Year M. Tech., Sem I
Course Code	7CO511
Course Name	Image processing
Desired Requisites:	Computer Graphics

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	3 Hrs/week	**MSE**	**ISE**	**ESE**	**Total**
Tutorial	-	30	20	50	100
		Credits: 3			

Course Objectives	
1	To provide knowledge about fundamentals of digital image processing.
2	To illustrate concepts of image transforms, image enhancement, image segmentation, morphological operations, color image processing, compression.
3	To apply the image processing algorithms to real world problems.

Course Outcomes (CO) with Bloom's Taxonomy Level

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

CO	**Course Outcome Statement/s**	**Bloom's Taxonomy Level**	**Bloom's Taxonomy Description**
CO1	explain fundamental concepts of digital image processing, mathematical transforms, image enhancement, segmentation, morphology, compression.	II	Understanding
CO2	apply image processing algorithms to solve real life problems and compare the results.	III	Applying
CO3	analyse the effects of image transform.	IV	Analysing
CO4	design and compare different image processing algorithms.	V	Evaluating

Module	**Module Contents**	**Hours**
I	**Digital Image Fundamentals** **Introduction**: Concept, Fundamental Steps and Components of Image Processing System **Digital Image Fundamentals:** Image Acquisition, A simple image model, Sampling and Quantization, Imaging Geometry, Different types of digital images	06
II	**Image Transforms** 2D systems and Necessary Mathematical preliminaries, 2D Orthogonal and Unitary Transforms, 1-D DFT, KL-Transforms, Cosine, Hadamard Transforms, Introduction to Wavelet transforms	07
III	**Image Enhancement** Point Processing, Basic Gray Level Transformations, Histogram Processing, Spatial domain Filtering, Frequency domain filtering	06

IV	**Image Segmentation and Analysis** Edge Detection – using first and second order derivatives, LoG, Canny edge detector, Boundary Extraction – Connectivity, Heuristic Graph Search, Hough Transform, Active Contour, Watershed Transform, Region-based Segmentation – region growing, region splitting and merging, Feature Extraction	07
V	**Image Compression** Fundamentals, Compression model, Lossless Vs Lossy Compression, Fundamentals of Information Theory, Run-length coding, Huffman coding, Dictionary-based compression, Predictive coding, Transform-based coding, Image Compression Standards	06
VI	**Morphological Image Processing** Introduction, Dilation and Erosion, Opening and Closing, The Hit-or-miss transformation, Basic Morphological Algorithms, Boundary Extraction, Region Filling, Extraction of connected components, Thinning, Thickening	07

Textbooks

1	Gonzalez R. C., Woods R. E., "Digital Image Processing", PHI, Second Edition. 2002
2	Jain A. K., "Fundamentals of Digital Image Processing", PHI

References

1	Sonka Milan, Vaclav Hlavac, Boyle, "Digital Image Processing and Computer Vision", Cengage Learning, Third edition, 2013
2	S. Jayaraman, S. Esakkirajan, T. Veerkumar, "Digital Image Processing", Tata McGrawHill, Third edition, 2010

Useful Links

1	https://www.mathworks.com/products/image-processing

CO-PO Mapping

	Programme Outcomes (PO)					
	1	2	3	4	5	6
CO1	1					
CO2	1					
CO3	1	2	2			
CO4	1	3	2			

The strength of mapping is to be written as 1: Low, 2: Medium, 3: High
Each CO of the course must map to at least one PO.

Assessment

The assessment is based on MSE, ISE and ESE. MSE shall be typically on modules 1 to 3. ISE shall be taken throughout the semester in the form of teacher's assessment. Mode of assessment can be field visit, assignments etc. and is expected to map at least one higher order PO. ESE shall be on all modules with around 40% weightage on modules 1 to 3 and 60% weightage on modules 4 to 6. For passing a theory course, Min. 40% marks in (MSE+ISE+ESE) are needed and Min. 40% marks in ESE are needed. (ESE shall be a separate head of passing)

Walchand College of Engineering, Sangli

(Government Aided Autonomous Institute)

AY 2024-25

Course Information

Programme	M.Tech. (Computer Science and Engineering)
Class, Semester	First Year M. Tech., Sem I
Course Code	7CO516
Course Name	Professional Elective-I: Computational Complexity
Desired Requisites:	Theory of computation

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	3 Hrs/week	**MSE**	**ISE**	**ESE**	**Total**
Tutorial	-	30	20	50	100
		Credits: 3			

Course Objectives

1	To know the examples of problems in the basic complexity classes: NL, P, NP, PSPACE, P/poly, BPP.
2	To understands successive levels of generality: complexity of an algorithm, complexity of a problem, a class of complexity.
3	To understand the usefulness of the information on computational complexity of practical problems.

Course Outcomes (CO) with Bloom's Taxonomy Level

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

CO	**Course Outcome Statement/s**	**Bloom's Taxonomy Level**	**Bloom's Taxonomy Description**
CO1	understand the foundational concepts of NP completeness and P vs NP and time hierarchy.	II	Understanding
CO2	show use of various techniques to analyze and compare space complexity and randomized complexity classes.	III	Applying
CO3	illustrate different techniques to solves problems related to polynomial class.	III	Applying
CO4	explain communication, counting complexity and interactive proofs and their role in verifying computational tasks efficiently.	IV	Analyzing

Module	**Module Contents**	**Hours**
I	**Introduction** Review of NP Completeness, P vs NP, Cook-Levin Theorem, Time Hierarchy Theorem, Polynomial Hierarchy.	6
II	**Space complexity** Introduction to Space Complexity, Savitch's Theorem, NL-Completeness, NL = coNL, PSPACE Completeness, Space Hierarchy Theorem, Baker-Gill-Solovay Theorem.	7
III	**Randomized and Nonuniform computation** Randomized Complexity Classes, BPP is in polynomial hierarchy, Nonuniform computation, Circuit Complexity.	7

IV	**Circuits and Polynomial hierarchy** Parity not in AC^0, Karp-Lipton Theorem, Adleman's Theorem, Polynomial Identity Testing, Isolation Lemma, Perfect Matching is in RNC^2.	7
V	**Complexity of counting** #P and #P Completeness. Permanent is #P Complete, Valiant Vazirani Theorem and Toda's Theorem.	6
VI	**Communication Complexity and Interactive proofs** Communication Complexity, Monotone depth lower bound for matching, Interactive Proofs.	6

Textbooks	
1	Computational Complexity, by Christos Papadimitriou
2	Computational Complexity: A Modern Approach, by Sanjeev Arora and Boaz Barak.

References	
1	Introduction to the Theory of Computation by Michael Sipser.
2	Computational Complexity: A Modern Approach Sanjeev Arora and Boaz Barak.

Useful Links	
1	https://onlinecourses.nptel.ac.in/noc21_cs90/preview

CO-PO Mapping

	Programme Outcomes (PO)					
	1	2	3	4	5	6
CO1						
CO2	1			2		
CO3	1			2		2
CO4	1				2	2

The strength of mapping is to be written as 1: Low, 2: Medium, 3: High
Each CO of the course must map to at least one PO.

Assessment

The assessment is based on MSE, ISE and ESE. MSE shall be typically on modules 1 to 3. ISE shall be taken throughout the semester in the form of teacher's assessment. Mode of assessment can be field visit, assignments etc. and is expected to map at least one higher order PO. ESE shall be on all modules with around 40% weightage on modules 1 to 3 and 60% weightage on modules 4 to 6. For passing a theory course, Min. 40% marks in (MSE+ISE+ESE) are needed and Min. 40% marks in ESE are needed. (ESE shall be a separate head of passing)

Walchand College of Engineering, Sangli

(Government Aided Autonomous Institute)

AY 2024-25

Course Information	
Programme	M.Tech. (Computer Science and Engineering)
Class, Semester	First Year M. Tech., Sem I
Course Code	7CO513
Course Name	Human Computer Interaction
Desired Requisites:	Software Engineering

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	3 Hrs/week	**MSE**	**ISE**	**ESE**	**Total**
Tutorial	-	30	20	50	100
		Credits: 3			

Course Objectives	
1	Introduction to concept related to Human Computer Interaction.
2	Understand the theoretical dimensions of human factors involved in the acceptance of computer interfaces.
3	Identify the impact of usable interfaces in the acceptance and performance utilization of information systems.
4	Identify the importance of working in teams and the role of each member within an interface development phase.

Course Outcomes (CO) with Bloom's Taxonomy Level

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

CO	**Course Outcome Statement/s**	**Bloom's Taxonomy Level**	**Bloom's Taxonomy Description**
CO1	understand the fundamentals of Human-Computer Interaction and Interaction design.	II	Understanding
CO2	apply human Capabilities and Core Cognitive aspects of interaction design.	III	Applying
CO3	analyse quantitative analysis, evaluation, and redesign through HCI concepts.	IV	Analysing
CO4	evaluate sample interfaces using different models of HCI.	V	Evaluating

Module	**Module Contents**	**Hours**
I	**Introduction to Human-Computer Interaction** What is HCI – design, models, evaluation, Need to understand people, computers and methods. Basic human abilities - vision, hearing, touch, memory. The difference between good and poor interaction design, what interaction design is and how it relates to human-computer interaction and other fields. Need for Design - Examples from Design of everyday things, case studies, Evolution of the web and digital interfaces. Exercise – Identify problems around us requiring design solution or problems solved using design.	7

II	**The Design Process** Interaction design basics, HCI in the software process, Design rules, Evaluation techniques, Universal design, User support, Individual differences, designing interfaces for all, User research and techniques, Understanding Persona, Good and poor design, Ergonomics. Exercise- Creating persona for different application in everyday use.	6
III	**The Interaction** What, why and when to evaluate, Design guidelines, Golden rules and heuristics, Goals of Evaluation, Evaluation criteria, DECIDE framework, Evaluation through: Expert analysis, User participation. Exercise-User Persona: Creating personae for different application in everyday use. Develop a precise description of the user of the product in focus of the design and what the user wishes to accomplish. Design a small prototype (Web/Mobile App) of it and evaluate it using different evaluation techniques	6
IV	**UI Evaluation Techniques** Models- Cognitive models, Goal and Task hierarchy models, Linguistic models, Physical and Device models, Design principles.	6
V	**Real Time Applications** Conduct evaluation of different sample interfaces using different models. Introduction to Prototyping tools, Understanding how UI Interaction & Prototype Design works, UX - Industry overview. Prototyping / wire framing tool.	7
VI	**Advances of Human Computer Interaction** Introduction, Relation between AR,VR and HCI,Different tool kits in AR and VR,implementation of HCI using AR and VR, AI in HCI	7

Textbooks	
1	"Human Computer Interaction" by Alan Dix, Janet Finlay, ISBN:9788131717035, Pearson Education (2004)
2	"Designing the User Interface - Strategies for Effective Human Computer Interaction", by Ben Shneiderman ISBN: 9788131732557, Pearson Education (2010).
References	
1	Usability Engineering: Scenario-Based Development of Human-Computer Interaction, by Rosson, M. and Carroll, J. (2002)
2	The Essentials of Interaction Design, by Cooper, et al., Wiley Publishing (2007)
3	Usability Engineering, by Nielsen, J. Morgan Kaufmann, San Francisco, 1993. ISBN 0-12-518406-9
4	The Resonant Interface: HCI Foundations for Interaction Design, by Heim, S., Addison-Wesley. (2007)
Useful Links	
1	https://www.hcii.cmu.edu/research-areas/artificial-intelligence-ai
2	https://www.linkedin.com/advice/1/how-does-ai-impact-human-computer-interaction
3	https://www.interaction-design.org/literature/topics/human-computer-interaction

CO-PO Mapping

	Programme Outcomes (PO)					
	1	2	3	4	5	6
CO1	2	1	2			
CO2	2	1	2			
CO3	2	1	2			
CO4	2	1	2			

The strength of mapping is to be written as 1: Low, 2: Medium, 3: High
Each CO of the course must map to at least one PO.

