Walchand College of Engineering, Sangli

(Government Aided Autonomous Institute)

AY 2022-23

Course Information	
Programme	B.Tech. (Computer Science and Engineering)
Class, Semester	Third Year B. Tech., Sem V
Course Code	5CS301
Course Name	Compiler Design
Desired Requisites:	Formal Language and Automata Theory, Discrete Mathematics

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

Course Objectives	
1	To introduce fundamentals of compiler design and various tools used to design a compiler
2	To inculcate role of various phases involved during design of a compiler and impart in depth working of each phase
3	To exercise design of various phases of a compiler using compiler design tools and techniques
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	Discuss the need of a compiler, fundamental concepts and various tools used to design a compiler.	II	Understanding
CO2	Demonstrate role and working of each phase involved during compilation	III	Applying
CO3	Analyze the working of various phases of compiler	IV	Analyzing
CO4	Assess various phases of compiler using compiler design tools and techniques	V	Evaluating

Module	**Module Contents**	**Hours**
I	**Module 1: Fundamentals of Compiler** Overview- Structure of a compiler, applications of compiler, one pass and two pass compiler. Lexical analysis - The role of a lexical analyzer, specification of tokens, recognition of tokens, LEX.	6
II	**Module 2 Syntax Analysis** Context-free grammar, writing grammars for context free environments, parse trees and ambiguity, role of parser, specification and recognition of tokens, top-down parsing, recursive descent and predictive parsers (LL), bottom-up parsing, operator precedence parsing, LR, SLR and LALR parsers.	9
III	**Module 3 Syntax Directed Translation & Run time environments** Syntax-directed definitions, evaluation orders for attributes of an SDD, S-attributed and L-attributed SDDs, construction of syntax tree, source language issues, storage organization and allocation strategies, parameter passing, symbol table organizations and generations, dynamic storage allocations.	6

IV	**Module 4 Intermediate Code Generation** Intermediate languages, declarations, different intermediate representations – quadruples, triples, trees, flow graphs, SSA forms, and their uses; assignment statements and Boolean expressions, case statements, back patching, procedure calls.	6
V	**Module 5 Code Optimization** Sources of optimization, basic blocks and flow graphs, optimization of basic blocks, loops in flow graphs, loop optimization, machine-independent optimization, machine-dependent optimization, dead-code Elimination, code improving transformations.	6
VI	Module 6 Code Generation Issues in the design of a code generator, run time storage management; simple code generator- register and address descriptors, code generation algorithm, design of the function getReg, DAG, peephole optimization, register allocation and assignment, selection of instruction, register allocation, parallel compilation, Just-in-Time compiler, study of compiler construction tools.	6

Textbooks	
1	A.V. Aho, R. Shethi and J.D. Ullman, "Compilers - Principles, Techniques and Tools", Pearson Education, Second Edition, 2007.
2	D.M. Dhamdhere, "Systems Programming and Operating Systems", Tata McGraw- Hill Publishing Company limited, New Delhi, Second revised Edition, 2005.

References	
1	K Cooper, L Torczon, "Engineering a Compiler", Morgan Kaufmann, Second Edition, 2011
2	John J Donavan, "System Programming", Tata McGraw- Hill Publishing Company limited, New Delhi
3	Sumitabha Das, "Unix Concepts and Administration", TMGH, 3rd Edition
4	A.V. Aho, R. Shethiand J.D. Ullman, "Compilers - Principles, Techniques and Tools", Addison Wesley Publishing Company, 2007

Useful Links	
1	https://onlinecourses.nptel.ac.in/noc21_cs07/preview
2	https://nptel.ac.in/courses/106108052

CO-PO Mapping

	Programme Outcomes (PO)												**PSO**	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2												2	
CO2	3												3	
CO3		3												
CO4	2	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)

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AY 2022-23

Course Information

Programme	B.Tech. (Computer Science and Engineering)
Class, Semester	Third Year B. Tech., Sem V
Course Code	5CS302
Course Name	Design and Analysis of Algorithm
Desired Requisites:	Data structure

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

Course Objectives

1	To illustrate and apply the algorithm analysis techniques.
2	To discuss the efficient algorithm for various problem
3	To explain and demonstrate different algorithm techniques for real world problem
4	To compute and prove complexity class of various algorithm 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	Discuss the fundamentals of algorithm design and analysis techniques.	II	Understanding
CO2	Apply knowledge of computing and mathematics to algorithm design	III	Applying
CO3	Critically analyze the various algorithm design techniques for a given problem.	IV	Analyzing
CO4	Classify computational problems into P, NP, NP-Hard and NP-Complete.	V	Evaluating
CO5	Design efficient algorithms to improve complexity of existing algorithm.	VI	Creating

Module	**Module Contents**	**Hours**
I	**Introduction** Introduction to Algorithm Analysis Time and Space Complexity, Elementary operations and Computation of Time Complexity-Best, worst and Average Case Complexities- Complexity Calculation of simple algorithms. Recurrence Equations: Solution of Recurrence Equations –Iteration Method and Recursion Tree Methods. Master's theorem for complexity computation.	6
II	**Divide and conquer** Binary Search, Merge sort, Quick sort, Heap Sort, Multiplication of Large Integers, Closest-Pair and Convex, Hull Problems, Strassen's Matrix Multiplication.	7
III	**Greedy Technique** Greedy Technique – Container loading problem, Job sequencing with deadlines, Minimum cost spanning trees, Knapsack problem, Optimal Merge pattern, Huffman Trees.	6
IV	**Dynamic Programming** Principle of optimality – Coin changing problem, Computing a Binomial Coefficient – Floyd's algorithm – Multi stage graph – Optimal Binary Search Trees – 0/1 Knapsack problem and Memory functions.	7

V	**Backtracking** Backtracking-General method, applications The 4, 8-queen problem, sum of subsets problem, graph coloring, Hamiltonian cycles.	6
VI	**Graph Traversal Techniques & Class of problem** Techniques for Graphs – Breadth First Search & Traversal, Depth First Search & Traversal, Topological sorting of DAGs AND/OR graphs, Connected components P, NP, NP- Complete and NP Hard Problems, Approximation Algorithms for NP-Hard Problems.	7

Textbooks	
1	Ellis Horowitz, Sartaj Sahni and Rajasekaran "Fundamentals of Computer Algorithms" , Galgotia Publications, 2nd Edition.
2	Aho, Hopfcraft and Ullman, Addison Wesley "Design and Analysis of Algorithms",
3	
4	
References	
1	Thomas Cormen, Leiserson, Rivest, and Stein "Introduction to Algorithms", PHI Publication. 3rd Edition, 2009
2	Goodman ,"Introduction to Design and Analysis of Algorithm", McGraw Hill.
3	R.C.T. Lee, S.S. Tseng, R.C. Chang, "Introduction to the Design and Analysis of Algorithm", Tata
4	
Useful Links	
1	https://online.stanford.edu/courses/soe-ycsalgorithms1-algorithms-design-and-analysis-part-1
2	
3	
4	

CO-PO Mapping

	Programme Outcomes (PO)												**PSO**	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2	--	--	--	--	--	--	--	--	--	--	--	--	--
CO2	3	1	--	--	--	--	--	--	--	--	--	--	--	--
CO3	--	3	--	2	--	--	--	--	--	--	--	--	--	--
CO4	--	--	--	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)

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AY 2022-23

Course Information

Programme	B.Tech. (Computer Science and Engineering)
Class, Semester	Third Year B. Tech., Sem V
Course Code	5CS351
Course Name	Design and Analysis of Algorithm Lab
Desired Requisites:	Data structure

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

Course Objectives

1	Learn key techniques for designing and analyzing algorithms.
2	Study fundamental concepts and notations used in Algorithm design.
3	Study and apply different algorithm design methods namely, greedy method, divide and conquer, dynamic programming and backtracking.
4	Study the Parallel architectures for designing parallel algorithms.
5	Design and analyze the complexities of various algorithms following

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 different algorithm techniques for given problem.	III	Applying
CO2	Identify appropriate data structure to implement selected algorithmic approach	IV	Analyzing
CO3	Design and Implement an algorithm for complex problem in polynomial time.	VI	Creating
CO4	Exhibit technical and professional skill to demonstrate and convince accomplished algorithmic solution.	III	Applying

List of Experiments / Lab Activities/Topics

List of Topics(Applicable for Interaction mode):

List of Lab Activities:

Students will be given hands-on experience to design and implement efficient and effective algorithms for various problems based on syllabus covered in the course Design and Analysis of Algorithm in the practical hours using any suitable programming language like C, C++, Java. The List of experiments may include 12 to 14 experiments from among the following-

1. To implement sorting algorithm using array as a data structure and analyse its time complexity for different values of n. The large number of elements may be generated using Random Number generator or may be stored in a file. (Quick Sort, Merge Sort)
2. To implement different search techniques using array and/or trees and analyze their time complexity. (Linear, Binary, Binary recursive)
3. To implement Fractional Knapsack problem and activity selection problem using Greedy method.
4. Find Minimum Cost Spanning Tree of a given undirected graph using Kruskal's& Prim's algorithm and compare.
5. To apply Greedy method to solve problems of
a) Job sequencing with deadlines
b) Optimal storage on tapes
6. Implement the following using Dynamic Programming
a) Matrix-chain multiplication
b) Longest common subsequence
c) Optimal binary search trees
7. To implement Strassen's matrix multiplication algorithm
8. From a given vertex in a weighted connected graph, find shortest paths to other vertices using Dijkstra's algorithm.
9. Find a subset of a given set S = {s1,s2,.....,sn} of n positive integers whose sum is equal to a given positive integer d. For example, if S= {1, 2, 5, 6, 8} and d = 9 there are two solutions {1,2,6} and {1,8}. A suitable message is to be displayed if the given problem instance doesn't have a solution.
10. Implement any scheme to find the optimal solution for the Traveling Salesperson problem and then solve the same problem instance using any approximation algorithm and determine the error in the approximation.
11. Implement the following using Back Tracking
a) 8-Queen's problem
b) Hamiltonian cycle
c) Graph coloring Problem
12. Write a program to
a) Print all the nodes reachable from a given starting node in a digraph using BFS method.
b) Check whether a given graph is connected or not using DFS method.
13. Implement All-Pairs Shortest Paths Problem using Floyd's algorithm. Parallelize this algorithm by creating multiple threads and determine the speed-up achieved.
14. Compare and evaluate the performance of different Randomization and Approximation algorithms

Textbooks	
1	Ellis Horowitz, Sartaj Sahni and Rajasekaran "Fundamentals of Computer Algorithms" , Galgotia Publications, 2nd Edition.
2	Aho, Hopfcraft and Ullman, Addison Wesley "Design and Analysis of Algorithms",
3	
4	
References	
1	Thomas Cormen, Leiserson, Rivest, and Stein "Introduction to Algorithms", PHI Publication. 3rd Edition, 2009
2	Goodman ,"Introduction to Design and Analysis of Algorithm", McGraw Hill.
3	R.C.T. Lee, S.S. Tseng, R.C. Chang, "Introduction to the Design and Analysis of Algorithm", Tata
4	
Useful Links	
1	https://online.stanford.edu/courses/soe-ycsalgorithms1-algorithms-design-and-analysis-part-1

CO-PO Mapping														
	Programme Outcomes (PO)												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	--	--	2	--	--	--	--	--	--	--	--	--	--	--
CO2	--	3	--	2	--	--	--	--	--	--	--	--	--	--
CO3	--	--	3	1	--	--	--	--	--	--	--	--	--	--
CO4	--	--	--	2	--	--	--	2	2	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.				

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Course Information

Programme	B.Tech. (Computer Science Engineering)
Class, Semester	Third Year B. Tech., Sem V
Course Code	5CS352
Course Name	Programming Laboratory-3
Desired Requisites:	Basics of Object-Oriented Programming

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 inculcate understanding of World Wide Web, Internet, the concepts of web applications development and web programming languages.
2	to introduce selection of appropriate concepts of internet and web programming such as HTML, CSS, JavaScript, and other server-side scripting languages.
3	to infuse skills of combining different components and technologies to design a web application for real world problem.
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	summarize the different concepts and components of WWW, web development technologies and web security.	II	Understanding
CO2	illustrate the concepts of different web development technologies using different web development tools.	III	Applying
CO3	test the components of WWW, HTML tags, CSS properties, client-side and server-side programming concepts, web data representation formats and AJAX components using different web development tools.	IV	Analyzing
CO4	classify the components of WWW, HTML tags, CSS properties, client-side and server-side programming concepts, web data representation formats, AJAX components and web security threats and measures.	V	Evaluating
CO5	build a web application, individually or in a team by combining different web development technologies and web security measures for real world problems using different web development tools.	VI	Creating

List of Experiments / Lab Activities/Topics

Module 1: Introduction to World Wide Web

Client, Server, Communication, Protocols, Ports, Client-Server Architectures, Internet, World Wide Web, HTTP, HTTP Status Codes, Web Clients/Browsers, and Web Servers.

Experiments:

1. Describe client, server, communication, ports, protocols, HTTP, browsers and web servers.
2. Distinguish between client and server, Internet, WWW, and client-server architectures.
3. Get header information of a web page using browser‟s developer mode.
4. Installation of web server.

Module 2: Markup Languages and Building Web Pages

Introduction to Markup Languages, Introduction to HTML and HTML5, Fundamental HTML Elements, HTML Forms, HTML Media, HTML Graphics, HTML APIs, HTML Web Components.

Experiments:

1. Design and develop web pages using fundamental HTML elements, such as head, title, body, header, comment, etc.
2. Design and develop web pages using HTML Formatting elements, such as abbr, address, etc.
3. Design and develop HTML Forms using HTML Form and Input elements, such as form, input, textarea, etc.
4. Design and develop web pages that embed images and client-side maps, audio and video and links, lists and tables.
5. Design and develop web pages with styles, semantics and layouts, such as header, footer, section, data, div, etc.
6. Design and develop web pages to embed YouTube videos, graphics using canvas and SVG.
7. Design and develop web pages using HTML APIs, web components.

Module 3: Style sheet Languages and Presentation of Web Pages

Introduction to style sheet languages, Introduction to Cascading Style Sheet (CSS), Text Formatting, Colours and Backgrounds, Borders and Margins, Floating and Positioning, Page Layout, Navigation Bars and Dropdowns, CSS Selectors.

Experiments:

1. Design and develop web pages by applying CSS text formatting properties, such as Text Alignment, Text Decoration, Text Transformation, Text Spacing, Text Shadow, Font Family, Font Style, Font Size, etc.
2. Design and develop web pages by applying CSS colors and backgrounds properties, such as colour, RGB, HEX, HSL values, background image, background color, etc.
3. Design and develop web pages by applying CSS borders and margin properties, such as Border Width, Border Color, Margins, etc.
4. Design and develop web pages by applying CSS floating, overflow and positioning properties, such as float, overflow, position, etc.
5. Design and develop web pages by applying CSS page layout properties, such as display, padding, height, width, max-width, align, etc.
6. Design and develop web pages by applying CSS properties to links, lists and tables.
7. Design and develop web pages by using CSS navigation bars and dropdowns.
8. Design and develop web pages by using CSS Selectors.
9. Design and develop web pages by using inline CSS, internal CSS and external CSS.

Module 4: Client-side Programming

JavaScript: Introduction to JavaScript, Basic Syntax, Variables, Data Types, Statements, Operators, Conditions, Loops, Functions, Arrays, Objects, Form Validation, DOM, JavaScript Objects, JavaScript Functions, Asynchronous JavaScript and any one of the state-of-the-art JavaScript libraries.

Experiments:

1. Implement a script using JavaScript that changes HTML content, HTML attributes hides and show HTML elements, HTML output and window alert box for web pages.
2. Implement a script using JavaScript that shows use of JavaScript variables, data types and statements for web pages.
3. Implement a script using JavaScript that shows use of JavaScript Arithmetic, Assignment and String Concatenation operations for web pages.
4. Implement a script using JavaScript that shows use of JavaScript conditionals and loops for web pages.
5. Implement a script using JavaScript that shows use of JavaScript Functions, Arrays, and Objects for web pages.
6. Implement a script using JavaScript that shows use of Asynchronous JavaScript.
7. Design and develop web pages and insert JavaScript in head tag, body tag, external file, external URL and external folder.
8. Implement a script using JavaScript library.

Module 5: Server-side Programming

Introduction to Server-side Programming, Installation of Web and database Server, Process user input, Efficient storage and delivery of information to and from databases, File handling and controlled access to the content, store session/state information, cookies, notifications and communication.

Note:

1. One of the following server-side scripting languages can be used for the implementation: PHP, Node.js, or other state-of-art scripting languages.
2. One of the following databases can be used for data storage and retrieval: MySQL, MongoDB, Firebase or other state-of-art databases.

Experiments:

1. Installation and configuration of web server and database server.
2. Implement basic functionalities of server-side scripting language, such as data types, operators,conditionals, and loops.
3. Implement basic functionalities of server-side scripting language, such as objects, arrays, and functions.
4. Implement web page form validations using server-side scripting language.
5. Implement file handling using server-side scripting language.
6. Implement cookies using server-side scripting language.
7. Implement sessions using server-side scripting language.
8. Implement CRUD operations on database using server-side scripting language.

Module 6: Representation of Web Data, AJAX and Web Security

XML: Introduction to XML, Basics of XML, DTD, Namespaces, XHTML, XPath, XLinks, XQuery and XSLT.

JSON: Introduction to JSON, JSON vs XML, Syntax, Data Types, Parse, Stringify, Objects and Arrays, JSON in HTML.

AJAX: Introduction to AJAX, XMLHttpRequest, AJAX XML, AJAX PHP, and AJAX Database. Web Security: Introduction, types of web threats, and prevention measures.

Experiments:

1. Create a XML file and display in the browser.
2. Create a XML file with the help of namespaces and display in the browser.
3. Create a DTD file and display in the browser.
4. Create and display XSLT file using XML and display in the browser.
5. Create XSLT file using XPath and XPointer and display in the browser.
6. Create a hyperlink using XLinks and display in the browser.
7. Create and display JSON files in HTML.
8. Create a JSON file using basic concepts and use it in HTML.
9. Extract and display the information using XQuery.
10. Implement an AJAX Request-Response with server.
11. Implement an AJAX Request-Response using PHP.
12. Implement an AJAX Request-Response with database.
13. Implementing basic security measures in web development.

Textbooks	
1	Jennifer Niederst Robbins, “Learning Web Design: A Beginner's Guide to HTML, CSS, JavaScript, and Web Graphics”, O'Reilly Media, 5th Edition, 2018, ISBN-13: 978- 1491960202.
2	Robin Nixon, “Learning PHP, MySQL & JavaScript with j Query, CSS & HTML5”, O‟Reilly Media, 5th Edition, 2018, ISBN-13: 978-9352130153

References	
1	Robert W. Sebesta, “Programming the World Wide Web”, Pearson, 8th Edition, 2015, ISBN-13: 9780133776058
2	Terry Ann Felke-Morris, “Basics of Web Design: HTML5 & CSS”, Pearson, 5th Edition, 2019, ISBN-13: 9780133970746
3	Elliotte Harold, W. Means, “XML in a Nutshell, A Desktop Quick Reference”, O'Reilly Media 3rd Edition, 2004, ISBN-13: 9780596007645.
Useful Links	
1	https://www.w3schools.com/
2	https://www.javatpoint.com/
3	https://developer.mozilla.org/en-US/docs/Web

CO-PO Mapping

	Programme Outcomes (PO)												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2	1				1								
CO2	3	2	2	3	3								1	
CO3		3		2	2									
CO4		2		2	3	1								
CO5			3	2	3	1			3				2	

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

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Course Information

Programme	B.Tech. (Computer Science Engineering)
Class, Semester	Third Year B. Tech., Sem V
Course Code	5CS345
Course Name	Mini Project – 1
Desired Requisites:	Nil

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 use latest design and development tools .
2	To undergo project management techniques and project design principles.
3	To implement the project with appropriate programming languages and testing tools.
4	To develop analytical vision and skills to analyse, compare the outcome with other 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	Demonstrate present technological trends through seminar and presentation.	I	Remember
CO2	Demonstrate the appropriate selection of software tool for project implementation.	II	Understand
CO3	Work in teams and participate in group activity of software development.	III	Apply
CO4	Develop a software product and demonstrate its significance .	V	Evaluate

List of Experiments / Lab Activities/Topics

List of Topics(Applicable for Interaction mode):

List of Lab Activities:

1. The theme of Mini Project 1 should be based on current or previous semester courses completed, focus should be more on the courses which don't have lab courses.
2. Students should maintain a project log book containing weekly progress of the project
3. At the end of the semester the project group should achieve all the proposed objectives of the problem statement.
4. The work should be completed in all aspects of design, implementation and testing.
5. Project report should be prepared and submitted in soft and hard form along with all the code and datasets.
6. Group should demonstrate the work with various test cases and results obtained and explain future scope.
7. The group should participate in technical symposiums, paper presentations to demonstrate their work and findings in technical community.

Textbooks

1	Nil

References

1	Nil

Useful Links	
1	Nil

CO-PO Mapping														
	Programme Outcomes (PO)												**PSO**	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2												3	3
CO2	2	3											3	3
CO3		2		3	2								2	
CO4	2										3			3
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%				
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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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Course Information

Programme	B.Tech. (Computer Science Engineering)
Class, Semester	Third Year B. Tech., Sem V
Course Code	5CS346
Course Name	Mini Project – 2
Desired Requisites:	Nil

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 use latest design and development tools .
2	To undergo project management techniques and project design principles.
3	To implement the project with appropriate programming languages and testing tools.
4	To develop analytical vision and skills to analyse, compare the outcome with other 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	Demonstrate present technological trends through seminar and presentation.	I	Remember
CO2	Demonstrate the appropriate selection of software tool for project implementation.	II	Understand
CO3	Work in teams and participate in group activity of software development.	III	Apply
CO4	Develop a software product and demonstrate its significance .	V	Evaluate

List of Experiments / Lab Activities/Topics

List of Topics(Applicable for Interaction mode):

List of Lab Activities:

1. Mini Project 2 should be on customer specific requirements useful to real life or industry specific, major focus should be on Machine learning / Image Processing / Internet (Web) of Things (Preference should give to the course which are not covered in previous Mini Project 1 task).
2. Students should maintain a project log book containing weekly progress of the project
3. At the end of the semester the project group should achieve all the proposed objectives of the problem statement.
4. The work should be completed in all aspects of design, implementation and testing.
5. Project report should be prepared and submitted in soft and hard form along with all the code and datasets.
6. Group should demonstrate the work with various test cases and results obtained and explain future scope.
7. The group should participate in technical symposiums, paper presentations to demonstrate their work and findings in technical community.

Textbooks

1	Nil

References

1	Nil
Useful Links	
1	Nil

CO-PO Mapping														
	Programme Outcomes (PO)												**PSO**	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2												3	3
CO2	2	3											3	3
CO3		2		3	2								2	
CO4	2										3			3
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.				

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Course Information

Programme	B.Tech. (Computer Science and Engineering)
Class, Semester	Third Year B. Tech., Sem V
Course Code	5HS302
Course Name	Humanities 1: Human Relations at Work
Desired Requisites:	Nil

Teaching Scheme		**Examination Scheme (Marks)**			
Practical		**LA1**	**LA2**	**Lab ESE**	**Total**
Interaction	3 Hrs/ Week	30	30	40	100
		Credits: 3			

Course Objectives

1	To inculcate awareness of human relations at work its relationship with self and the processes involved in interaction with people at work.
2	To provide relevant knowledge to address human relations at work by exposure to personal growth, team building, ethical values and challenges at work
3	To infuse the ability to positively consider other's views and to work effectively with others in team and to support a shared purpose or goal.