Assessment
The assessment is based on MSE, ISE and ESE. MSE shall be typically on modules 1 to 3. ISE shall be taken throughout the semester in the form of teacher's assessment. Mode of assessment can be field visit, assignments etc. and is expected to map at least one higher order PO. ESE shall be on all modules with around 40% weightage on modules 1 to 3 and 60% weightage on modules 4 to 6. For passing a theory course, Min. 40% marks in (MSE+ISE+ESE) are needed and Min. 40% marks in ESE are needed. (ESE shall be a separate head of passing)

Walchand College of Engineering, Sangli

(Government Aided Autonomous Institute)

AY 2024-25

Course Information

Programme	M.Tech. (Computer Science and Engineering)
Class, Semester	First Year M. Tech., Sem I
Course Code	7CO517
Course Name	Artificial Intelligence
Desired Requisites:	Data structures, Algorithms, Probability and Statistics

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	3 Hrs/week	**MSE**	**ISE**	**ESE**	**Total**
Tutorial	-	30	20	50	100
		Credits: 3			

Course Objectives

1	To acquaint students with the meaning, purpose, scope, applications, and effects of AI.
2	To solve problems by applying a suitable search method, knowledge representation.
3	To understand and represent knowledge in AI systems.
4	To analyse real life problems and provide solutions by applying AI techniques.

Course Outcomes (CO) with Bloom's Taxonomy Level

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

CO	**Course Outcome Statement/s**	**Bloom's Taxonomy Level**	**Bloom's Taxonomy Description**
CO1	explain fundamental concepts and challenges in AI	II	Understanding
CO2	use the basic principles, models and algorithms of AI to recognize, model and solve problems.	III	Applying
CO3	examine performance AI techniques used to solve real life problems.	IV	Analyzing
CO4	recommend AI techniques used to solve real life problems.	V	Evaluating

Module	**Module Contents**	**Hours**
I	**Artificial Intelligence and Its Issues:** Definitions - Importance of AI, Evolution of AI - Applications of AI, AI agent and environments, classification of AI systems with respect to environment, knowledge inferring systems and planning, uncertainty, learning systems, state-of-the-art of AI systems, responsible AI	5

II	**Problem Solving by search** **Solving problems by searching**: Problem solving agents, Formulating problems, Solution search; **Search strategies:** BFS, DFS, Uniform cost, Depth limited; **Informed search methods:** Best first, A*, AO*, Hill climbing, Simulated annealing	6
III	**Knowledge Representation & Reasoning-I** **Knowledge based agents:** Introduction **Propositional logic:** Syntax, Semantics, Inference, Rules **First order predicate logic:** Syntax and semantics, Extensions and notational variations, Simple reflex agent; **Knowledge base creation:** Example; **Logical reasoning systems:** Introduction, Indexing, Retrieval, Unification, Logic programming systems - Prolog	8
IV	**Knowledge Representation & Reasoning-II** Probability, conditional probability, Bayes Rule, Bayesian Networks-representation, construction and inference, temporal model, hidden Markov model. MDP formulation, utility theory.	8
V	**Game playing and Introduction to Planning** **Game playing**: Introduction, Minimax search procedure, Alpha beta pruning; **Planning:** Introduction, Components of planning, Goal stack planning, Partial order planning, Full order planning	6
VI	**Learning Systems & Expert Systems:** Forms of Learning Types - Supervised, Unsupervised, Reinforcement Learning, Decision Trees. Expert Systems (ES): Stages in the development , probability based ES, ES tools, difficulties in developing ES, Applications of ES, State-of-the-art case study.	6
Textbooks		
1	Elaine Rich and Kerin Knight, Artificial Intelligence, 3rd Edition, McGraw Hill. ISBN13: 9780070087705	
2	Eugene, Charniak, Drew Mcdermott, Introduction to artificial intelligence, AddisonWesley. ISBN 0-07-052263-4.	
3	Deepak Khemani,"A First Course in Artificial Intelligence", McGraw Hill Education (India), 2013.	
4	Stuart Russell, Peter Norvig, "Artificial Intelligence A Modern Approach", Prentice Hall, 3rd Edition, 2009	
References		
1	Khemani D., "Artificial Intelligence: Knowledge Representation and Reasoning", IIT Madras, Lecture Notes.	
2	Herbert A. Simon, The Sciences of the Artificial, MIT Press, 3rd Edition, 1998. ISBN: 9780262190510. George F Luger, Artificial Intelligence: Structures and Strategies for Complex Problem Solving, Pearson Edu., 4th Edition. ISBN-13: 978-0-321-54589-3	
Useful Links		

1	Artificial Intelligence: Knowledge Representation and Reasoning Course on NPTEL: Link NPTEL
2	Artificial Intelligence Search Methods for Problem Solving Course on NPTEL: Link

CO-PO Mapping

	Programme Outcomes (PO)					
	1	2	3	4	5	6
CO1	1	1	1	1	1	1
CO2			1	2	1	2
CO3			2	3		3
CO4			3	2		2

The strength of mapping is to be written as 1: Low, 2: Medium, 3: High
Each CO of the course must map to at least one PO.

Assessment

The assessment is based on MSE, ISE and ESE. MSE shall be typically on modules 1 to 3. ISE shall be taken throughout the semester in the form of teacher's assessment. Mode of assessment can be field visit, assignments etc. and is expected to map at least one higher order PO. ESE shall be on all modules with around 40% weightage on modules 1 to 3 and 60% weightage on modules 4 to 6. For passing a theory course, Min. 40% marks in (MSE+ISE+ESE) are needed and Min. 40% marks in ESE are needed. (ESE shall be a separate head of passing)

Walchand College of Engineering, Sangli

(Government Aided Autonomous Institute)

AY 2024-25

Course Information	
Programme	M.Tech. (Computer Science and Engineering)
Class, Semester	First Year M. Tech., Sem I
Course Code	7CO515
Course Name	Professional Elective 2 - Advanced Network Technology
Desired Requisites:	Computer Network

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	3 Hrs/week	**MSE**	**ISE**	**ESE**	**Total**
Tutorial	-	30	20	20	100
Practical		**Credits: 3**			

Course Objectives	
1	To explain key concepts of wireless networks, standards, technologies and their basic operations.
2	To appraise architectures, functions and performance of wireless sensor network systems.
3	To examine SDN/NFV motivation and its benefits in data center.
4	

Course Outcomes (CO) with Bloom's Taxonomy Level

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

CO	**Course Outcome Statement/s**	**Bloom's Taxonomy Level**	**Bloom's Taxonomy Description**
CO1	explain ,compare characteristics of wireless networks, and describe wireless sensor network and SDN/NFV technologies.	II	Understanding
CO2	apply acquired knowledge to recognize the performance of wireless sensor and SDN/NFV networks .	III	Applying
CO3	Apply the knowledge of SDN and NFV for designing network	III	Applying
CO4	analyze wireless sensor network with case study and SDN/NFV techniques in Data center.	IV	Analyzing

Module	**Module Contents**	**Hours**
I	**Introduction to Wireless Networks** Network Architecture, Network Components, Design Issues, Network Protocols, Technologies and Applications of BAN, PAN, LAN, MAN. Wireless Wide Area Networks: Introduction to Cellular and Satellite Networks, Interworking of WLAN and WWAN, WWAN Applications	7
II	**Introduction to Mobile Ad hoc, Wireless Sensor, Wireless Mesh and Vehicular Networks:** Introduction to Network, It's Motivations, Applications, Performance metrics, History and Design factors, Network Architecture: Traditional layered stack, Cross-layer designs, Different used Network Architectures Vehicular Networks	7

III	**Research Issues in Wireless Networks:** Sensor Motes, and Hardware parameters configuration, Channel Allocation, Error Control and Coding, Congestion Control, Routing, Addressing, Network Access Control, Mobility Control, Flow Control, Security and Privacy, QoS Management, Power Management, Cross-Layer Control, Network Modeling, Traffic Modeling, Network Measurements. Simulation - Introduction to one Network Simulator for wireless sensor network (NS2/NS3/Cooja /OMNET++/ Exata Cyber etc.)	
IV	**Evolution of Software Defined Networking (SDN):** Separation of Control Plane and Data Plane: Concepts, Advantages and Disadvantages, OpenFlow protocol. Control Plane: Introduction of existing SDN Controllers including Floodlight and Open Daylight projects. Data Plane: Software-based and Hardware-based; Programmable Network Hardware. Programming SDNs: Northbound Application Programming Interface, (Assignments related to languages and tools)	8
V	**Network Virtualization:** Concepts, Applications, Existing Network Virtualization Framework (VMWare and others),(assignments related to Mininet based examples) **Network Functions Virtualization (NFV) and SDN:** Network architecture, NFV Infrastructure, NFV Management and Orchestration (MANO), NFV and SDN	6
VI	**Data Center Networks:** Data Center Networks: Packet, Optical and Wireless Architectures, Network Topologies. Use Cases of SDNs: Data Centers, Backbone Networks, Home Networks, Traffic Engineering.	6

Textbooks	
1	Sunilkumar S., Mahabaleshwar Manvi, Kakkasageri S., "Wireless and Mobile Networks: Concepts and Protocols", Wiley Second edition, 2016.
2	Schiller J, "Mobile Communications", Addison Wesley, 2000.
3	Stallings W, "Wireless Communications and Networks", Pearson Education, Schiller, 2005.
4	Nadeau Thomas D., "SDN: Software Defined Networks, An Authoritative Review of Network Programmability Technologies", Ken Gray Publisher: O'Reilly Media, August 2013.
5	Goransson Paul and Black Chuck, "Software Defined Networks: A Comprehensive Approach", Morgan Kaufmann, June 2014.