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 human relations including diversity, attitudes, self-esteem, and interpersonal skills important at workplace.	II	Understanding
CO2	Identify the challenges in decision making, team building, ethical values and effects of stress in the workplace.	II	Understanding
CO3	Describe how theories of motivation, team work and human behaviour impact strategies of the management.	II	Understanding

List of Experiments / Lab Activities/Topics

List of Topics (Applicable for Interaction mode):

1. Human Relations and Personal Growth

Introduction to Human Relations, Understanding and Managing Yourself and Human Relations, Self-Esteem, Self-Confidence, Self-Motivation and Goal Setting, Emotional Intelligence, Attitudes, Happiness, Values, Ethics, Improving Personal and Organizational Communication, Problem Solving and Creativity.

2. Challenges in Human Relations

Dealing effectively with People, Communication in the Workplace, Specialized tactics for getting along with others in the workplace, Becoming an effective leader, Motivating Others, Diversity and Cross-Cultural Competence. Managing or Resolving Conflict and Dealing with Difficult People, A Life Plan for Effective Human Relations

3. Teamwork

Definition, Importance, Benefits of teamwork, Promoting effective teamwork at workplace, Elements of Teamwork, Team Building.

4. Personal Strategies for improving Human Relations

***Staying Physically Healthy*:** Yoga, Pranayama and Exercise, Motivating Yourself, Improving Interpersonal Relations, Achieving Emotional Balance in a Chaotic world, Finding Your Emotional Balance, Building Stronger Relationships with Positive Energy.

5. Individual Career Management

***Staying psychologically healthy*:** Managing Stress and Personal Problems, Meditation. Developing Career Thrust, Getting Ahead in Your Career, Learning and Developing Individual Strategies, Environmental Awareness, Career Goals, Career Strategies, Career Appraisal, Individual Career Management

6. Measures for Successful Human Relations

Developing Good Work Habits. Responding and managing to work related stress, Self-Improvement Plan, Valuing work load, The changing roles of men and women, Sexual harassment of women at workplace, Respect to employees (men, women and transgender).

Textbooks	
1	Shiv Khera, (2014), You Can Win, New edition published by Bloomsbury 2014.
2	John Adair, (2007), The Art of Creative thinking, Kogan Page, Britain and United States.
3	Mathew Allen, (2004), Smart Thinking (2nd edition), Oxford University Press.
4	
References	
1	Greenberg, J. S. (2017). Comprehensive stress management (14th edition). New York: McGraw Hill
2	Dubrien, A. J. (2017). Human Relations for Career and Personal Success: Concepts, Applications and Skills, (11th edition) Upper Saddle River, NJ: Pearson.
3	Alder Ronald B, (2010), Communicating at Work, (10th edition), New York: McGraw Hill
4	
Useful Links	
1	u
2	https://www.youtube.com/watch?v=HkP5VWCxcP0
3	https://www.youtube.com/watch?v=WfWgThjXpXo
4	https://www.youtube.com/watch?v=B7T5rITvMJY
5	https://www.youtube.com/watch?v=4duPBWzf46E
6	https://www.youtube.com/watch?v=KWpGEj2dSR0
7	https://www.youtube.com/watch?v=r8LJ5X2ejqU
8	https://www.youtube.com/watch?v=o1UwpMoHILQ
9	https://www.youtube.com/watch?v=RSlc9IxdBw8
10	https://www.youtube.com/watch?v=cDHGpfpw9kY&list=PLxNHpNhDaEFITDZXhEdybTxMOeh206-Nb

CO-PO Mapping														
	Programme Outcomes (PO)												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1							2			2				
CO2								2	3					
CO3									3					
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.				

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Course Information	
Programme	B.Tech. (Computer Science and Engineering)
Class, Semester	Third Year B. Tech, Sem V
Course Code	5CS311
Course Name	Elective 1: Image Processing
Desired Requisites:	B.Tech. (Computer Science and Engineering)

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 fundamental of digital image processing
2	To learn the concepts of image enhancement, image segmentation, compression etc and apply the algorithms to build applications
3	To compare various algorithms and select the appropriate for a particular application.
4	To create initial background of the area of Image Processing to excel in this stream for further research.
5	To develop engineering skills and intuitive understanding of the tools used in Image Processing.

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	Discuss general terminology of digital image processing.	II	Understanding
CO2	Apply and demonstrate image processing algorithms in practical applications	III	Applying
CO3	Illustrate and critique different techniques employed for the enhancement, segmentation, morphology and compression of images	V	Evaluating

Module	**Module Contents**	**Hours**
I	**Digital Image Fundamentals** Introduction and applications, 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	6
II	**Image Transforms** 2D systems and Necessary Mathematical preliminaries, 2D Orthogonal and Unitary Transforms, KL-Transforms, Hadamard Transforms	6
III	**Image Enhancement** Point Processing, Basic Gray Level Transformations, Histogram Processing, Spatial domain Filtering, Frequency domain filtering	6
IV	**Image Segmentation and Analysis** Edge Detection – using first and second order derivatives, LoG, Canny edge detector, Boundary Extraction – Connectivity, Heuristic Graph Search, Region-based Segmentation – region growing, region splitting and merging, Feature Extraction	8

V	**Morphological Image Processing** Mathematical Morphology, Erosion and Dilation, Opening and Closing, Hit-or-Miss transformation, Basic morphological algorithm: Boundary extraction, Hole filling, Extracting of connected components. Thinning, Thickening	7
VI	**Image Compression** Fundamentals, Compression model, Lossless Vs Lossy Compression, Fundamentals of Information Theory, Run-length coding, Huffman coding, Dictionary-based compression, Image Compression Standards	6

Textbooks	
1	R. C. Gonzalez, R. E. Woods, Digital Image Processing, 4th Edition. 2018, PHI
2	A. K. Jain, Fundamentals of Digital Image Processing, PHI

References	
1	Milan Sonka, Vaclav Hlavac, Boyle, Digital Image Processing and Computer Vision, Cengage Learning
2	S. Jayaraman, S. Esakkirajan, T. Veerkumar, Digital Image Processing, Tata McGrawHill
3	Rafael C. Gonzalez, Richard E. Woods, Steven L. Eddins, Digital Image Processing Using MATLAB, 2nd ed.

Useful Links	
1	NPTEL course: Link
2	NPTEL course: Link

CO-PO Mapping

	Programme Outcomes (PO)												**PSO**	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1		2												
CO2	3		2											
CO3	1			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)

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Course Information	
Programme	B.Tech. (Computer Science and Engineering)
Class, Semester	Third Year B. Tech., Sem V
Course Code	5CS312
Course Name	Elective 1: Artificial Intelligence and Machine Learning
Desired Requisites:	

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, stages, applications, and effects of AI
2	To share the basic tasks and algorithms in Machine Learning
3	To provide understanding of how system learns in supervised learning
4	To understand how machine learning algorithms works for 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	Explain fundamental concepts and challenges in AI and ML	II	Understand
CO2	Create representations of the domain of interest and reason with these representations	III	Apply
CO3	Apply search methods that agents can employ for problem solving.	III, IV	Apply, Analyze
CO4	Recreate machine learning algorithms to solve real life problems and compare the results	VI, IV	Create, Analyze

Module	**Module Contents**	**Hours**
I	**Introduction** Introduction, Reinforcement learning, Intelligent agents, Search Strategies- State space search, Heuristic Search, Backtracking, Finding Optimal Paths: Branch & Bound, A*, Admissibility of A*, A9 Algorithm.	7
II	**Supervised Learning** Machine Learning Paradigms, Predictive Modelling- Classification & Regression, Classification types, Classification Algorithms- Decision Trees, Naïve Bayes, Support Vector Machine, Neural Networks, Performance metrics, Handling Imbalanced Datasets.	7
III	**Knowledge Representation & Reasoning** Introduction to Formal Logics, Propositional Logic, Syntax, Semantics, Forward Chaining, Programming in a Rule Based language.	6
IV	**Regression** Linear Regression with One Variable, Gradient Descent, Gradient Descent for Multiple Variables, Polynomial Regression, Normal Equation Non-invertibility, Logistic Regression, Impact of scaling, learning rate and regularization, Performance measures.	7

V	**Unsupervised Learning** Unsupervised Learning: Introduction, K-Means Algorithm, Optimization Objective, Random Initialization, Choosing the Number of Clusters, KNN Clustering Algorithm, Dimensionality Reduction with PCA.	6
VI	**Game Playing** Game Theory, Board Games and Game Trees, Algorithm Minimax, AlphaBeta and SSS*, Automated Planning: Domain Independent Planning, Blocks World, Forward & Backward Search, Goal Stack Planning, Plan Space Planning	6

Textbooks	
1	Bell J., "*Machine Learning Hands-On for Developers and Technical Professionals*", Wiley 2015
2	Mitchell T. M., "Machine Learning", MGH
3	Marsland S., "*Machine Learning: An Algorithmic Perspective*", Chapman & Hall/CRC, 2nd edition 2014.
4	Khemani D., "*A First Course in Artificial Intelligence*", McGraw Hill Education (India), 2013.

References	
1	Khemani D., "*Artificial Intelligence: Knowledge Representation and Reasoning*", IIT Madras, Lecture Notes.

Useful Links	
1	Artificial Intelligence: Knowledge Representation and Reasoning Course on NPTEL: Link
2	Introduction to Machine Learning Course on NPTEL: Link
3	Machine Learning Course on CourseEra: Link
4	Artificial Intelligence Search Methods for Problem Solving Course on NPTEL: Link

CO-PO Mapping

	Programme Outcomes (PO)												**PSO**	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	1												1	
CO2		2												2
CO3			2										2	
CO4			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)

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Course Information

Programme	B.Tech. (Computer Science and Engineering)
Class, Semester	Third Year B. Tech., Sem V
Course Code	5CS313
Course Name	Elective 1: Internet (Web) of Things
Desired Requisites:	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	To illustrate the basic concepts of Internet of Things.
2	To demonstrate working of Ardino and Raspberry pi.
3	To develop the skill of providing solution for real life problem using IOT.

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 how to design and develop Applications in IOT.	III	Apply
CO2	To Illustrate how IOT devices works	III	Apply
CO3	To access different operations using IOT applications.	V	Evaluate
CO4	To produce a program to solve a real-world problem.	VI	Create

Module	**Module Contents**	**Hours**
I	**Introduction to Internet of Things** Introduction, Physical design of IOT, Logical Design of IOT, IOT Enabling Technology.	07
II	**IOT and Communication Protocols** Basics of Networking, Communication Protocols, Sensor Networks, Machine-to Machine Communications	06
III	**Interoperability in IoT** Introduction to Arduino Programming, Introduction to Python programming, Introduction to Raspberry Pi, Implementation of IoT with Raspberry Pi.	06
IV	**Data Analytics for IOT** Apache Hadoop, Apache Oozie, Apache Spark, Using Apache Storm for real time Data analysis.	06
V	**Industrial IoT** Introduction to IIOT, AWS-IOT, Introduction to Lora-wan, Node MCU IOT Platform	07
VI	**Domain Specific IOT Case Studies** Home Automation, Smart Cities, Environment, Energy, Retail, Logistic, Agriculture, Industry, Health and Lifestyle.	07

Textbooks

1	S. Misra, A. Mukherjee, and A. Roy, 2020. Introduction to IoT. Cambridge University Press.
2	S. Misra, C. Roy, and A. Mukherjee, 2020. Introduction to Industrial Internet of Things and Industry 4.0. CRC Press.