References	
1	Stojmenic Ivan, "Handbook of Wireless Networks and Mobile Computing", John Wiley and Sons Inc 2002.
2	Yi Bing Lin and Imrich Chlamtac, "Wireless and Mobile Network Architectures", John Wiley and Sons Inc 2000.
3	Pandya Raj, "Mobile and Personal Communications Systems and Services", PHI 2008.

4	Dargie W. and Poellabauer C., “Fundamentals of Wireless Sensor Networks –Theory and Practice”, Wiley 2010.
5	Kazem Sohraby, Minoli Daniel and Znati Taieb, “wireless sensor networks -Technology, Protocols, and Applications”, Wiley Interscience, 2007.
6	Hara Takahiro, Zadorozhny Vladimir I, and Buchmann Erik , “Wireless Sensor Network Technologies for the Information Explosion Era”, Springer, 2010.

Useful Links	

CO-PO Mapping

	Programme Outcomes (PO)					
	1	2	3	4	5	6
CO1			2	3		
CO2			2	1		2
CO3			2	1		2
CO4	2				3	2

The strength of mapping is to be written as 1: Low, 2: Medium, 3: High
Each CO of the course must map to at least one PO.

Assessment

The assessment is based on MSE, ISE and ESE. MSE shall be typically on modules 1 to 3. ISE shall be taken throughout the semester in the form of teacher’s assessment. Mode of assessment can be field visit, assignments etc. and is expected to map at least one higher order PO. ESE shall be on all modules with around 40% weightage on modules 1 to 3 and 60% weightage on modules 4 to 6. For passing a theory course, Min. 40% marks in (MSE+ISE+ESE) are needed and Min. 40% marks in ESE are needed. (ESE shall be a separate head of passing)

Walchand College of Engineering, Sangli

(Government Aided Autonomous Institute)

AY 2024-25

Course Information

Programme	M.Tech. (Computer Science and Engineering)
Class, Semester	First Year M. Tech., Sem I
Course Code	7CO518
Course Name	Cloud computing
Desired Requisites:	Operating System, Computer Networks

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	3 Hrs/week	**MSE**	**ISE**	**ESE**	**Total**
Tutorial	-	30	20	50	100
		Credits: 3			

Course Objectives

1	To providing basic ideas and principles in cloud management techniques, virtualization techniques and cloud software deployment consideration.
2	To understand the Cloud architecture and cloud application.
3	To Study development environments for service development.
4	To understand the cloud IT model.

Course Outcomes (CO) with Bloom's Taxonomy Level

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

CO	Course Outcome Statement/s	Bloom's Taxonomy Level	Bloom's Taxonomy Description
CO1	explain fundamental cloud computing concepts, including its history, service options, deployment models, and business implications.	II	Understanding
CO2	use virtualization tools and techniques within various cloud platforms and compare different cloud service providers.	III	Applying
CO3	assess the reliability, security, performance, and scalability of cloud services and their management tools.	IV	Analysing
CO4	evaluate cloud-based applications and services using case studies to determine their effectiveness in improving cost efficiency and business operations.	V	Evaluating

Module	Module Contents	Hours
I	**Introduction to Cloud Technologies** Introduction to the Cloud Computing, History of cloud computing, Cloud service options, Cloud Deployment models, Business concerns in the cloud.	6

II	**Virtualization and Cloud Platforms** Exploring virtualization, Load balancing, Hypervisors, Machine imaging, Cloud marketplace overview, and Comparison of Cloud providers.	7
III	**Cloud Applications** Technologies and the processes required when deploying web services, Deploying a web service from inside and outside a cloud architecture, advantages and disadvantages.	7
IV	**Cloud Service Management** Reliability, availability, and security of services deployed from the cloud. Performance and scalability of services, tools, and technologies used to manage cloud services deployment.	6
V	**Cloud IT Model** Analysis of Case Studies when deciding to adopt cloud computing architecture. How to decide if the cloud is right for your requirements. Cloud-based service, applications, and development platform deployment so as to improve the total cost of ownership (TCO).	6
VI	**Case Studies** Google App Engine(GAE) - GAE Architecture - Functional Modules of GAE - Amazon Web Services(AWS) - GAE Applications - Cloud Software Environments - Eucalyptus - Open Nebula - Open Stack.	7
Textbooks		
1	Cloud Computing: Concepts, Technology & Architecture (The Pearson Service Technology Series from Thomas Erl) Hardcover – 23 May 2013.	
2	Enterprise Cloud Computing: Technology, Architecture, Applications Paperback by Gautam Shroff14 October 2010.	
3	CLOUD COMPUTING A PRACTICAL APPROACH Paperback by Toby Velte, Anthony Velte, Robert Elsenpeter,1 July 2017	
References		
1	Cloud Computing: Concepts, Technology & Architecture, 1/e Paperback – by Erl, 1 January 2014	
2	GautamShroff,"Enterprise Cloud Computing - Technology, Architecture, Applications", Cambridge University Press, 2010.	
3	Ronald L. Krutz, Russell Dean Vines ,"Cloud Security: A Comprehensive Guide to Secure Cloud Computing", Wiley- India,2010.	
4	RajkumarBuyya, James Broberg, Andrzej M. Goscinski,"Cloud Computing: Principles and Paradigms", Wiley, 1 Edition 2013. 2 3	
Useful Links		
1	https://www.simplilearn.com/	
2	https://www.mygreatlearning.com/	
3	Barrie Sosinsky,"Cloud Computing Bible", Wiley-India, 2010.	
4	https://cloud.google.com/training	

CO-PO Mapping						
	Programme Outcomes (PO)					
	1	2	3	4	5	6
CO1	1					
CO2	2		2			
CO3			2	1		
CO4		1				
The strength of mapping is to be written as 1: Low, 2: Medium, 3: High Each CO of the course must map to at least one PO.						

Assessment
The assessment is based on MSE, ISE and ESE. MSE shall be typically on modules 1 to 3. ISE shall be taken throughout the semester in the form of teacher's assessment. Mode of assessment can be field visit, assignments etc. and is expected to map at least one higher order PO. ESE shall be on all modules with around 40% weightage on modules 1 to 3 and 60% weightage on modules 4 to 6. For passing a theory course, Min. 40% marks in (MSE+ISE+ESE) are needed and Min. 40% marks in ESE are needed. (ESE shall be a separate head of passing)

Walchand College of Engineering, Sangli

(Government Aided Autonomous Institute)

AY 2024-25

Course Information	
Programme	M.Tech. (Computer Science and Engineering)
Class, Semester	First Year M. Tech., Sem I
Course Code	7CO519
Course Name	Professional Elective- Internet of Things
Desired Requisites:	Computer Networks

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	03 Hrs/week	**MSE**	**ISE**	**ESE**	**Total**
Tutorial	-	30	20	50	100
		Credits: 03			

Course Objectives	
1	To discuss various topics related to wireless sensor networks significant towards emerging internet-of-things (IoT).
2	To impart knowledge of hardware, operating systems, distributed systems, networking, security and databases required for IoT technology.
3	To illustrate wireless sensor network (WSN) /Internet of Things (IoT) specific issues such as localization, time synchronization, and topology control.

Course Outcomes (CO) with Bloom's Taxonomy Level

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

CO	**Course Outcome Statement/s**	**Bloom's Taxonomy Level**	**Bloom's Taxonomy Description**
CO1	describe requirements from emerging Smart applications, communication systems, protocols and middleware.	II	Understanding
CO2	compare and analyse communication and network protocols used in IoT	III	Applying
CO3	assess and evaluate mechanisms and algorithms for time synchronization, security and localization in WSNs and IoT	IV	Analysing
CO4	evaluate the impact of these trends on the scalability, efficiency, and security of IoT systems.	V	Evaluating

Module	**Module Contents**	**Hours**
I	**Introduction and Applications:** smart transportation, smart cities, smart Living, smart energy, smart health, and smart learning. Examples of research areas include for instance: Self-Adaptive Systems, Cyber Physical Systems, Systems of Systems, Software Architectures and Connectors, Software Interoperability, Big Data and Big Data Mining, Privacy and Security.	06

II	**IoT Reference Architecture** Introduction, Functional View, Information View, Deployment and Operational View, Other Relevant architectural views. **Real-World Design Constraints-** Introduction, Technical Design constraints hardware, Data representation and visualization, Interaction and remote control.	07
III	**Industrial Automation** Service-oriented architecture-based device integration, SOCRADES: realizing the enterprise integrated Web of Things, IMC-AESOP: from the Web of Things to the Cloud of Things. **Commercial Building Automation-** Introduction, Case study: phase one- commercial building automation today, Case study: phase two- commercial building automation in the future.	07
IV	**Hardware Platform for IoT** Hardware Platforms and Energy Consumption, Operating Systems, Time Synchronization, Positioning and Localization, Medium Access Control, Topology and Coverage Control, Routing: Transport Protocols, Network Security, Middleware, Databases.	08
V	**IOT Physical Devices & Endpoints** What is an IOT Device, Exemplary Device Board, Linux on Raspberry, Interface and Programming & IOT Device.	07
VI	**Recent trends in IoT with case studies:** Recent trends in sensor network and IOT architecture, Automation in Industrial aspect of IOT.	05

Textbooks	
1	Mandler B., Barja J., Campista Mitre, M.E., Cagá_ová, D. Chaouchi, H. Zeadally, S. Badra, M. Giordano, S. Fazio, M. Somov, A. Vieriu, R.-L., "Internet of Things. IoT Infrastructures" , Springer International Publishing, Second International Summit, IoT 360° 2015, Rome, Italy, October 27-29, 2015. Revised Selected Papers, Part I
2	Kyung, C.-M., Yasuura, H. Liu, Y. Lin, Y.-L., "Smart Sensors and Systems", Springer International Publishing,2017.
References	
1	Hersent Olivier, Boswarthick David , Elloumi Omar , "The Internet of Things: Key Applications and Protocols", Wiley-Blackwell, Second Edition ,2012
Useful Links	
1	https://onlinecourses.nptel.ac.in/noc22_cs53/preview

CO-PO Mapping

	Programme Outcomes (PO)					
	1	2	3	4	5	6
CO1	1		1		3	
CO2				3	1	2
CO3	1			2		2
CO4						

The strength of mapping is to be written as 1: Low, 2: Medium, 3: High
Each CO of the course must map to at least one PO.