References	
1	Arashdeep Bahga ,Vijay Madisetti Internet of Things an Hands on Approach,University Press.
Useful Links	
1	https://onlinecourses.nptel.ac.in/noc21_cs17

CO-PO Mapping														
	Programme Outcomes (PO)												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1		3	3										2	
CO2	1		2										2	
CO3	3	3	2										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)

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Course Information	
Programme	B.Tech. (Computer Science and Engineering)
Class, Semester	Third Year B. Tech., Sem V
Course Code	5CS314
Course Name	Elective 1: Computer Graphics
Desired Requisites:	C/C++ Programming, Data Structures & Files, Java Programming

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

Course Objectives	
1	To introduce the use of the components of a graphics system and become familiar with building approach of graphics system components and algorithms related with them.
2	To learn the basic principles of 3- dimensional computer graphics
3	Provide an understanding of how to scan convert the basic geometrical primitives, how to transform the shapes to fit them as per the picture definition.
4	Provide an understanding of mapping from world coordinates to device coordinates, clipping, and projections.
5	To be able to discuss the application of computer graphics concepts in the development of computer games, information visualization, and business applications
6	To comprehend and analyze the fundamentals of animation, virtual reality, underlying technologies, principles, and applications.

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	Perceive the fundamental concepts of Computer Graphics	II	Understand
CO2	Handle different transformation algorithms.	III	Apply
CO3	Execute 2D Clipping Algorithms	III	Apply
CO4	Appraise acquired transformations with projection using modern tools	IV	Analyze
CO5	Rehash technique of computer animation and its relationship with image and storage	IV	Analyze

Module	**Module Contents**	**Hours**
I	**Introduction to computer Graphics** Definition, Input and output Devices, Introduction to graphics primitives such as points, lines, polygons, etc.; representation of pictures using primitives; storage & retrieval of pictures; Rasterization techniques: Line – DDA; Bradenham‟s generalized integer version; Mid-point rasterization. Circle – Bradenham‟s algorithm; Mid-Point algorithm 1st order difference & 2nd order difference methods	6
II	**2D and 3D introduction** 2D Scan conversion & polygon filling: Active-Edge-List (ybucket) scan conversion of lines & polygons; Edge –fill , simple Seed – fill & Scan –line seed –fill algorithms. 2D Geometric transformations: Introduction to representation of 2D objects as matrices; transformation matrices for scaling, shear, rotation, reflection 3D Geometric transformations: Introduction to representation of 3 D objects as matrices; transformation matrices for scaling, shear, rotation, reflection	7

III	**2D Clipping** Clipping against regular window – Explicit line clipping; Sutherland & Cohen line clipping, Mid-point subdivision line clipping; Sutherland & Hodgemann polygon clipping	5
IV	**Projection** Introducing the idea of projecting 3D object on to 2D plane; broad classification – parallel & perspective projection; different types of parallel projection & examples of each; formal definition of 3D to 2D projection and derivation of projection matrix; 1-point, 2-point & 3-point perspective projection; formal derivation of vanishing point(s) and physical implication of the same.	5
V	**Computer Animation Introduction**, Key frame animation, Construction of an animation sequence, Motion control methods, Procedural animation, Keyframe animation vs. Procedural animation, Introduction to Morphing, Wraping techniques, Three dimensional morphing.	7
VI	**Image Manipulation and Storage** What is an Image? Digital image file formats, Image compression standard – JPEG, Image Processing - Digital image enhancement, contrast stretching, Histogram Equalization, smoothing and median Filtering	6

Textbooks	
1	"Mathematical Elements for Computer Graphics", David F. Rogers, J Alan, Adams, TMGH, 2nd Edition
2	"Procedural Elements for Computer Graphics", David F. Rogers, TMGH, 2nd Edition
3	"Interactive Comp. Graphics, A Top-Down Approach using OpenGL", Edward Angel, Pearson, 5 th Edition

References	
1	Procedural Elements for Computer Graphics by David F.Rogers, TMH publication
2	Mathematical Elements for Computer Graphics by David F. Rogers and J. A. Adams, TMH Publication
3	Computer Graphics, principles & practices by J.D. Foley, A. van Dam, S.K. Feiner and J.F. Huges, Addison Wesley
4	Computer Graphics, C version, by D. Hearn and M.P. Baker, Pearson Education
5	Computer Graphics, a programming approach, by S. Harrington, TMH publication
6	Computer Graphics by A.N. Sinha and A.D. Udai, TMH publication

Useful Links	
1	https://www.geeksforgeeks.org/
2	https://nptel.ac.in/courses/106/106/106106090/
3	https://www.youtube.com/playlist?list=PLcZUy0j06PrGTnQUDUfucj6pG5alC4Klo

CO-PO Mapping

	Programme Outcomes (PO)												**PSO**	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2	2	-	-	-	-	-	-	-	-	-	-	1	-
CO2	3	2	2	-	-	-	-	-	-	-	-	-	1	-
CO3	2	2	3	-	-	-	-	-	-	-	-	-	-	-
CO4	1	2	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)

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Course Information	
Programme	B.Tech. (Computer Science and Engineering)
Class, Semester	Third Year B. Tech., Sem V
Course Code	5CS316
Course Name	Elective 1: MOOC on Introduction to Game Theory and Mechanism Design
Desired Requisites:	Basic knowledge of probability, algorithms, and (very basic) computational complexity.

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 a foundation of game theory to help students apply game theory to problem solving in a rigorous way.
2	To get insights of applications of game theory in social decision making.

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	To Identify and explain common game theory concepts.	II	Understand
CO2	To design interactions between agents in order to achieve good social outcomes.	III	Apply
CO3	To design and analyse game theoretic solutions to solve real-world problems.	IV	Analyze

Module	**Module Contents**	**Hours**
I	**Introduction to Game Theory** Introduction, the game of chess, proof of chess theorem, normal form games Dominance, Nash equilibrium, Maxmin strategies, elimination of dominated strategies, preservation of pure Nash equilibrium (PSNE), matrix games, relation between maxmin and PSNE in matrix games	07
II	**Mixed strategies** Mixed strategies, mixed strategy Nash equilibrium (MSNE), finding MSNE, MSNE characterization theorem, algorithm to find MSNE Correlated equilibrium (CE), computing CE, extensive form games, subgame perfection, limitations of subgame perfect Nash equilibrium	06
III	**Extensive Form Games** Imperfect information extensive form games (IIEFG), strategies in IIEFGs, equivalence of strategies in IIEFGs, perfect recall Equilibrium in IIEFG, game theory in practice: P2P file sharing, Bayesian games, strategy and utility in Bayesian games, equilibrium in Bayesian games	06
IV	**Basic mechanism design** Introduction to mechanism design, revelation principle, introduction and proof of Arrow's impossibility result, introduction to social choice setup Introduction and proof of Gibbard-Satterthwaite theorem, domain restriction, median voter theorem	06

V	**More mechanism design and auction theory** Task sharing domain, uniform rule, mechanism design with transfers, examples of quasi-linear preferences, Pareto optimality and Groves payments Introduction to VCG mechanism, VCG in Combinatorial allocations, applications to Internet advertising, slot allocation and payments in position auctions, pros and cons of VCG mechanism	07
VI	**Optimal mechanism design** Affine maximizers, single object allocation, Myerson's lemma, optimal mechanism design Single and multi-agent optimal mechanism design, examples of optimal mechanisms	07

Textbooks	
1	Game Theory" — Michael Maschler, Eilon Solan, Shmuel Zamir
2	"Multiagent Systems" — Y. Shoham and K. Leyton Brown, Cambridge University Press, online copy available

References	
1	"Game Theory and Mechanism Design" — Y. Narahari, World Scientific and IISc Press – Indian edition available
2	Martin J. Osborne, An Introduction to Game Theory, Oxford University Press, 2003.

Useful Links	
1	https://onlinecourses.nptel.ac.in/noc22_cs77/preview

CO-PO Mapping

	Programme Outcomes (PO)												**PSO**	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	1		3										2	
CO2	1	2	2										2	
CO3	2	3	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

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Course Information

Programme	B.Tech. (Computer Science and Engineering)
Class, Semester	Third Year B. Tech., Sem V
Course Code	5CS353
Course Name	Elective 2 Lab: Image Processing Lab
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	To share in-depth knowledge of the course
2	To deliver hand-on experience in the field
3	To inculcate interest in different domain areas

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 various techniques of image processing related to theoretical knowledge gained.	III	Applying
CO2	To analyse and compare the results of various algorithms	IV	Analysing

List of Experiments / Lab Activities/Topics

List of Topics(Applicable for Interaction mode):

List of Lab Activities:

Lab sessions are to be utilized for problem solving/designing/implementation, to ensure that students have properly learnt the topics covered in the theory course. From below at least 10-12 assignments should be taken

1. Implement and apply different types of image transforms : scaling, rotation, transformation
2. Applying and analysing result of different image processing techniques: thresholding, contrast stretching.
3. Application of histogram equivalization technique
4. Implement image enhancement technique: Unsharp masking
5. Implement image enhancement technique: High boost filtering
6. Apply Different edge detection techniques: (canny, image subtraction etc)
7. Implement and / or apply different image segmentation techniques and analyse them
8. Implement different morphological image operations
9. Apply different image compression techniques

Textbooks

1	R. C. Gonzalez, R. E. Woods, Digital Image Processing, 4th Edition. 2018, PHI
2	A. K. Jain, Fundamentals of Digital Image Processing, PHI

References

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

3	Rafael C. Gonzalez, Richard E. Woods, Steven L. Eddins, Digital Image Processing Using MATLAB, 2nd ed.
Useful Links	
1	NPTEL course: Link
2	NPTEL course: Link

CO-PO Mapping														
	Programme Outcomes (PO)												**PSO**	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	1			2									1	
CO2					3									
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.				

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Course Information

Programme	B.Tech. (Computer Science Engineering)
Class, Semester	Third Year B. Tech., Sem V
Course Code	5CS354
Course Name	Elective 2 Lab: Artificial Intelligence and Machine Learning Lab
Desired Requisites:	Knowledge of Statistics and Probability

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 make students do practical implementation of the different AI and ML concepts and techniques.
2	To make students familiar with steps involved in applying machine learning algorithms to real-life problems
3	To get insights of how pure AI algorithms can be used
4	To develop research interest towards this 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	**Apply** AI and ML algorithms to **solve** real world problems and **analyze** the results.	III, IV	Apply, Analyze
CO2	**Design** and **provide** best solution to AI and ML problems by **measuring** the performance of different algorithms/tools, and **comparing** them.	V, VI	Evaluate, Create

List of Experiments / Lab Activities/Topics

List of Topics(Applicable for Interaction mode):

List of Lab Activities:

1. Represent knowledge in different forms
   a) Logical Representation.
   b) Semantic Networks
   c) Production Rules
   d) Frame Representation.
2. Apply Branch-and-bound technique to Travelling Salesman Problem
3. Apply Backtracking to Sudoku/ N-Queen/ Subset sum problem.
4. Use Minimax approach to find optimal move in a Tic-Tac-Toe Game.
5. Design and implementation of Naïve Bayes Algorithm to find the probability of playing a Golf or not playing it, under given environmental conditions.
6. Adopt procedures to handle imbalanced datasets and compare performance.
7. Perform regression on given House Prices dataset considering one variable (Area) and multiple variables.
8. Implement K-means and KNN Clustering algorithm to given dataset by varying the number of clusters and compare the results.

Mini-project: Group (2/3) students may select topic from research journal/ literature as a problem statement. Design and build the AI system for that problem. OR The problem statement may be assigned group-wise.