Assessment
The assessment is based on MSE, ISE and ESE. MSE shall be typically on modules 1 to 3. ISE shall be taken throughout the semester in the form of teacher's assessment. Mode of assessment can be field visit, assignments etc. and is expected to map at least one higher order PO. ESE shall be on all modules with around 40% weightage on modules 1 to 3 and 60% weightage on modules 4 to 6. For passing a theory course, Min. 40% marks in (MSE+ISE+ESE) are needed and Min. 40% marks in ESE are needed. (ESE shall be a separate head of passing)

Walchand College of Engineering, Sangli

(Government Aided Autonomous Institute)

AY 2024-25

Course Information	
Programme	M.Tech. (Computer Science and Engineering)
Class, Semester	First Year M. Tech., Sem II
Course Code	7CO521
Course Name	Advanced Computer Algorithm
Desired Requisites:	Design and Analysis of Algorithms Basics

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	3 Hrs/week	**MSE**	**ISE**	**ESE**	**Total**
Tutorial	-	30	20	50	100
		Credits: 03			

Course Objectives	
1	To introduce students to the advanced methods of designing and analysing algorithms.
2	To allow students choose appropriate algorithm and use it for a specific problem.
3	To impart knowledge of different classes of problems along with recent developments in the area of algorithmic design.
4	

Course Outcomes (CO) with Bloom's Taxonomy Level

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

CO	**Course Outcome Statement/s**	**Bloom's Taxonomy Level**	**Bloom's Taxonomy Description**
CO1	understand basic concepts of algorithm	II	Understanding
CO2	apply algorithms involving different strategies for problem solving	III	Applying
CO3	analyse algorithm for given problem at hand	IV	Analysing
CO4	evaluate the complexity of the algorithm	V	Evaluating

Module	**Module Contents**	**Hours**
I	**Elementary Algorithms** **Sorting:** Review of various sorting algorithms **Graph:** Topological sorting, Definitions and Elementary Algorithms: Shortest path by BFS, shortest path in edge-weighted case (Dijkstra's), depth-first search and computation of strongly connected components, emphasis on correctness proof of the algorithm and time/space analysis, example of amortized analysis.	8
II	**Graph Algorithms** **Matroids:** Introduction to greedy paradigm, algorithm to compute a maximum weight maximal independent set. Application to Minimum Spanning Tree. **Shortest Path in Graphs:** Floyd-Warshall algorithm and introduction to dynamic programming paradigm. More examples of dynamic programming.	6

III	**Parallel Algorithms** Introduction, Data and Temporal parallelism, RAM and PRAM Model, Shared Memory and Message Passing Models, PRAM Algorithms: Prefix Sum, List Ranking, Merging two sorted lists, Matrix multiplication, Analysis of PRAM Algorithms.	7
IV	**Modulo Representation and DFT** Modulo Representation of integers/polynomials: Chinese Remainder Theorem, Conversion between base-representation and modulo- representation, Powers of an element, The RSA public-key cryptosystem. Discrete Fourier Transform (DFT): In complex field, DFT in modulo ring. Fast Fourier Transform algorithm.	7
V	**NP-completeness:** Basic concepts of complexity classes- P, NP, NP-Hard, NP Complete, Examples, Proof of NP-hardness and NP-completeness. One or more of the following topics based on interest- Approximation algorithms, Randomized Algorithms, Interior Point Method, Advanced Number Theoretic Algorithm	6
VI	**Recent Trends** Recent Trends in problem solving paradigms using recent searching and sorting techniques by applying recently proposed data structures.	5

Textbooks	
1	C. R. Kothari, Research Methodology, New Age international
2	Deepak Chopra and Neena Sondhi, Research Methodology : Concepts and cases, Vikas Publishing House, New Delhi
References	
1	Kleinberg and Tardos, *Algorithm Design*, Pearson Education Limited
2	Robert Sedgewick, "*Algorithms in C++*", Addison-Wesley Professional, Third Edition
Useful Links	
1	NPTEL Videos of '*Data Structures and Algorithms*' Course: Link

CO-PO Mapping						
	Programme Outcomes (PO)					
	1	2	3	4	5	6
CO1	2					
CO2	2					
CO3	2	3	2			
CO4	2	1	1			

The strength of mapping is to be written as 1: Low, 2: Medium, 3: High
Each CO of the course must map to at least one PO.

Assessment
The assessment is based on MSE, ISE and ESE. MSE shall be typically on modules 1 to 3. ISE shall be taken throughout the semester in the form of teacher's assessment. Mode of assessment can be field visit, assignments etc. and is expected to map at least one higher order PO. ESE shall be on all modules with around 40% weightage on modules 1 to 3 and 60% weightage on modules 4 to 6. For passing a theory course, Min. 40% marks in (MSE+ISE+ESE) are needed and Min. 40% marks in ESE are needed. (ESE shall be a separate head of passing)

Walchand College of Engineering, Sangli

(Government Aided Autonomous Institute)

AY 2024-25

Course Information	
Programme	M.Tech. (Computer Science and Engineering)
Class, Semester	First Year M. Tech., Sem II
Course Code	7CO524
Course Name	High Performance Computing
Desired Requisites:	Data structures, Basic Programming knowledge

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	3 Hrs/week	**MSE**	**ISE**	**ESE**	**Total**
Tutorial	-	30	20	50	100
		Credits: 3			

Course Objectives	
1	Introduce fundamental parallel computing concepts and types of parallelism.
2	Explore current trends in shared memory and manycore/multicore architectures.
3	Explore current trends in shared memory and manycore/multicore architectures.
4	Cover performance optimization techniques for high-performance parallel programs.

Course Outcomes (CO) with Bloom's Taxonomy Level

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

CO	**Course Outcome Statement/s**	**Bloom's Taxonomy Level**	**Bloom's Taxonomy Description**
CO1	Design efficient parallel algorithms for matrix, graph, and sorting operations, demonstrating proficiency in task decomposition and synchronization.	III	Applying
CO2	Evaluate and predict the performance of parallel programs using analytical models, considering scalability, load balancing, and communication overhead.	V	Evaluating
CO3	Implement algorithms using programming models suited for shared and distributed memory systems, showcasing versatility in application across different parallel architectures.	III	Applying
CO4	Optimize efficiency of parallel algorithms for matrix, graph, and sorting tasks, achieving enhanced speedup, scalability, and reduced communication costs on parallel systems.	V	Evaluating

Module	**Module Contents**	**Hours**
I	**Introduction to Parallel Computing** Implicit Parallelism, Limitations of Memory, Dichotomy of Parallel Computing Platforms, Physical Organization of Parallel Platforms, Communication Costs in Parallel Machines, Routing Mechanisms for Interconnection Networks, Impact of Process-Processor Mapping and Mapping Techniques	6

II	**Principals of Parallel Algorithm Design** Decomposition Techniques, Characteristics of Tasks and Interactions, Mapping Techniques for Load Balancing, Methods for Containing Interaction Overheads, Parallel Algorithm Models Basic Communication Operations: One-to-All Broadcast and All-to-One Reduction, All-to-All Broadcast and Reduction, All-Reduce and Prefix-Sum Operations, Scatter and Gather	7
III	**Analytical Modeling** Performance Metrics for parallel systems. The effect of Granularity and Data Mapping on Performance. The Scalability of parallel systems, Iso efficiency metric of scalability, sources of parallel overhead, Minimum execution time and minimum cost-optimal execution time.	6
IV	**Parallel Programming** OpenMP, MPI, CUDA/OpenCL, Chapel, etc. Thread basics ,Work Sharing constructs, Scheduling, Reduction, Mutual Exclusion Synchronization & Barriers, The MPI Programming Model, MPI Basics, Global Operations , Asynchronous Communication, Modularity, Other MPI Features Basic of GPGPU, CUDA Programming model, CUDA memory type Performance Issues	7
V	**Dense Matrix Algorithms** Matrix-Vector Multiplication, Matrix-Matrix Multiplication Sorting: Issues, Sorting Networks, Bubble Sort and its Variants, Quicksort	6
VI	**Graph Algorithms** Definitions and Representation, Minimum Spanning Tree: Prim's Algorithm, Single-Source Shortest Paths: Dijkstra's Algorithm, All-Pairs Shortest Path	6

Textbooks	
1	Grama Ananth, Gupta Anshul, George Karypis, and Vipin Kumar, Introduction to Parallel Computing, Addison Wesley (2nd ed.),.
2	Buyya Raijkumar, High Performance Cluster Computing : Programming and Applications, Volume 2, Printice Hall PTR Upper Saddle River, New Jersey
3	Cook shane, CUDA Programming: A Developer's Guide to Parallel Computing with GPUs

References	
1	Michael J. Quinn, Parallel Programming in C with MPI and OpenMP, McGraw-Hill.

Useful Links	
1	High Performance Computing, Charles Severance, 1998. Link
2	Marc Snir, Steve Otto, Steven Huss-Lederman, David Walker, and Jack Dongarra, MPI: The Complete Reference, 1996. Link
3	Ian Foster, Designing and Building Parallel Programs, 1995. Link

CO-PO Mapping

	Programme Outcomes (PO)					
	1	2	3	4	5	6
CO1			2			2
CO2	1	2	2	1		1
CO3	2		3	2		1
CO4		2		3	2	

The strength of mapping is to be written as 1: Low, 2: Medium, 3: High
Each CO of the course must map to at least one PO.

Assessment
The assessment is based on MSE, ISE and ESE. MSE shall be typically on modules 1 to 3. ISE shall be taken throughout the semester in the form of teacher's assessment. Mode of assessment can be field visit, assignments etc. and is expected to map at least one higher order PO. ESE shall be on all modules with around 40% weightage on modules 1 to 3 and 60% weightage on modules 4 to 6. For passing a theory course, Min. 40% marks in (MSE+ISE+ESE) are needed and Min. 40% marks in ESE are needed. (ESE shall be a separate head of passing)

Walchand College of Engineering, Sangli

(Government Aided Autonomous Institute)

AY 2024-25

Course Information	
Programme	M.Tech. (Computer Science and Engineering)
Class, Semester	First Year M. Tech., Sem I
Course Code	7CO523
Course Name	Information Security
Desired Requisites:	Data Communication, Computer Networks

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	3 Hrs/week	**MSE**	**ISE**	**ESE**	**Total**
Tutorial	-	30	20	50	100
		Credits: 3			

Course Objectives	
1	To learn the fundamentals of cryptography and is applications to network security
2	To understand network security threats, issues, security issues and countermeasures
3	To understand vulnerability analysis of network security with the help of trade-offs and criteria/concerns for security countermeasure development
4	To apply methods for authentication, access control, intrusion detection and prevention

Course Outcomes (CO) with Bloom's Taxonomy Level

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

CO	**Course Outcome Statement/s**	**Bloom's Taxonomy Level**	**Bloom's Taxonomy Description**
CO1	explain the risks faced by computer systems and networks	II	Understanding
CO2	identify and analyze security problems in computer systems and networks	III	Applying
CO3	develop security mechanisms to protect computer systems and networks	IV	Analyzing
CO4	use cryptography algorithms and protocols to achieve computer security	V	Evaluating

Module	**Module Contents**	**Hours**
I	**Introduction to Information Security:** Attacks, Vulnerability, Security Goals, Security Services and mechanisms.	5
II	**Conventional Cryptographic Techniques:** Conventional substitution and transposition ciphers, One-time Pad, Block cipher and Stream Cipher, Steganography	6
III	**Symmetric and Asymmetric Cryptographic Techniques:** DES, AES, RSA algorithms	7
IV	**Authentication and Digital Signatures:** Use of Cryptography for authentication, Secure Hash function, Key management, Kerberos	7

V	**Program Security:** Non-malicious Program errors– Buffer overflow, Incomplete mediation, Time-of-check to Time-of use Errors, Viruses, Trapdoors, Salami attack, Man-in-the middle attacks, Covert channels	5
VI	**Security in Networks:** Threats in networks, Network Security Controls– Architecture, Encryption, Content Integrity, Strong Authentication, 20 Access Controls, Wireless Security, Honeypots, Traffic flow security, Firewalls– Design and Types of Firewalls, Personal Firewalls, IDS, Email Security PGP, S/MIME	6

Textbooks	
1	Security in Computing, Fourth Edition, by Charles P. Pfleeger, Pearson Education
2	Cryptography And Network Security Principles And Practice, Fourth or Fifth Edition, William Stallings, Pearson
3	Modern Cryptography: Theory and Practice, by Wenbo Mao, Prentice Hall.
4	Network Security Essentials: Applications and Standards, by William Stallings. Prentice Hall.

References	
1	The Complete Reference - Network Security Roberta Bragg, Mark Rhodes-Ousley & Keith Strassberg, Reprint 2007
2	Applied Cryptography, Second Edition:John Wiley and Sons, Inc.,

Useful Links	
1	https://archive.nptel.ac.in/courses/106/106/106106129/
2	https://www.classcentral.com/course/openlearn-science-maths-technology-information-security-96035

CO-PO Mapping

	Programme Outcomes (PO)													
	1	2	3	4	5	6								
CO1	2		1											
CO2	2	2	2		2	2								
CO3		2				2								
CO4	2	2		2		2								

The strength of mapping is to be written as 1: Low, 2: Medium, 3: High
Each CO of the course must map to at least one PO.

Assessment

The assessment is based on MSE, ISE and ESE. MSE shall be typically on modules 1 to 3. ISE shall be taken throughout the semester in the form of teacher's assessment. Mode of assessment can be field visit, assignments etc. and is expected to map at least one higher order PO. ESE shall be on all modules with around 40% weightage on modules 1 to 3 and 60% weightage on modules 4 to 6. For passing a theory course, Min. 40% marks in (MSE+ISE+ESE) are needed and Min. 40% marks in ESE are needed. (ESE shall be a separate head of passing)

Walchand College of Engineering, Sangli

(Government Aided Autonomous Institute)

AY 2024-25

Course Information	
Programme	M.Tech. (Computer Science and Engineering)
Class, Semester	Second Year M. Tech., Sem II
Course Code	7CO571
Course Name	Advanced Computer Algorithm Lab
Desired Requisites:	Design and Analysis of Algorithms Basics, Programming

Teaching Scheme		**Examination Scheme (Marks)**			
Practical	2 Hrs/ Week	**LA1**	**LA2**	**Lab ESE**	**Total**
Interaction	-	30	30	40	100
		Credits: 01			

Course Objectives

1	To introduce students to the advanced methods of designing and analysing algorithms.
2	To allow students choose appropriate algorithm and use it for a specific problem.
3	To impart knowledge of different classes of problems along with recent developments in the area of algorithmic design.

Course Outcomes (CO) with Bloom's Taxonomy Level

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

CO	**Course Outcome Statement/s**	**Bloom's Taxonomy Level**	**Bloom's Taxonomy Description**
CO1	apply algorithm to solve problem	III	Applying
CO2	analyse algorithms involving different strategies for problem solving	IV	Analysing
CO3	evaluate the complexity of the algorithm	V	Evaluating
CO4	develop the solution for open-ended problems and document it	VI	Creating

List of Experiments / Lab Activities/Topics

1. Implement various algorithms.
2. Implement BFS algorithm.
3. Implement DFS algorithm.
4. Implement Dijkstra algorithm.
5. Implement kruskal's algorithm.
6. Implement Floyd-Warshall algorithm.
7. Implement matrix multiplication.
8. Implement CRT.
9. Implement RSA algorithm.
10. Implement Fourier transform algorithm.
11. Implement P-NP, NP-Hard.

Textbooks

1	Cormen Thomas H., Leiserson Charles E., Rivest Ronald L., Stein Clifford, Introduction to Algorithms PHI, Third Edition, 2009
2	Aho, Hopcroft, Ullman, The Design and Analysis of Computer Algorithms, Addison-Wesley Pub.Co., 1974.

References	
1	Kleinberg and Tardos, *Algorithm Design*, Pearson Education Limited
Useful Links	
1	NPTEL Videos of '*Data Structures and Algorithms*' Course: Link

CO-PO Mapping						
	Programme Outcomes (PO)					
	1	2	3	4	5	6
CO1	2					
CO2	2	1	2			
CO3	2	1			3	2
CO4	2	1				
The strength of mapping is to be written as 1,2,3; where, 1: Low, 2: Medium, 3: High Each CO of the course must map to at least one PO, and preferably to only one PO.						

Assessment				
There are three components of lab assessment, LA1, LA2 and Lab ESE. IMP: Lab ESE is a separate head of passing (min 40 %), LA1+LA2 should be min 40%				
Assessment	**Based on**	**Conducted by**	**Typical Schedule**	**Marks**
LA1	Lab activities, attendance, journal	Lab Course Faculty	During Week 1 to Week 8 Marks Submission at the end of Week 8	30
LA2	Lab activities, attendance, journal	Lab Course Faculty	During Week 9 to Week 16 Marks Submission at the end of Week 16	30
Lab ESE	Lab activities, journal/ performance	Lab Course Faculty and External Examiner as applicable	During Week 18 to Week 19 Marks Submission at the end of Week 19	40
Week 1 indicates starting week of a semester. Lab activities/Lab performance shall include performing experiments, mini-project, presentations, drawings, programming, and other suitable activities, as per the nature and requirement of the lab course. The experimental lab shall have typically 8-10 experiments and related activities if any.				

Walchand College of Engineering, Sangli

(Government Aided Autonomous Institute)

AY 2024-25

Course Information

Programme	M.Tech. (Computer Science and engineering)
Class, Semester	First Year M. Tech., Sem II
Course Code	7CO574
Course Name	High Performance Computing Lab
Desired Requisites:	Data structures, Basic Programming knowledge

Teaching Scheme		**Examination Scheme (Marks)**			
Practical	2 Hrs/ week	**LA1**	**LA2**	**Lab ESE**	**Total**
Interaction	-	30	30	40	100
		Credits: 1			

Course Objectives

1	To provide basics of parallel architectures
2	To provide basics of parallel algorithm design and analysis
3	To provide basics of parallel programming platforms

Course Outcomes (CO) with Bloom's Taxonomy Level

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

CO	**Course Outcome Statement/s**	**Bloom's Taxonomy Level**	**Bloom's Taxonomy Description**
CO1	illustrate different parallel programming techniques	III	Applying
CO2	measure performance of model using different metrics	III	Applying
CO3	analyze and apply different parallel strategies to a parallel program to improve its performance	VI	Analyzing
CO4	design a parallelization strategy for computing patterns on different hardware and using different parallel computing languages.	VI	Analyzing

List of Experiments / Lab Activities/Topics

List of Lab Activities:

A. Implementation of following tasks using OpenMP.

1. Implementation of sum of two lower triangular matrices.
2. Implementation of Matrix-Matrix Multiplication.
3. Implementation of dot product
4. Implementation of Prefix sum

B. Implementation of following tasks using MPI.

5. Implementation of Matrix-Vector Multiplication.
6. Implementation of Matrix-Matrix Multiplication.
7. Implementation of 2D Convolution
8. Implementation of dot product
9. Implementation of Prefix sum

C. Implementation of following tasks using CUDA.

10. Implementation of Matrix-matrix Multiplication using global memory.
11. Implementation of Matrix-Matrix Multiplication using shared memory.
12. Implementation of Histogram
13. Implementation of Odd even sort
14. Implementation of Prefix sum
15. Implement 2D Convolution using shared memory

D. Performance evaluation of following computations using open-source libraries or OpenACC compare to sequential and explicit parallel implementation

16. Implementation of Matrix-Matrix multiplication using OpenACC MKL, and cuBLAS.

    Compare their performance with OpenMP based implementation from assignment no.2, 10 and 11.

Textbooks

1	Zbigniew J. Czech, Introduction to Parallel Computing, Cambridge University Press, 2016.
2	Kumar, V., Grama, A., Gupta, A., & Karypis, G. (1994). Introduction to parallel computing (Vol. 110). Redwood City, CA: Benjamin/Cummings.
3	Chandra, R., Dagum, L., Kohr, D., Menon, R., Maydan, D., & McDonald, J. (2001). Parallel programming in OpenMP. Morgan kaufmann.
4	Cheng, J., Grossman, M., & McKercher, T. (2014). Professional CUDA c programming. John Wiley & Sons.

References

1	Michael Quinn, Parallel Computing: Theory and Practice, McGrawHill Publishers, July 2017.
2	Arch Robison, James Reinders, and Michael Macoul, Structured Parallel Programming: Patterns for Efficient Computation, Morgan Kaufman, Elsevier, 2012.

Useful Links

CO-PO Mapping														
	Programme Outcomes (PO)													
	1	2	3	4	5	6								
CO1	2													
CO2	2													
CO3				2	2									
CO4				2	2									

The strength of mapping is to be written as 1,2,3; where, 1: Low, 2: Medium, 3: High

Each CO of the course must map to at least one PO, and preferably to only one PO.