Textbooks	
1	Bell J., "*Machine Learning Hands-On for Developers and Technical Professionals*", Wiley 2015
2	Mitchell T. M., "Machine Learning", MGH
3	Marsland S., "*Machine Learning: An Algorithmic Perspective*", Chapman & Hall/CRC, 2nd edition 2014.
4	Khemani D., "*A First Course in Artificial Intelligence*", McGraw Hill Education (India), 2013.
References	
1	Khemani D., "*Artificial Intelligence: Knowledge Representation and Reasoning*", IIT Madras, Lecture Notes.
Useful Links	
1	Artificial Intelligence: Knowledge Representation and Reasoning Course on NPTEL: Link
2	Introduction to Machine Learning Course on NPTEL: Link
3	Machine Learning Course on CourseEra: Link
4	Artificial Intelligence Search Methods for Problem Solving Course on NPTEL: Link

CO-PO Mapping														
	Programme Outcomes (PO)												**PSO**	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3												1	
CO2		2	2		2									3
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.				

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Course Information

Programme	B.Tech. (Computer Science and Engineering)
Class, Semester	Third Year B. Tech., Sem V
Course Code	5CS355
Course Name	Elective 2 Lab: Internet (Web) of Things Lab
Desired Requisites:	Nil

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 share in-depth knowledge of the IOT.
2	To deliver hand-on experience in the field.
3	To inculcate interest in different domain areas

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	To apply the knowledge gained for solving different problems.	III	Apply
CO2	To Demonstrate basics of IOT	III	Apply
CO3	To analyse and evaluate the solutions and compare them.	V	Evaluate
CO4	To create and implement mini project to solve real life problems.	VI	Create

List of Experiments / Lab Activities/Topics

List of Topics(Applicable for Interaction mode):

List of Lab Activities:

Experiment 1: Arduino basics and Introduction to python programming.
Experiment 2: Study of Raspberry pi.
Experiment 3: Implementation of IOT with Raspberry pi.
Experiment 4: Blink an LED with an Arduino in Tinkercad.
Experiment 5: Smart gate system using Tinkercad.
Experiment 6: Traffic light system using Tinkercad.
Experiment 7: Study of IOT cloud platforms such as ThingSpeak AWS IOT core, Microsoft Azure IOT Hub, Cisco IOT cloud connect etc.
Experiment 8: Study Amazon web services-IOT
Experiment 9: Implementation of Amazon S3, Amazon Dynamo DB, AWS Lambda, Amazon SNS.
Experiment 10: Study of Node MCU IOT platform.
Experiment 11: Introduction to Lora-Wan.
Experiment 12: Any Mini project implementation using concepts of IOT.

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
2	S. Misra, A. Mukherjee, and A. Roy, 2020. Introduction to IoT. Cambridge University Press.
3	S. Misra, C. Roy, and A. Mukherjee, 2020. Introduction to Industrial Internet of Things and Industry 4.0. CRC Press.
Useful Links	
1	https://onlinecourses.nptel.ac.in/noc21_cs17/preview
2	https://www.tinkercad.com/things/55ubLwvGK0g-1st-iot-project

CO-PO Mapping

	Programme Outcomes (PO)												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1					1	1					2		3	
CO2					1	1					2		3	
CO3					1	1					2		3	
CO4					1	1					2		3	

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.

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Course Information

Programme	B.Tech. (Computer Science Engineering)
Class, Semester	Third Year B. Tech., SemV
Course Code	5CS356
Course Name	Elective 2 Lab: Computer Graphics Lab
Desired Requisites:	C/C++ Programming, Data Structures & Files, Java Programming

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 introduce the use of the components of a graphics system and become familiar with building approach of graphics system components and algorithms related with them.
2	To learn the basic principles of 3- dimensional computer graphics.
3	Provide an understanding of how to scan convert the basic geometrical primitives, how to transform the shapes to fit them as per the picture definition.
4	Provide an understanding of mapping from world coordinates to device coordinates, clipping, and projections.
5	To be able to discuss the application of computer graphics concepts in the development of computer games, information visualization, and business applications.
6	To comprehend and analyze the fundamentals of animation, virtual reality, underlying technologies, principles, and applications.

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	Outline the fundamental concepts of Computer Graphics.	II	Understand
CO2	Illustrate the fundamental concepts of computer graphics with its different transformations using algorithms.	III	Applying
CO3	Solve different algorithms on 2D clipping	III	Applying
CO4	Investigate acquired transformations with projection.	IV	Analyzing
CO5	Scrutinize technique of computer animation and figure out relation with image and storage.	IV	Analyzing

List of Experiments / Lab Activities/Topics

List of Topics(Applicable for Interaction mode):

List of Lab Activities:

Minimum 8 experiments will be performed to understand functioning of Computer graphics & its visualization.
The list contains;
1. Practical based on C/C++ graphics library.
2. Introductory OpenGL programming.
3. Visualization of Data Sets. 4. 2D Transformations.
5. 3D Transformations and animation.
6. Line/Circle generation algorithm.
7. Polygon filling algorithms.
8. Hidden line/surface elimination algorithms (Z Buffer)
9. Curve Generation (Cubic spline, Bezier).
10. Study of Multimedia-file formats. (BMP-JPG/WAV-MP3/DAT-MPG etc).
11. Visualization applications / Case tools/ animation using Multimedia concepts

Textbooks	
1	"Mathematical Elements for Computer Graphics", David F. Rogers, J Alan, Adams, TMGH, 2nd Edition
2	"Procedural Elements for Computer Graphics", David F. Rogers, TMGH, 2nd Edition
3	"Interactive Comp. Graphics, A Top-Down Approach using OpenGL", Edward Angel, Pearson, 5th Edition

References	
1	Procedural Elements for Computer Graphics by David F.Rogers, TMH publication.
2	Mathematical Elements for Computer Graphics by David F. Rogers and J. A. Adams, TMH publication.
3	Computer Graphics, principles & practices by J.D. Foley, A. van Dam, S.K. Feiner and J.F. Huges, Addison Wesley.
4	Computer Graphics, C version, by D. Hearn and M.P. Baker, Pearson Education.
5	Computer Graphics, a programming approach, by S. Harrington, TMH publication.
6	Computer Graphics by A.N. Sinha and A.D. Udai, TMH publication

Useful Links	
1	https://www.youtube.com/playlist?list=PLcZUy0j06PrGTnQUDUfucj6pG5alC4Klo

CO-PO Mapping

	Programme Outcomes (PO)												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2	2	1	-	-	-	-	-	-	-	-	-	-	-
CO2	3	2	1	2	-	-	-	-	-	-	-	-	-	-
CO3	-	2	1	-	2	-	-	-	-	-	-	-	3	-
CO4	1	2	1	2	3	-	-	-	-	-	-	2	-	-
CO5	1	2	1	-	3	-	-	-	-	-	-	-	-	-

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.				

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Course Information	
Programme	B.Tech. (Computer Science Engineering)
Class, Semester	Third Year B. Tech., SemV
Course Code	5CS358
Course Name	Elective 2 Lab: Introduction to Game Theory and Mechanism Design Lab
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	To share in-depth knowledge of the course
2	To deliver hand-on experience in the field
3	To inculcate interest in different domain areas

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	To apply game theory concepts.	III	Applying
CO2	To demonstrate the concepts using various tools.	III	Applying
CO3	To analyse game theoretic solutions.	IV	Analyzing

List of Experiments / Lab Activities/Topics

List of Topics(Applicable for Interaction mode):

List of Lab Activities:

Minimum 8 experiments will be performed to implement the concepts from Game Theory and Mechanism design based on theory MOOC course.

Textbooks

1	Game Theory" — Michael Maschler, Eilon Solan, Shmuel Zamir
2	"Multiagent Systems" — Y. Shoham and K. Leyton Brown, Cambridge University Press, online copy available

References

1	"Game Theory and Mechanism Design" — Y. Narahari, World Scientific and IISc Press – Indian edition available

Useful Links

1	https://onlinecourses.nptel.ac.in/noc22_cs77/

CO-PO Mapping														
	Programme Outcomes (PO)												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2	2	1	-	-	-	-	-	-	-	-	-	-	-
CO2	3	2	1	2	-	-	-	-	-	-	-	-	-	-
CO3	-	2	1	-	2	-	-	-	-	-	-	-	3	-

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.

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Course Information	
Programme	B.Tech. (Computer Science and Engineering)
Class, Semester	Third Year B. Tech., Sem V
Course Code	5OE372
Course Name	Open Elective-1: Data Science using Python
Desired Requisites:	Nil

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	2 Hrs/week	**MSE**	**ISE**	**ESE**	**Total**
Tutorial	-	30	20	50	100
		Credits: 2			

Course Objectives

1	Introduce python as a programming language
2	Introduce the mathematical foundations required for data science
3	Introduce the first level data science algorithms
4	Introduce a practical capstone case study

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 a flow process for data science problems	II	Understand
CO2	Implement Python codes for data science solutions	III	Apply
CO3	Correlate results to the solution approach followed	III	Apply
CO4	Construct use cases to validate approach and identify modifications required	IV	Analyze

Module	**Module Contents**	**Hours**
I	**Introduction and Programming in python** Introduction to Data Science, Introduction to basics of Python, Tables, Building Tables	4
II	**Data Visualization** Census, Charts, Histograms, Functions, Groups	5
III	**Introduction to Statistics** Iteration, Chance, Sampling, Models, Comparing Distributions	4
IV	**Hypothesis Testing** A/B Testing, Causality, Confidence Intervals, Interpreting Confidence, Center and Spread, The Normal Distribution	5
V	**Classification and Regression** Classification, Classifiers, Correlation, Linear Regression, Logistic Regression	4
VI	**Classification and Regression Case Studies** Residuals, Regression Inference, Case Study	4

Textbooks

1	Computational and Inferential Thinking, The Foundations of Data Science By Ani Adhikari and John DeNero UC Berkeley. (Available Online)
2	The Elements of Statistical Learning, Data Mining, Inference, and Prediction (2nd Edn.), Trevor Hastie Robert Tibshirani, Jerome Friedman, Springer, 2014

References	
1	Probability & Statistics for Engineers & Scientists (9th Edn.), Ronald E. Walpole, Raymond H. Myers, Sharon L. Myers and Keying Ye, Prentice Hall Inc.

Useful Links	
1	http://data8.org/

CO-PO Mapping

	Programme Outcomes (PO)												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2													2
CO2					3									
CO3			2									1		
CO4			3	3									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)

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Course Information

Programme	B.Tech. (Computer Science and Engineering)
Class, Semester	Third Year B. Tech., Sem V
Course Code	5OE371
Course Name	Open Elective-2 Software Engineering and Database Essentials
Desired Requisites:	Nil

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

Course Objectives

1	Understand importance of engineering approach to software development and comprehend the knowledge of software processes & models practiced at IT industries.
2	Be acquainted with the SDLC phases in detail and appreciate the importance of software quality by virtue of software testing methods.
3	To use conceptual designs to prepare database schemas.
4	To understand the relational model and the theoretical issues associated with relational database Design.
5	To learn SQL and Database Architectures.