Assessment

There are three components of lab assessment, LA1, LA2 and Lab ESE.
IMP: Lab ESE is a separate head of passing.(min 40 %), LA1+LA2 should be min 40%

Assessment	Based on	Conducted by	Typical Schedule	Marks
LA1	Lab activities, attendance, journal	Lab Course Faculty	During Week 1 to Week 8 Marks Submission at the end of Week 8	30
LA2	Lab activities, attendance, journal	Lab Course Faculty	During Week 9 to Week 16 Marks Submission at the end of Week 16	30
Lab ESE	Lab activities, journal/ performance	Lab Course Faculty and External Examiner as applicable	During Week 18 to Week 19 Marks Submission at the end of Week 19	40

Week 1 indicates starting week of a semester. Lab activities/Lab performance shall include performing experiments, mini-project, presentations, drawings, programming, and other suitable activities, as per the nature and requirement of the lab course. The experimental lab shall have typically 8-10 experiments and related activities if any.

Walchand College of Engineering, Sangli

(Government Aided Autonomous Institute)

AY 2024-25

Course Information	
Programme	M.Tech. (Computer Science and Engineering)
Class, Semester	First Year M. Tech., Sem II
Course Code	7CO545
Course Name	Pre-Dissertation Work and Seminar
Desired Requisites:	

Teaching Scheme		**Examination Scheme (Marks)**			
Practical	2 Hrs/ Week	**LA1**	**LA2**	**Lab ESE**	**Total**
Interaction	-	30	30	40	100
		Credits: 1			

Course Objectives	
1	Develop advanced research skills in computer science engineering.
2	Enhance the ability to critically review and synthesize existing literature in a chosen area of study
3	Improve technical writing skills for producing high-quality research proposals and reports.
4	Strengthen presentation skills for effectively communicating research findings and ideas.

Course Outcomes (CO) with Bloom's Taxonomy Level

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

CO	**Course Outcome Statement/s**	**Bloom's Taxonomy Level**	**Bloom's Taxonomy Description**
CO1	conduct advanced research in a specific area of computer science engineering.	III	Applying
CO2	critically analyze and synthesize literature to identify gaps and opportunities for further research.	IV	Analysing
CO3	produce high-quality research proposals and technical reports with clear, concise, and accurate writing.	III	Applying
CO4	deliver effective presentations to communicate research findings and ideas clearly and persuasively.	V	Evaluating

List of Experiments / Lab Activities/Topics

List of Lab Activities:

This course designed to provide students with both theoretical knowledge and practical skills necessary for advanced research and professional practice in the field of Computer Science Engineering.

Textbooks	
1	Suitable books based on the contents of the topic.

References	
1	Suitable books based on the contents of the selected topic and research papers from reputed national and international journals and conferences.

Useful Links	
1	As per the need of the topic of report and presentation

CO-PO Mapping						
	Programme Outcomes (PO)					
	1	2	3	4	5	6
CO1		3	1			
CO2		3	1			
CO3		3	1			
CO4				2	1	1
The strength of mapping is to be written as 1,2,3; where, 1: Low, 2: Medium, 3: High Each CO of the course must map to at least one PO, and preferably to only one PO.						

Assessment				
There are three components of lab assessment, LA1, LA2 and Lab ESE. IMP: Lab ESE is a separate head of passing (min 40 %), LA1+LA2 should be min 40%				
Assessment	**Based on**	**Conducted by**	**Typical Schedule**	**Marks**
LA1	Lab activities, attendance, journal	Lab Course Faculty	During Week 1 to Week 8 Marks Submission at the end of Week 8	30
LA2	Lab activities, attendance, journal	Lab Course Faculty	During Week 9 to Week 16 Marks Submission at the end of Week 16	30
Lab ESE	Lab activities, journal/ performance	Lab Course Faculty and External Examiner as applicable	During Week 18 to Week 19 Marks Submission at the end of Week 19	40
Week 1 indicates starting week of a semester. Lab activities/Lab performance shall include performing experiments, mini-project, presentations, drawings, programming, and other suitable activities, as per the nature and requirement of the lab course. The experimental lab shall have typically 8-10 experiments and related activities if any.				

Walchand College of Engineering, Sangli

(Government Aided Autonomous Institute)

AY 2024-25

Course Information	
Programme	M.Tech. (Computer Science and Engineering)
Class, Semester	First Year M. Tech., sem II
Course Code	7CO538
Course Name	Natural Language Processing
Desired Requisites:	Mathematics – Linear Algebra, Probability Theory

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	Hrs/week	**MSE**	**ISE**	**ESE**	**Total**
Tutorial	-	30	20	50	100
		Credits: 03			

Course Objectives	
1	To build AI applications such that it will enable computer to read text, hear speech and interpret it
2	To acquaint students with the basics of text processing
3	To illustrate steps involved in building text mining applications
4	To share the importance of different set of features for machine learning tasks

Course Outcomes (CO) with Bloom's Taxonomy Level

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

CO	**Course Outcome Statement/s**	**Bloom's Taxonomy Level**	**Bloom's Taxonomy Description**
CO1	explain fundamental concepts of text processing	II	Understand
CO2	apply text processing algorithms to derive different representations of text	III	Apply
CO3	automate the real-life problems by choosing appropriate features and models	IV	Evaluate
CO4	develop models for Information Retrieval and Chatbot application	V	Creating

Module	**Module Contents**	**Hours**
I	Introduction, Steps Involved, Tokenization, Stemming, Lemmatization, Regular expressions- extraction of information using Regex, Text Normalization, Minimum edit distance, Document Similarity measures - Cosine and cluster measures, exploration of python libraries like NLTK, SciPy, re.	6
II	**Language Models** Information Retrieval & Language Models Introduction, IDF, Tf-Idf, Boolean Model, Vector Space Model, N-gram Language Models, Spelling correction - Edit distance, Advanced smoothing for language modelling, POS tagging, Performance Measures, Precision, Recall, F-measure	6

III	**Distributed Word Representation** Vector Space Model - word vectors, GloVe/Word2Vec model, word embedding, Contextual Embeddings, Deriving Word Vectors from Corpus, Word Senses and WordNet	4
IV	**Text Classification** Constituency Grammars, Context-Free Grammar, Constituency Parsing, Dependency Parsing, Lexicons for Sentiment, Distributional Semantics, Topic Models, Sentiment Classification	4
V	**Sequence Classification** Sequence Labelling for Parts of Speech and Named Entities, Deep Learning Architectures for Sequence Processing, Models for Sequential tagging – MaxEnt, CRF, Recurrent Neural network relevant to NLP	5
VI	**Case Study** Machine Translation and Encoder-Decoder Models, Discourse Coherence, Question Answering, Chatbots & Dialogue Systems, Sentiment Analysis and Opinion Mining, Text Generation using Language Models	4

Textbooks	
1	Steven Bird, Ewan Klein, and Edward Loper, "*Natural Language Processing with Python*", O'reilly Publications, 2009.
2	Yoav Goldberg**, "***Neural Network Methods for Natural Language Processing",* Synthesis Lectures on Human Language Technologies, 2017

References	
1	Dan Jurafsky and James H. Martin, "*Speech and Language Processing*", Standford University, 3rd Edition, 2020
2	Jason Brownlee, "*Deep Learning for Natural Language Processing*", 2017.

Useful Links	
1	NLP Course on NPTEL: Link(https://onlinecourses.nptel.ac.in/noc19_cs56/preview)

CO-PO Mapping

	Programme Outcomes (PO)					
	1	2	3	4	5	6
CO1	1					
CO2	2		3			
CO3			2	1		
CO4		1				

The strength of mapping is to be written as 1: Low, 2: Medium, 3: High
Each CO of the course must map to at least one PO.

Assessment
The assessment is based on MSE, ISE and ESE. MSE shall be typically on modules 1 to 3. ISE shall be taken throughout the semester in the form of teacher's assessment. Mode of assessment can be field visit, assignments etc. and is expected to map at least one higher order PO. ESE shall be on all modules with around 40% weightage on modules 1 to 3 and 60% weightage on modules 4 to 6. For passing a theory course, Min. 40% marks in (MSE+ISE+ESE) are needed and Min. 40% marks in ESE are needed. (ESE shall be a separate head of passing)

Walchand College of Engineering, Sangli

(Government Aided Autonomous Institute)

AY 2024-25

Course Information

Programme	M. Tech. (Computer Science and Engineering)
Class, Semester	First Year M. Tech., Sem II
Course Code	7CO533
Course Name	Professional Elective: Blockchain Technology
Desired Requisites:	Basics of mathematics , and security algorithms

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	3 Hrs/week	**ISE**	**MSE**	**ESE**	**Total**
Tutorial	-	20	30	50	100
Practical	-	Nil			
Interaction	-	**Credits: 3**			

Course Objectives

1	Understand the fundamental concepts of blockchain technology, including decentralization, transparency, and immutability
2	Gain insights into the cryptographic techniques used in blockchain, such as hashing and digital signatures.
3	Examine real-world applications of blockchain across industries, including finance, supply chain, and healthcare.

Course Outcomes (CO) with Bloom's Taxonomy Level

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

CO	**Course Outcome Statement/s**	**Bloom's Taxonomy Level**	**Bloom's Taxonomy Description**
CO1	describe cryptographic techniques like hashing and digital signatures used in blockchain security.	II	Understanding
CO2	illustrate the working of cryptography techniques with help of example.	III	Applying
CO3	design a basic smart contracts using Solidity.	III	Applying
CO4	analyze and compare features of blockchain platforms like Ethereum and Hyperledger for different use cases	IV	Analyzing

Module	**Module Contents**	**Hours**
I	**Introduction to Blockchain** Overview of blockchain technology and its core principlesTypes of blockchains: public, private, and consortium Basics of decentralization, consensus, and immutability	8
II	**Cryptography and Security** Cryptographic techniques in blockchain: hashing, digital signatures Consensus mechanisms: Proof of Work (PoW), Proof of Stake (PoS)Security considerations and vulnerabilities in blockchain	8

III	**Smart Contracts and DApps** Introduction to smart contracts and their benefits Ethereum Virtual Machine (EVM) and Solidity programming language Design principles and development of decentralized applications (DApps)	7
IV	**Blockchain Platforms and Frameworks** In-depth exploration of blockchain platforms: Ethereum, Hyperledger Setting up a development environment for Ethereum or Hyperledger	7
V	**Blockchain Applications and Use Cases** Real-world applications of blockchain in finance, supply chain, etc. Case studies of successful blockchain implementations Challenges and limitations of blockchain technology	7
VI	**Blockchain Development and Capstone Project** Hands-on lab sessions for developing smart contracts Building a simple decentralized application (DApp) Students work on a blockchain-related project as a capstone	6

Text Books	
1	"Mastering Bitcoin: Unlocking Digital Cryptocurrencies" by Andreas M. Antonopoulos
2	"Blockchain Basics: A Non-Technical Introduction in 25 Steps" by Daniel Drescher
References	
1	"Blockchain Applications: A Hands-On Approach" by Arshdeep Bahga and Vijay Madisetti
2	"Blockchain Basics: A Practical Approach" by Pete Harris
Useful Links	
1	NPTEL Videos

CO-PO Mapping

	Programme Outcomes (PO)														
	1	2	3	4	5	6									
CO1	1			2											
CO2	2			3											
CO3	2			3											
CO4	1		1			2									

The strength of mapping is to be written as 1,2,3; Where, 1:Low, 2:Medium, 3:High
Each CO of the course must map to at least one PO.