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 proficiency to undertake software projects based on software engineering practices.	II	understanding
CO2	summarizing the spirit of team-working in SDLC phases & project planning benefits.	II	understanding
CO3	describe the conceptual designs of Database, identifies the need, analyse the problem and Design ER diagram as well as prepare the relational database schema.	I, IV	Remembering, Analysing
CO4	apply SQL to extract required information from the database. Compare, analyses various ways of writing the queries for a given problem and Differentiating database Architecture.	IV	Analysing

Module	**Module Contents**	**Hours**
I	**Introduction Software Engineering Basics** Software Crisis, Need of software engineering approach. Software Processes: project management process, software development process models, Configuration management process, process management process.	7
II	**Software Quality & Project Planning** **Notion of Software Quality:** Quality objectives, Need for improvement, Software quality factors, Quality standards, **Project Planning Basics:** Project management plan, Cost estimation, Project scheduling, Staffing and personnel Planning, Risk management.	6
III	**Software Development Phases** Software Requirement Process, Design principles, Structured design methodology, Coding Standards, levels of Testing.	6

IV	**Introduction and Database Modelling using ER Model** **Introduction:** General introduction to database systems, its advantages and applications, Database System Architecture, Database users and Administrator, Data models, Database management system, Database languages, View of Database, Data Models. **ER Model:** Entity set, Entity types, attributes, Notations, Relationship sets, Relationship types, Keys- super key, candidate key, primary key, Extended Features of ER Model-Generalization, Specialization and aggregation	6
V	**Relational Model and SQL** **Relational Model:** Structure of Relational Database, Reduction of ER model into Relational schemas, Schema-instance distinction, Key, Relational algebra, Tuple relation calculus, Domain relational calculus, Example queries, **SQL:** Introduction to SQL, Data definition statements with constraints, Insert, Update and Delete, Set Operations, Aggregate functions group by and having clauses, Nested Queries, Views, Joins.	8
VI	**Database Architectures** Centralized &Client-Server architectures, server system architecture, Architectures for parallel databases, Distributed database concepts, Homogeneous & Heterogeneous databases, distributed data storage, data fragmentation, and replication and allocation techniques for distributed database.	6

Textbooks	
1	Pankaj Jalote, "An integrated approach to S/W engineering", Narosa Publishers, 2nd Edition.
2	Abraham Silberschatz, Henry F. Korth and S. Sudarshan, Database System Concepts, Mc-Graw Hill, 4th Edition 2002 / 6th Edition 2011
3	Pankaj Jalote, "Software Project Management in practice", Pearson education
References	
1	Roger S. Pressman, "Software Engineering: Practitioner‟s Approach". McGraw Hill
2	Raghu Ramakrishnan and Johannes Gehrke, Database Management Systems, 3rd Edition. 2002
Useful Links	
1	https://www.javatpoint.com/software-engineering-tutorial
2	https://www.w3schools.com/sql/trysql.asp?filename=trysql_asc

CO-PO Mapping														
	Programme Outcomes (PO)												**PSO**	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3					2	1							
CO2			3						3		1			
CO3			3	1										
CO4		2			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
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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Course Information	
Programme	B.Tech. (Computer Science and Engineering)
Class, Semester	Third Year B. Tech., Sem VI
Course Code	5CS321
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	An understanding of fundamental ideas behind Cloud Computing, the evolution of the paradigm, its applicability; benefits, as well as current and future challenges.
2	Providing basic ideas and principles in cloud management techniques, virtualization techniques and cloud software deployment considerations.
3	Exploring cloud computing driven open source and commercial systems and applications.

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	Distinguish concepts of distributed paradigm from other computing paradigm and the mechanism of inter process communication in distributed systems.	II	Understanding
CO2	Describe main concepts, key technologies, strengths, and limitations of cloud computing and the possible applications for state-of-the-art cloud computing.	II	Understanding
CO3	Illustrate different cloudinfrastructure models, cloud computing architecture and various deployment models.	III	Applying
CO4	Classify different hypervisors and virtualization techniques based on their characteristics.	IV	Analyzing
CO5	Identify core issues of cloud computing such as security, privacy, and interoperability.	IV	Analyzing
CO6	Examine the components of Open and commercial cloud platform.	IV	Analyzing

Module	**Module Contents**	**Hours**
I	**Principles of distributed computing** Eras of computing, Elements of distributed computing – General concepts and definitions, components of a distributed system, architectural styles for distributed computing, models for inter-process communication, Technologies for distributed computing – Remote procedure call, distributed object frameworks. GraphQL, REST API.	7
II	**Introduction to Cloud Computing** Cloud Computing (NIST Model)Introduction to Cloud Computing, History of Cloud Computing, Cloud service providers Properties, Characteristics & Disadvantages,Pros and Cons of Cloud Computing, Benefits of Cloud Computing, Cloud computing vs. Cluster computing vs. Grid computing, Role of Open Standards.	5

III	**Cloud Computing Architecture** Cloud computing stack,Comparison with traditional computing architecture (client/server), Services provided at various levels, How Cloud Computing Works, Role of Networks in Cloud computing, protocols used, Role of Web services, Service Models (XaaS), Infrastructure as a Service(IaaS), Platform as a Service(PaaS), Software as a Service(SaaS), Deployment Models: Public cloud, Private cloud, Hybrid cloud, Community cloud.	7
IV	**Virtualization** Introduction, characteristics of virtualized environments, Taxonomy of virtualization Techniques, Virtualization and cloud computing, Pros and Cons of virtualization, technology Examples, Micro-services, Serverless architecture, Hypervisors, Containerization.	6
V	**Cloud Security** Type of attack, Security stack of IaaS, PaaS, SaaS, Gartner's seven cloud computing security Risks, Other cloud security issues: Virtualization, Access Control and identity Management, Application security, Data life cycle management, AWS IAM.	6
VI	**Case Study on Open Source & Commercial Clouds** Eucalyptus, Microsoft Azure, Amazon EC2, Open Stack, Open Nebula, AWS, Free Amazon tiers and Google compute, Problems related to Big data analytics, Metering and Monitoring of cloud infrastructure.	8

Textbooks	
1	RajkumarBuyya, James Broberg, Andrzej M. Goscinski ,"Cloud Computing: Principles and Paradigms", Wiley, 1 Edition 2013.
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.

References	
1	Barrie Sosinsky,"Cloud Computing Bible", Wiley-India, 2010.

Useful Links	
1	

CO-PO Mapping

	Programme Outcomes (PO)												**PSO**	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	1													
CO2		2											2	
CO3		2											1	
CO4		2											1	
CO5		2											1	
CO6		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)

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Course Information	
Programme	B.Tech. (Computer Science and Engineering)
Class, Semester	Third Year B. Tech., Sem VI
Course Code	5CS322
Course Name	Advanced Database Systems
Desired Requisites:	Database Engineering

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

Course Objectives	
1	An understanding of the fundamentals in object-based databases and explore the database centric design issues involved in application development, the advances in database system.
2	Providing the methodology to implement the complex and real-world database applications.
3	Evaluation and analysis of the different types of advanced databases.

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	**Exploit** the fundamental concepts involved in advanced databases and apply it in complex data handling.	III	Apply
CO2	**Analyse** the architectures and performance of different databases using **modern tools** for domain specific applications.	IV	Analyse
CO3	**Recommend** the optimal database-based solution to solve real world problem.	V	Evaluate
CO4	**Apply** the acquired knowledge in databases to **design** and **build** the different business applications.	VI	Create

Module	**Module Contents**	**Hours**
I	**Object-Based Databases** Overview, Complex Data Types, Structure Types and Inheritance in SQL, Table Inheritance, Arrays and Multiset Types in SQL, Object-Identity and Reference Types in SQL, Implementing O-R Features, Object-Relational Mapping	5
II	**Application development & Administration** Application Programs and User Interfaces, Application Architectures, Standardization, Rapid Application Development, Application Performance, Application Security. Performance Tuning, Performance Benchmarks, Other issues in Application Development	6
III	**Data Warehousing** Introduction, Data Warehouse Building Blocks, Data Warehouse Architecture, Data warehouse design process, dimensional modelling, conceptual modelling, Multi-dimensional data – cube, building the data warehouse – Data Extraction, Transformation and Loading (ETL Process)	8

IV	**Distributed and Cloud Databases** **Distributed databases:** Homogeneous & heterogeneous databases, distributed data storage, distributed transactions, concurrency control in distributed databases, distributed query processing, Heterogeneous distributed databases. **Cloud Databases – I** Introduction, Architecture of a cloud data storage system, Data Models, Transactions and replication, Deployment models, Comparison of Relational databases and Cloud databases, Challenges to develop Cloud Databases.	4 3
V	**Cloud Databases – II** Case study of any four NoSQL databases: Voldemort , MongoDB , Cassandra , Neo4J , Cloud Native , Data Lake	7
VI	**Spatial, Temporal Data and Mobility** Motivation, Time in Databases, Spatial and Geographic Data, Multimedia Databases, Mobility and Personal Databases.	6

Textbooks	
1	Silberschatz, Korth, Sudarshan "Database system concepts" MGH 6th Edition.
2	Raghu Ramkrishnan "Database Management System" MGH
3	Paulraj Ponniah "Data Warehousing - Fundamentals for IT Professional" 2nd Edition. Wiley

References	
1	Thomas Connolly & Carolyn Begg "Database Systems : A practical approach to design, implementation & Management" Pearson 3rd Edition
2	RamezElmasri and ShamkantNavathe, "Fundamentals of Database Systems" Benjamin Cummings, 2nd Ed, 1994.
3	Open source databases official websites
4	W. H. Inmon, "Building the Data Warehouse" Wiley Dreamtech India Pvt. Ltd...
5	RALPH KIMBALL, "The Data Warehouse Life cycle Tool kit" WILEY STUDENT EDITION

Useful Links	
1	https://nptel.ac.in/courses/106/106/106106093/
2	https://freevideolectures.com/course/2280/database-design/37
3	https://onlinecourses.nptel.ac.in/noc21_cs04/preview
4	https://onlinecourses.nptel.ac.in/noc21_cs58/preview
5	https://docs.oracle.com/en/database/oracle/oracle-database/21/dwhsg/

CO-PO Mapping

	Programme Outcomes (PO)												**PSO**	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3												2	
CO2					2								2	2
CO3			2										2	
CO4			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)

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Course Information

Programme	B.Tech. (Computer Science Engineering)
Class, Semester	Third Year B. Tech., Sem VI
Course Code	5CS371
Course Name	Advanced Database System Laboratory
Desired Requisites:	Database Engineering

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

Course Objectives

1	Practicing the concepts/techniques studied in theory course.
2	Providing hands-on with different database servers / platforms / tools.
3	Designing and implementation of the database based applications.

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	Scrutinize different database servers, application architectures / models, frameworks and identify optimal one, suitable for particular application.	IV	Analyze
CO2	Select the advanced/modern databases and recommend for prediction and modelling of complex real world data.	V	Evaluate
CO3	Design and build the different enterprise applications using modern tools.	VI	Create

List of Experiments / Lab Activities/Topics

List of Topics(Applicable for Interaction mode):

List of Lab Activities:

1. Minimum 12 assignments or 6 mini-projects should be practice/perform based on the understanding of concepts covered in theory course.
2. The detail list of assignments/mini-projects will be display by subject teacher.
3. Explore to all the state of the art technology related to each module in theory course.
4. Use industry standard development tools for above laboratory work.
5. All assignments/laboratory work should follow software engineering standards.

Textbooks

1	Silberschatz, Korth, Sudarshan "Database system concepts" MGH 4th Edition
2	Raghu Ramkrishnan "Database Management System" MGH

References

1	Thomas Connolly & Carolyn Begg "Database Systems : A practical approach to design, implementation & Management" Pearson 3rd Edition

2	RamezElmasri and ShamkantNavathe, “Fundamentals of Database Systems” Benjamin Cummings 2nd Ed, 1994
3	Official websites of open source databases
Useful Links	
1	Parallel processing :- https://docs.oracle.com/cd/A58617_01/server.804/a58238/ch2_succ.htm
2	Distributed database:- https://docs.oracle.com/database/121/ADMIN/ds_concepts.htm#ADMIN12134
3	www.mongodb.com , https://cassandra.apache.org
4	https://neo4j.com/developer/cypher/

CO-PO Mapping

	Programme Outcomes (PO)												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1													2	
CO2					2								2	
CO3					3						1		2	3
CO4													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.