Assessment

The assessment is based on MSE, ISE and ESE. MSE shall be typically on modules 1 to 3. ISE shall be taken throughout the semester in the form of teacher's assessment. Mode of assessment can be field visit, assignments etc. and is expected to map at least one higher order PO. ESE shall be on all modules with around 40% weightage on modules 1 to 3 and 60% weightage on modules 4 to 6. For passing a theory course, Min. 40% marks in (MSE+ISE+ESE) are needed and Min. 40% marks in ESE are needed. (ESE shall be a separate head of passing)

Walchand College of Engineering, Sangli

(Government Aided Autonomous Institute)

AY 2024-25

Course Information	
Programme	M.Tech. (Computer Science and Engineering)
Class, Semester	First Year M. Tech., Sem II
Course Code	7CO534
Course Name	Theory and Applications of Remote Sensing & GIS
Desired Requisites:	Fundamentals of Image processing

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	3 Hrs/week	**MSE**	**ISE**	**ESE**	**Total**
Tutorial	-	30	20	50	100
		Credits: 3			

Course Objectives	
1	Introduce fundamental concepts and principles of RS and GIS.
2	Familiarize students with RS and GIS data types and products.
3	Highlight advantages and diverse applications of RS and GIS.
4	Provide practical experience with RS and GIS software and data analysis techniques.

Course Outcomes (CO) with Bloom's Taxonomy Level

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

CO	**Course Outcome Statement/s**	**Bloom's Taxonomy Level**	**Bloom's Taxonomy Description**
CO1	Understand and summarize fundamental concepts in RS and GIS	II	Understanding
CO2	Interpret and Apply various satellite RS data and demonstrate GIS data and GIS database management system	III	Applying
CO3	Compare and examine data and data Products of RS and GIS	IV	Analysing
CO4	Select and Verify RS and GIS data and data products to design solution for various interdisciplinary problems	V	Evaluating

Module	**Module Contents**	**Hours**
I	**Concepts and Foundation of Remote Sensing** Introduction, Remote Sensing System, Electromagnetic Energy, Electromagnetic Spectrum and its Characteristics, Energy Interaction in the Atmosphere and with the Earth's Surface, Resolution in Remote Sensing, Broad Classifications of Sensors and Platform, Earth Observation Satellite and Sensors, Data Reception, Transmission and Processing, Remote Sensing Data and Data Products.	4
II	**Satellite Image Interpretation and Processing** Interpretation Procedure and Elements, Interpretation strategies and keys, Digital Image processing and Image Analysis steps, Image Rectification and Restoration, Image Enhancement, Spatial Filtering, Image Transformation, Image Classification and Analysis.	5

III	**Applications of Remote Sensing** Land use Land Cover Mapping, Crop Inventory, Ground Water Mapping, Urban Growth, Flood Plain Mapping, Disaster Management.	5
IV	**GIS – An Overview** Introduction, Geographical concepts and Terminology, Difference between Image Processing system and GIS, Various GIS packages and their salient features, Essentials components of GIS, Utility of GIS, GPS	4
V	**GIS Data** GIS Data types and Data Representation, Data Acquisition, Georeferencing of GIS Data, Raster and Vector data, Raster to Vector conversion, Remote Sensing Data in GIS, GIS Database and Database Management System	5
VI	**GIS Spatial Data Analysis and Applications** Measurements in GIS-Lengths, Perimeters, and Areas, Queries, Reclassification, Buffering and Neighborhood Functions, Map Overlay, Spatial Interpolation, Analysis of Surfaces, Network Analysis, GIS Applications	4

Textbooks	
1	Chandra, A.M. and Gosh, S.K., "Remote Sensing and GIS", Narosa Publishing House. 2008
2	Lo, C.P. and Young, A.K.W., "Concepts and Techniques of Geographical Information System", Prentice Hall India. 20012

References	
1	Lillesand, T.M. and Kieffer, "Remote Sensing and Image Interpretation", John Wiley and Sons, 6th Edition. 2012
2	Chang, K, "Introduction to Geographical Systems", Tata McGraw-Hill, 4th Edition. 2010

Useful Links	
1	NPTEL: https://nptel.ac.in/noc/courses/noc19/SEM1/noc19-ce08
2	https://nptel.ac.in/noc/courses/noc18/SEM1/noc18-ce10

CO-PO Mapping

	Programme Outcomes (PO)					
	1	2	3	4	5	6
CO1			2			
CO2			2			
CO3	2			2		
CO4	3			2		2

The strength of mapping is to be written as 1: Low, 2: Medium, 3: High
Each CO of the course must map to at least one PO.

Assessment
The assessment is based on MSE, ISE and ESE. MSE shall be typically on modules 1 to 3. ISE shall be taken throughout the semester in the form of teacher's assessment. Mode of assessment can be field visit, assignments etc. and is expected to map at least one higher order PO. ESE shall be on all modules with around 40% weightage on modules 1 to 3 and 60% weightage on modules 4 to 6. For passing a theory course, Min. 40% marks in (MSE+ISE+ESE) are needed and Min. 40% marks in ESE are needed. (ESE shall be a separate head of passing)

Walchand College of Engineering, Sangli

(Government Aided Autonomous Institute)

AY 2024-25

Course Information

Programme	M.Tech. (Computer Science and Engineering)
Class, Semester	First Year M. Tech., Sem II
Course Code	7CO535
Course Name	PE4: Deep Learning
Desired Requisites:	Linear Algebra, Statistics and Probability Theory, Machine Learning

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	3 Hrs/week	**MSE**	**ISE**	**ESE**	**Total**
Tutorial	-	30	20	50	100
		Credits: 3			

Course Objectives

1	To emphasise significance of deep learning in AI.
2	To educate participants on use of deep learning architectures for real life scenarios.
3	To infuse skills required to optimize performance of deep learning architectures.
4	To enable participants to choose appropriate deep learning techniques to solve real life problems.

Course Outcomes (CO) with Bloom's Taxonomy Level

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

CO	**Course Outcome Statement/s**	**Bloom's Taxonomy Level**	**Bloom's Taxonomy Description**
CO1	grasp fundamentals of deep learning using foundation of mathematics.	II	Understanding
CO2	use suitable deep learning architecture for a given problem.	III	Applying
CO3	examine performance of deep learning architecture using proper performance metrics and hyperparameter tuning techniques.	IV	Analysing
CO4	recommend appropriate deep learning architecture, performance improvement measures and regularization techniques for a given problem scenario.	V	Evaluating

Module	**Module Contents**	**Hours**
I	**Introduction** Neural network fundamentals: General Introduction to Deep Learning, Activation functions, Perceptron algorithm, Back propagation and Multi-layer Networks, Deep L architectures.	6
II	**Hyperparameter tuning and optimization**	8

	Bias - variance, Regularization technioques, Optimizers – GD, SGD, Adam, RMSProp, Hyperparameter tuning, Batch normalization, Multiclass-classification	
III	**Convolutional Neural Networks (CNN)** Understanding Convolutions: Convolutions versus cross-correlation, “Big Matrix” and “Tiny Matrix" analogy, kernels, CNN Building blocks: Layer Types, convolutional layers, activation layers, Pooling Layers, Fully-connected Layers, Batch Normalization, Dropout, ShallowNet, LeNet, MiniVGGNET	8
IV	**Deep learning-based object detection** Fundamentals of Object detection, Family of R-CNN, Single shot detectors (SSD), You only look once (YOLO)	6
V	**Sequence models** Introduction to RNN, Applications of sequence models/RNN, Drawback of traditional NN for sequence data, Backpropagation in time, RNN architecture types, how to build language model, Basic tasks of language models, Bidirectional RNN, Deep RNN, vanishing gradient problem. GRU, LSTM	6
VI	**Advanced sequence models and auto encoders** Word embedding, Encoder - Decoder (seq2seq) model, Attention mechanism, Transformers, Introduction to Auto encoder, Denoising auto encoder, Sparse auto encoder, Variational auto encoder, state-of-the-art case studies/architectures	5

Textbooks	
1	Ian Goodfellow, Yoshua Bengio and Aaron Courville Deep Learning, MIT Press, 2016
2	Aurelien Geron, “Hands-On Machine Learning with Scikit-Learn & TensorFlow”, O’REILLY, Dec 2017

References	
1	Neural Networks: A Systematic Introduction, Raúl Rojas, 1996
2	Pattern Recognition and Machine Learning, Christopher Bishop, 2007

Useful Links	
1	https://nptel.ac.in/courses/106/106/106106184/
2	https://www.coursera.org/specializations/deep-learning
3	Transformer: https://huggingface.co/course/chapter1/1?fw=pt

CO-PO Mapping

	Programme Outcomes (PO)					
	1	2	3	4	5	6
CO1	1	1	1	1		2
CO2	1	1	2	2		3

CO3	1	1	2	2		3
CO4			1	1		3
The strength of mapping is to be written as 1: Low, 2: Medium, 3: High Each CO of the course must map to at least one PO.						