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Course Information

Programme	B.Tech. (Computer Science Engineering)
Class, Semester	Third Year B. Tech., Sem VI
Course Code	5CS347
Course Name	Mini Project – 3
Desired Requisites:	Nil

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 use latest design and development tools .
2	To undergo project management techniques and project design principles.
3	To implement the project with appropriate programming languages and testing tools.
4	To develop analytical vision and skills to analyse, compare the outcome with other 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	Demonstrate present technological trends through seminar and presentation.	I	Remember
CO2	Demonstrate the appropriate selection of software tool for project implementation.	II	Understand
CO3	Work in teams and participate in group activity of software development.	III	Apply
CO4	Develop a software product and demonstrate its significance .	V	Evaluate

List of Experiments / Lab Activities/Topics

List of Topics(Applicable for Interaction mode):

List of Lab Activities:

1. The theme of Mini Project 3 should be based on current or previous semester courses completed, focus should be more on the courses which doesn't have lab course (Preference should give to the course which are not covered in previous Mini Project 1/2 task).
2. Students should maintain a project log book containing weekly progress of the project
3. At the end of the semester the project group should achieve all the proposed objectives of the problem statement.
4. The work should be completed in all aspects of design, implementation and testing.
5. Project report should be prepared and submitted in soft and hard form along with all the code and datasets.
6. Group should demonstrate the work with various test cases and results obtained and explain future scope.
7. The group should participate in technical symposiums, paper presentations to demonstrate their work and findings in technical community.

Textbooks

1	Nil

References

1	Nil
Useful Links	
1	Nil

CO-PO Mapping														
	Programme Outcomes (PO)												**PSO**	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2												3	3
CO2	2	3											3	3
CO3		2		3	2								2	
CO4	2										3			3
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.				

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Course Information

Programme	B.Tech. (Computer Science Engineering)
Class, Semester	Third Year B. Tech., Sem VI
Course Code	5CS348
Course Name	Mini Project – 4
Desired Requisites:	Nil

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 use latest design and development tools .
2	To undergo project management techniques and project design principles.
3	To implement the project with appropriate programming languages and testing tools.
4	To develop analytical vision and skills to analyse, compare the outcome with other 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	Demonstrate present technological trends through seminar and presentation.	I	Remember
CO2	Demonstrate the appropriate selection of software tool for project implementation.	II	Understand
CO3	Work in teams and participate in group activity of software development.	III	Apply
CO4	Develop a software product and demonstrate its significance .	V	Evaluate

List of Experiments / Lab Activities/Topics

List of Topics(Applicable for Interaction mode):

List of Lab Activities:

1. Mini Project 4 should be on customer specific requirements useful to real life or industry specific, major focus should be on Machine learning / Image Processing / Internet (Web) of Things (Preference should give to the course which are not covered in previous Mini Project 1/2/3 task).
2. Students should maintain a project log book containing weekly progress of the project
3. At the end of the semester the project group should achieve all the proposed objectives of the problem statement.
4. The work should be completed in all aspects of design, implementation and testing.
5. Project report should be prepared and submitted in soft and hard form along with all the code and datasets.
6. Group should demonstrate the work with various test cases and results obtained and explain future scope.
7. The group should participate in technical symposiums, paper presentations to demonstrate their work and findings in technical community.

Textbooks

1	Nil

References

1	Nil
Useful Links	
1	Nil

CO-PO Mapping														
	Programme Outcomes (PO)												**PSO**	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2												3	3
CO2	2	3											3	3
CO3		2		3	2								2	
CO4	2										3			3
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.				

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Course Information	
Programme	B.Tech. (Computer Science and Engineering)
Class, Semester	Third Year B. Tech., Sem VI
Course Code	5HS301
Course Name	Humanities 2- German Language
Desired Requisites:	10+2 level English

Teaching Scheme		**Examination Scheme (Marks)**			
Practical		**LA1**	**LA2**	**Lab ESE**	**Total**
Interaction	3 Hrs/ Week	30	30	40	100
		Credits: 3			

Course Objectives

1	To learn colloquial German language
2	Enable students to communicate in day to day situations

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	Communicate clearly in different scenarios	III	Applying
CO2	Handle oral and written communications independently	II	Understanding

List of Experiments / Lab Activities/Topics

List of Topics(Applicable for Interaction mode):

Module 1: Sentence structure and vocabulary building

1. Alphabet
2. Personal pronouns
3. German articles
4. Genders
5. Plural forms
6. Nouns

Module 2:

1. Date and days of week
2. Names of month
3. Numbers 1 to 1000
4. Names of Continents, Countries and their Capitals
5. Languages and Nationalities, main cultural festivals
6. Health and parts of body.

Module 3:

1. To introduce oneself and others
2. Greeting people/colleagues at office/work-place etc.
3. Exchanging information about country of origin
4. Place of residence, professions

Module 4: Grammar

1. Forming questions
2. Prepositions
3. Conjunctions
4. Verbs
5. Dative and Accusative forms with examples
6. Opposite

Module 5: Oral Communication

1. Asking for and telling telephone numbers with dial code numbers.
2. Making request
3. Word order in sentences/statements and full question.
4. Adding question tags.
5. Speak on given topic.
6. Asking questions

Module 6: Written communication: Basic writing skills

1. Paragraph writing
2. Comprehension
3. Short easy writing
4. Filling in personal information
5. Writing emails and short messages

Textbooks	
1	Hartmut Auf der Strasse, Heiko Bock, Mechthild Gerdes, Jutta Mueller, Helmut Mueller, "Themen Aktuell 1- Deutsch als Fremdsprache-Kursbuch", Max Hueber Verlag, Munich, Germany and Langers International Pvt.Ltd., New Delhi ,ISBN: 3-19-00016909, Reprint 2014
2	Hartmut Auf der Strasse, Heiko Bock, Mechthild Gerdes, Jutta Mueller, Helmut Mueller, "Themen Aktuell1- Deutsch als Fremdsprache-Arbeitsbuch", Max Hueber Verlag, Munich, Germany and Langers International Pvt.Ltd., New Delhi ,ISBN: 3-19-0116903, Reprint 201
3	Alan B, Jones A."Themen Aktuell 1- Deutsch als Fremdsprache - Glossar",Max Hueber Verlag, Munich, Germany and Langers International Pvt.Ltd., New Delhi ,ISBN: 3-19-0001690-9, Reprint 2014
4	

References	
1	Archana Gogate, "German Workbook", Shubhasha Publications, Pune, Reprint July 2016

2	Stefanie Dengler, Paul Rusch, Helen Schmitz, Tanja Sieber, "Netzwerk A1- Deutsch als FremdspracheKursbuch " Klett Langenscheidt, Munich, Germany and GOYAL Publishers Pvt. Ltd., New Delhi, First Indian edition-2015
3	Stefanie Dengler, Paul Rusch, Helen Schmitz,Tanja Sieber, "Netzwerk A1- Deutsch als Fremdsprache Arbeitsbuch ",Klett Langenscheidt, Munich, Germany and GOYAL Publishers Pvt.Ltd., New Delhi, First Indian edition-2015
4	Stefanie Dengler, Paul Rusch, Helen Schmitz, Tanja Sieber, Gavin Schalliol"Netzwerk A1- Deutsch aistremdsprache. Glossar ", Klett Langenscheidt, Munich, Germany and GOYAL Publishers Pvt.Ltd., New Delhi, First Indian edition-2015
Useful Links	
1	www.klett-sprachen.de/netzwerk
2	http://uztranslation.net.ru

CO-PO Mapping

	Programme Outcomes (PO)												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1										1				
CO2										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

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AY 2022-23

Course Information	
Programme	B.Tech. (Computer Science and Engineering)
Class, Semester	Third Year B. Tech., Sem VI
Course Code	5CS331
Course Name	Elective 3: Remote Sensing & Geographic Information System
Desired Requisites:	Fundamentals of Image processing

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	2 Hrs/week	**MSE**	**ISE**	**ESE**	**Total**
Tutorial	-	30	20	50	100
		Credits: 2			

Course Objectives	
1	To introduce the fundamentals of Remote Sensing (RS) and geographical information systems (GIS)
2	To explore various Remote Sensing satellites, their characteristics and data products
3	To inculcate advantages, limitations and interdisciplinary applications of RS and GIS

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 RS and GIS	II	Understand
CO2	Interpret and Apply various satellite sensor data and data products	III	Apply
CO3	Demonstrate GIS data and GIS database management system	III	Apply
CO4	Compare and Analyze RS and GIS data using modern tools and techniques	IV	Analyze
CO5	Select and Verify suitable RS and GIS data and data products to design solution for various interdisciplinary problems using RS and GIS tools and techniques	V	Evaluate

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, Applications of Remote Sensing.	5
II	**Sensors, Platforms and Satellite Data Products** Broad Classifications of Sensors and Platform, Earth Observation Satellite and Sensors, Data Reception, Transmission and Processing, Remote Sensing Data and Data Products	4
III	**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, Image Transformation	4
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, Applications of GIS, GPS, Introduction to ArcGIS	5

V	**GIS Data** Introduction, GIS Data types and Data Representation, Data Acquisition, Georeferencing of GIS Data, Raster and Vector data, Remote Sensing Data in GIS, GIS Database and Database Management System	4
VI	**Spatial Data Analysis** Measurements in GIS-Lengths, Perimeters, and Areas, Queries, Reclassification, Buffering and Neighborhood Functions, Map Overlay, Spatial Interpolation	4

Textbooks	
1	Chandra, A.M. and Ghosh, 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", - 6th Edition, John Wiley and Sons. 2012
2	Chang, K, "Introduction to Geographical Systems", 4th Edition, Tata McGraw-Hill. 2010

Useful Links	
1	https://nptel.ac.in/noc/courses/noc19/SEM1/noc19-ce08
2	https://nptel.ac.in/noc/courses/noc18/SEM1/noc18-ce10
3	https://www.usgs.gov
4	https://bhuvan.nrsc.gov.in/bhuvan_links.php#

CO-PO Mapping

	Programme Outcomes (PO)												**PSO**	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2													
CO2	3												2	
CO3	3												2	
CO4		2			3								3	3
CO5			2		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)

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Course Information	
Programme	B.Tech. (Computer Science and Engineering)
Class, Semester	Third Year B. Tech., Sem VI
Course Code	5CS332
Course Name	Elective 3: Advanced Computer Network
Desired Requisites:	Computer Networks

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	2 Hrs/week	**MSE**	**ISE**	**ESE**	**Total**
Tutorial	-	30	20	50	100
		Credits: 2			

Course Objectives	
1	Build an understanding of the fundamental concepts of wireless, mobile, ad hoc and Wireless Sensor Networks.
2	Develop an understanding of different components of computer networks, various protocols, routing algorithms, modern technologies and their applications.
3	Introduce the students to advanced networking concepts such as DWDM, WSNs, ATM and MPLS.
4	Allow the student to gain expertise in some specific areas of networking such as Network designing and Management.