Assessment
The assessment is based on MSE, ISE and ESE. MSE shall be typically on modules 1 to 3. ISE shall be taken throughout the semester in the form of teacher's assessment. Mode of assessment can be field visit, assignments etc. and is expected to map at least one higher order PO. ESE shall be on all modules with around 40% weightage on modules 1 to 3 and 60% weightage on modules 4 to 6. For passing a theory course, Min. 40% marks in (MSE+ISE+ESE) are needed and Min. 40% marks in ESE are needed. (ESE shall be a separate head of passing)

Walchand College of Engineering, Sangli

(Government Aided Autonomous Institute)

AY 2024-25

Course Information	
Programme	M.Tech. (Computer Science and Engineering)
Class, Semester	First Year M. Tech., Sem II
Course Code	7CO536
Course Name	Cyber Security
Desired Requisites:	Fundamentals of security

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	3 Hrs/week	**MSE**	**ISE**	**ESE**	**Total**
Tutorial	-	30	20	50	100
		Credits: 03			

Course Objectives	
1	Identify various types of cyber threats, including malware, hacking, and social engineering.
2	Examine and implement network security protocols such as IPsec, SSL/TLS, and VPNs.
3	Develop a comprehensive understanding of incident response planning and methodologies.

Course Outcomes (CO) with Bloom's Taxonomy Level

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

CO	**Course Outcome Statement/s**	**Bloom's Taxonomy Level**	**Bloom's Taxonomy Description**
CO1	Summarize the concepts of information security and the CIA triad.	II	Understanding
CO2	Apply network security measures to mitigate risks and protect against common vulnerabilities	III	Applying
CO3	Analyze and categorize common web vulnerabilities, proposing appropriate solutions.	IV	Analysing
CO4	Evaluate the security considerations of cloud computing environments and identify potential risks.	V	Evaluating

Module	**Module Contents**	**Hours**
I	Module 1: Introduction to Cyber Security Overview of cyber security importance, challenges, and threats Information security concepts: confidentiality, integrity, availability (CIA triad) Types of cyber threats: malware, hacking, social engineering	08
II	Module 2: Network Security and Cryptography Network vulnerabilities and attacks Network security protocols: IPsec, SSL/TLS, VPNs Cryptography basics: encryption, decryption, hashing Secure communication and data protection techniques	09

III	Module 3: Web and Application Security Common web vulnerabilities: SQL injection, XSS, CSRF Secure coding practices and application security testing Securing web applications: input validation, output encoding	08
IV	Module 4: Incident Response and Threat Intelligence Incident response planning and methodologies Threat intelligence sources, feeds, and analysis Handling security incidents: investigation, containment, recovery	07
V	Module 5: Cloud and IoT Security Cloud security considerations: data privacy, compliance Securing IoT devices and communication Identity and Access Management (IAM) in the cloud	06
VI	Module 6: Ethical Hacking and Penetration Testing Introduction to ethical hacking: goals and legal considerations Penetration testing methodologies and tools Reporting vulnerabilities and risk assessment	07

Textbooks	
1	"Principles of Computer Security: CompTIA Security+ and Beyond" by Wm. Arthur Conklin, Gregory White, Dwayne Williams, Chuck Cothren, Roger L. Davis
2	"Cybersecurity: A Business Solution" by Rob Arnold
References	
1	"Hacking: The Art of Exploitation" by Jon Erickson
2	"Cybersecurity and Cyberwar: What Everyone Needs to Know" by P.W. Singer and Allan Friedman
Useful Links	
1	NPTEL

CO-PO Mapping

	Programme Outcomes (PO)					
	1	2	3	4	5	6
CO1			2			
CO2			2			
CO3	2			2		
CO4	3			2		

The strength of mapping is to be written as 1: Low, 2: Medium, 3: High
Each CO of the course must map to at least one PO.

Assessment
The assessment is based on MSE, ISE and ESE. MSE shall be typically on modules 1 to 3. ISE shall be taken throughout the semester in the form of teacher's assessment. Mode of assessment can be field visit, assignments etc. and is expected to map at least one higher order PO. ESE shall be on all modules with around 40% weightage on modules 1 to 3 and 60% weightage on modules 4 to 6. For passing a theory course, Min. 40% marks in (MSE+ISE+ESE) are needed and Min. 40% marks in ESE are needed. (ESE shall be a separate head of passing)

Walchand College of Engineering, Sangli

(Government Aided Autonomous Institute)

AY 2024-25

Course Information	
Programme	M.Tech. (Computer Science and Engineering)
Class, Semester	First Year M. Tech., Sem II
Course Code	7CO537
Course Name	Advanced Database Management System
Desired Requisites:	Database System

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	3 Hrs/week	**MSE**	**ISE**	**ESE**	**Total**
Tutorial	-	30	20	50	100
		Credits: 3			

Course Objectives	
1	Understand fundamental database concepts and basic operations.
2	Utilize SQL for complex queries and optimize database performance.
3	Design and implement database systems based on specific requirements.
4	Design and implement database systems based on specific requirements.

Course Outcomes (CO) with Bloom's Taxonomy Level

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

CO	**Course Outcome Statement/s**	**Bloom's Taxonomy Level**	**Bloom's Taxonomy Description**
CO1	Understand various database systems and their design issues.	II	Understanding
CO2	Design and implement a database for a specified domain following established design principles	III	Applying
CO3	Formulate data retrieval queries in SQL and abstract query languages.	V	Creating
CO4	Formulate data retrieval queries in SQL and abstract query languages.	III	Applying

Module	**Module Contents**	**Hours**
I	Formal review of relational database and FDs Implication, Closure, its correctness	6
II	3NF and BCNF, Decomposition and synthesis approaches, Review of SQL99, Basics of query processing, external sorting, file scans	6
III	Processing of joins, materialized vs. pipelined processing, query transformation rules, DB transactions, ACID properties, interleaved executions, schedules, serialisability	7
IV	Correctness of interleaved execution, Locking and management of locks, 2PL, deadlocks, multiple level granularity, CC on B+ trees, Optimistic CC	7
V	T/O based techniques, Multiversion approaches, Comparison of CC methods, dynamic databases, Failure classification, recovery algorithm, XML and relational databases	6

VI	Advanced topics: Database Security, Distributed databases design, Object Oriented database design & its implementation, Introduction to recent advances in database technology.	7

Textbooks	
1	R. Ramakrishnan, J. Gehrke, Database Management Systems, McGraw Hill, 2004
2	A. Silberschatz, H. Korth, S. Sudarshan, Database system concepts, 5/e, McGraw Hill, 2008
References	
1	R. Ramakrishnan, J. Gehrke, Database Management Systems, McGraw Hill, 2004
2	A. Silberschatz, H. Korth, S. Sudarshan, Database system concepts, 5/e, McGraw Hill, 2008
Useful Links	
1	https://www.cse.iitb.ac.in/infolab/Data/Courses/CS632/

CO-PO Mapping

	Programme Outcomes (PO)					
	1	2	3	4	5	6
CO1	2			2		
CO2	2				2	
CO3		2				2
CO4	2		3			

The strength of mapping is to be written as 1: Low, 2: Medium, 3: High
Each CO of the course must map to at least one PO.

Assessment

The assessment is based on MSE, ISE and ESE. MSE shall be typically on modules 1 to 3. ISE shall be taken throughout the semester in the form of teacher's assessment. Mode of assessment can be field visit, assignments etc. and is expected to map at least one higher order PO. ESE shall be on all modules with around 40% weightage on modules 1 to 3 and 60% weightage on modules 4 to 6. For passing a theory course, Min. 40% marks in (MSE+ISE+ESE) are needed and Min. 40% marks in ESE are needed. (ESE shall be a separate head of passing)

Walchand College of Engineering, Sangli

(Government Aided Autonomous Institute)

AY 2024-25

Course Information	
Programme	M.Tech. (Computer Science and Engineering)
Class, Semester	First Year M. Tech., Sem II
Course Code	
Course Name	Machine Learning in practice
Desired Requisites:	Basic mathematics and python programming

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	Hrs/week	**MSE**	**ISE**	**ESE**	**Total**
Tutorial	3	30	20	50	100
		Credits: 3			

Course Objectives	
1	To introduce python and mathematical concepts required for machine learning
2	To prepare data for machine learning
3	To implement supervised and unsupervised learning algorithm

Course Outcomes (CO) with Bloom's Taxonomy Level

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

CO	**Course Outcome Statement/s**	**Bloom's Taxonomy Level**	**Bloom's Taxonomy Description**
CO1	understand fundamentals of python libraries used for Machine Learning	II	Understanding
CO2	apply different data pre-processing techniques required for data preparation.	III	Appling
CO3	identify and implement different machine learning algorithms to solve real life problems.	IV	Analyzing
CO4	evaluate and compare performance of the machine learning algorithms.	V	Evaluating

Module	**Module Contents**	**Hours**
I	**Introduction to Machine Learning:** Introduction, Types of machine learning, Applications of Machine Learning, Python basics: basic constructs of python, pandas, NumPy, Matplotlib for data visualization	6
II	**Data pre-processing:** Data Cleaning: handling missing values, removing noise from data, handling categorical features, Feature selection and reduction, Data normalization, Train/test split, cross-validation	6
III	**Supervised Learning-I**: Linear regression, multiple regression, MSE, RMSE Classification using Naïve Bayes classifier, Decision tree classifier, KNN, logistic regression	8

IV	**Supervised Learning-II** Ensemble models: tree-based algorithms, Bagging, Boosting, Stacking. **Model Performance**: Confusion matrices, accuracy, precision, recall, F1 score, Hyper parameter tuning, deployment	8
V	**Unsupervised Learning:** Clustering- K means clustering, HDBSCAN, Dimensionality reduction using PCA.	5
VI	**Reinforcement learning and Case study** Introduction to reinforcement learning, Types, elements and applications of Reinforcement learning, Case studies based on various applications of machine learning algorithms in real life.	6
Textbooks		
1	Machine Learning. Tom Mitchell. First Edition, McGraw- Hill, 1997.	
References		
1	Introduction to Machine Learning Edition 2, by Ethem Alpaydin.	
Useful Links		
1	https://www.geeksforgeeks.org/machine-learning/	
2	https://swayam.gov.in/nc_details/NPTEL	

CO-PO Mapping							
	Programme Outcomes (PO)						
	1	2	3	4	5	6	
CO1			1	1			
CO2			2	2	3		
CO3			2	2	3		
CO4			2	3	2		
The strength of mapping is to be written as 1,2,3; where, 1: Low, 2: Medium, 3: High Each CO of the course must map to at least one PO, and preferably to only one PO.							
Assessment							
The assessment is based on MSE, ISE and ESE. MSE shall be typically on modules 1 to 3. ISE shall be taken throughout the semester in the form of teacher's assessment. Mode of assessment can be field visit, assignments etc. and is expected to map at least one higher order PO. ESE shall be on all modules with around 40% weightage on modules 1 to 3 and 60% weightage on modules 4 to 6. For passing a theory course, Min. 40% marks in (MSE+ISE+ESE) are needed and Min. 40% marks in ESE are needed. (ESE shall be a separate head of passing)							