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 fundamental concepts of Wireless, Mobile, Ad Hoc, Sensor, Optical and ATM networks operation	II	Understand
CO2	Choose appropriate protocol for desired communication service	III	Apply
CO3	Compare various types of routing protocols	IV	Analyse
CO4	Evaluate advanced network technologies and network protocols	V	Evaluate

Module	**Module Contents**	**Hours**
I	**Wireless and Mobile Networks** Wired communication system, wireless communication system- paging system, cordless telephone system, cellular mobile system, Bluetooth. Wireless Local Area Network (WLAN), Wireless Generations-1G, 2G, 2.5G, 3G, 4G, 5G. Introduction to Cellular mobile Systems-GSM, CDMA. Cellular system design fundamental.	5
II	**Ad Hoc and Wireless Sensor Networks** Ad Hoc Networks-Elements of Ad hoc Wireless Networks, Issues in Ad hoc wireless networks, Example commercial applications of Ad hoc networking, Ad hoc wireless Internet, Issues in Designing a Routing Protocol for Ad Hoc Wireless Networks, Classifications of Routing Protocols, Table Driven Routing Protocols - Destination Sequenced Distance Vector (DSDV), On–Demand Routing protocols –Ad hoc On–Demand Distance Vector Routing (AODV). Wireless Sensor Networks- Challenges for Wireless Sensor Networks, Enabling Technologies for Wireless Sensor Networks, WSN application examples, Network Architecture	5

III	**Optical Networking** SONET/SDH standards, Dense Wavelength division multiplexing (DWDM), Performance and design Considerations	4
IV	**ATM: The WAN Protocol** Faces of ATM, ATM Protocol operations (ATM cell and Transmission) ATM Networking basics, Theory of Operations, B-ISDN reference model, PHY layer, ATM Layer (Protocol model), ATM layer and cell, Traffic Descriptor and parameters, Traffic Congestion control defined, AAL Protocol model, Traffic contract and QoS, User Plane overview, Control Plane AAL, Management Plane, Sub-DS3 ATM, ATM public services.	5
V	**Routing in the Internet** Routing in the Internet: Intra and inter domain routing; Unicast Routing Protocols: RIP, OSPF, BGP; Multicast Routing Protocols: MOSPF, DVMRP, Drawbacks of traditional routing methods, Idea of TE, TE and Different Traffic classes. IP over ATM, Multi-protocol Label switching (MPLS), Storage Area Networks (SAN).	5
VI	**Network Management** SNMP: Concept, Management Components, SMI, MIB, SNMP format, Messages, Backbone Network Design: Backbone Requirements, Network Capacities Topologies, Topologies Strategies, Tuning Network.	4

Textbooks	
1	Darren L Spohn, "Data Network Design", TMH
2	Clint Smith and Daniel Collins , "Wireless networks : design and integration for LTE, EVDO, HSPA, and WiMAX" , McGraw-Hill Education

References	
1	"Computer Networking: A Top-Down Approach featuring the Internet", 3e by James F.Kurose.
2	Peterson and Davie, Computer Networks: A Systems Approach, Morgan Kaufman, 2003, 3rd edition (ISBN: 155860832X).
3	"Ad Hoc Wireless Networks Architectures and Protocols", by C. Siva Ram Murthy, B.S. Manoj

Useful Links	
1	https://www.youtube.com/watch?app=desktop&v=sFhQzxAZzrw
2	https://www.youtube.com/watch?v=Sz1PThotOUQ
3	https://www.youtube.com/watch?v=BuIWNecUAE8

CO-PO Mapping

	Programme Outcomes (PO)												**PSO**	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2	-	-	-	-	-	-	-	-	-	-	3	2
CO2	3	3	-	-	-	-	-	-	-	-	-	-	3	2
CO3	3	2	3	-	-	-	-	-	-	-	-	-	3	2
CO4	3	2	3	-	-	-	-	-	-	-	-	-	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 2022-23

Course Information	
Programme	B.Tech. (Computer Science and Engineering)
Class, Semester	Third Year B. Tech., Sem VI
Course Code	5CS333
Course Name	Elective 3: Deep Learning
Desired Requisites:	Working knowledge of Linear Algebra, Statistics and Probability Theory

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	2 Hrs/week	**MSE**	**ISE**	**ESE**	**Total**
Tutorial	-	30	20	50	100
		Credits: 2			

Course Objectives	
1	To explain the fundamentals of neural networks, recurrent neural networks (RNN), long short term memory cells and convolutional neural networks (CNN).
2	To demonstrate various learning models for practical application.
3	To discuss CNN, RNN and Generative model according to accuracy and speed evaluation parameter's

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 fundamentals of deep learning using foundation of mathematics terminology	II	Understanding
CO2	Compare various deep learning models by hyper tuning various parameters	IV	Analyzing
CO3	Demonstrate various case studies of deep learning.	III	Applying
CO4	Design and deploy deep learning models on various frameworks and platform.	VI	Creating

Module	**Module Contents**	**Hours**
I	**Introduction to Deep Learning** Neural network fundamentals: General Introduction to Deep Learning, Perceptron algorithm, Back propagation and Multi-layer Networks. Image fundamentals: Pixels, Image coordinate, scaling and aspect ratios	5
II	**Parameterized Learning and Optimization Methods** parameterized Learning: Introduction to linear classification, Four components of parameterized learning, role of loss function. Optimization Methods: Optimization Methods: Gradient descent, stochastic gradient descent (SGD) and extensions to SGD, regularization	4
III	**Convolutional Neural Networks (CNN)** Understanding Convolutions: Convolutions versus Cross-correlation, The "Big Matrix" and "Tiny Matrix" Analogy, Kernels, A Hand Computation Example of Convolution The Role of Convolutions in Deep Learning. CNN Building blocks: Layer Types, Convolutional Layers, Activation Layers, Pooling Layers, Fully-connected Layers, Batch Normalization, Dropout, ShallowNEt, LeNet, MiniVGGNET	5
IV	**Deep learning-based object detection** Fundamentals of Object detection, Family of R-CNN, Single shot detectors (SSD), Family of You only look once (YOLO)	4

V	**Sequence Models** Recurrent Neural Networks, Vanishing gradients, Gated Recurrent Units (GRU), Long-short-term-memories (LSTMs), Transformer, Bidirectional Encoder Representations from Transformers (BERT)	4
VI	**Generative Models** Autoencoders, Variational Autoencoders, Generative Adversarial Networks	4

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
3	Prof. Mitesh M. Khapra, "Deep Learning", course on NPTEL, July 2018
4	Andrew Ng, "Deep Learning Specialization", Coursera online course

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

CO-PO Mapping

	Programme Outcomes (PO)												**PSO**	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2	--	--	--	--	--	--	--	--	--	--	--	--	--
CO2	--	2	--	1	--	--	--	--	--	--	--	--	--	--
CO3	--	--	2	--	--	--	--	--	--	--	--	--	--	1
CO4	--	--	3	--	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)

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AY 2022-23

Course Information	
Programme	B.Tech. (Computer Science and Engineering)
Class, Semester	Third Year B. Tech., Sem VI
Course Code	5CS334
Course Name	Elective 3: Soft Computing
Desired Requisites:	

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	2 Hrs/week	**MSE**	**ISE**	**ESE**	**Total**
Tutorial	-	30	20	50	100
		Credits: 2			

Course Objectives	
1	Understand comparative performance of soft and hard computing approaches.
2	Provide to students a sound foundation of mathematical, scientific and engineering principles to formulate, solve and analyse learning problems using soft computing.
3	Imbibe capability for innovation in soft computing.
4	Understand hybrid applications of ANN, Fuzzy and GA

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	Interpret soft computing schemes using knowledge of discrete mathematics, data structures, theory of computer science and computer architectures.	II	Understand
CO2	Demonstrate machine learning processes.	III	Apply
CO3	Compare and analyse soft computing schemes.	IV	Analyze
CO4	Design schemes using soft computing	VI	Create
CO5	Evaluate various schemes of soft computing	V	Evaluate

Module	**Module Contents**	**Hours**
I	**Module 1 Fundamentals of Neural Networks** Basics: Human Brain, Model of Artificial Neuron, Neural Network Architectures, Characteristics of Neural Networks, Learning Methods; McCulloch-Pitts model.	4
II	**Back propagation Networks (BPN)** BPN Architecture, Back propagation learning, applications: Parity Problem, Encoder Decoder, NETtalk and DEC-talk, Character Recognition, Cognitron; CNN, RCNN.	5
III	**Unsupervised Learning** Introductions, ARTI Architecture, ART1 Algorithm, Applications of ART1	4
IV	**Fuzzy Systems** Fuzzy logic: Fuzzy Quantifiers, Fuzzy Inference; Fuzzy Rule Based System; Defuzzification Methods, Applications.	4
V	**Genetic Algorithm** Fundamentals: Biological background, Creation of Offsprings, Working Principle, Encoding, Reproduction ; Mathematical Foundations; Data Structure: Mutation, Crossover, Selection; Applications	6

VI	**Hybrid Systems** Integration of neural networks, fuzzy logic and genetic algorithms: Hybrid Systems; Neuro-Fuzzy hybrids, Neuro-Evolutionary Hybrids, Fuzzy-Evolutionary Hybrids, GA-based BPN, Simplified Fuzzy ARTMAP.	3

Textbooks	
1	"Neural Networks, Fuzzy Logic and Genetic Algorithms",S. Rajasekaran, G.A.VijayalakshmiPai, PHI (ECE).
References	
1	MIT-OCW
2	Hertz, Krogh, Palmer"Introduction to the Theory of Neural Computation"
3	B. Yegnanarayana, PHI, "Artificial Neural Networks"
4	David E. Goldberg, Addison Wesley, "Genetic Algorithms"
Useful Links	
1	https://cse.iitkgp.ac.in/~dsamanta/courses/sca/index.html

CO-PO Mapping

	Programme Outcomes (PO)												**PSO**	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2													
CO2			3										3	
CO3		3		2										
CO4			3										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)

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Course Information

Programme	B.Tech. (Computer Science Engineering)
Class, Semester	Third Year B. Tech., Sem VI
Course Code	5CS372
Course Name	Elective 4 Lab: Software Engineering Tools Laboratory
Desired Requisites:	Software Engineering SDLC, Project Management, Agile Methodology

Teaching Scheme		**Examination Scheme (Marks)**			
Practical	4 Hrs/ Week	**LA1**	**LA2**	**Lab ESE**	**Total**
Interaction	-	30	30	40	100
		Credits: 2			

Course Objectives

1	To Understand the Software Development dearth and Tools practiced in the IT industry.
2	To Comprehend the hands on exploration of various Software frameworks and CASE tools used on SDLC.
3	To cognize with the Testing tools to ensure quality assurance.

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	Be familiar with open source software development tools currently used in the industry.	II	Understand
CO2	Utilize open source software for developing a variety of software applications, particularly Web applications.	III	Apply
CO3	Get acquainted with the use of software tools to achieve quality and industry readiness.	VI	Create

List of Experiments / Lab Activities/Topics

List of Topics(Applicable for Interaction mode):

List of Lab Activities:

1. Overview of FOSS.
2. Study of different software development frameworks.
3. Study of project management tools (e.g Jira).
4. Understanding version control using VSS.
5. Managing code using SVN.
6. Performing Functional testing
7. Performing regression testing
8. Performing performance testing
9. Study of Deployment and Integration tools.
10. Study of various software engineering tools (e.g CircleCI, Maven, Gradle).

Textbooks

1	Dr.K.V.K.K.Prasad, "Software Testing Tools"
2	Desikan, Ramesh, "Software Testing: principles and Practices", Pearson Education, ISBN

References

1	Nina Godbole, "Software Quality Assurance: Principles And Practice", Alpha Science International, Ltd (August 1, 2004)

Useful Links	
1	https://www.javatpoint.com/software-engineering-case-tools-for-software-metrics
2	https://www.javatpoint.com/github
3	https://www.javatpoint.com/software-testing-tutorial

CO-PO Mapping

	Programme Outcomes (PO)												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2	2											1	
CO2					2									
CO3				2		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.

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Course Information

Programme	B.Tech. (Computer Science Engineering)
Class, Semester	Third Year B. Tech., Sem VI
Course Code	5CS373
Course Name	Elective 4 Lab: Advanced Web and Mobile Application Development Lab
Desired Requisites:	Programming Lab-3

Teaching Scheme		**Examination Scheme (Marks)**			
Practical	4 Hrs/ Week	**LA1**	**LA2**	**Lab ESE**	**Total**
Interaction	-	30	30	40	100
		Credits: 2			

Course Objectives

1	to inculcate understanding of state-of-the-art front-end and back-end development frameworks of web programming and mobile app development tools.
2	to introduce selection of appropriate concepts from different state-of-the-art frameworks/libraries and tools for developing a web and mobile app.
3	to infuse skills of combining different components from state-of-the-art technologies to design a web and mobile app to solve 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	summarize the concepts of various state-of-the-art front-end, back-end web and mobile app development technologies & frameworks.	II	Understanding
CO2	illustrate the concepts of various state-of-the-art front-end, back-end web and mobile app development technologies & frameworks using different web development tools.	III	Applying
CO3	test the concepts and components of various state-of-the-art front-end, back-end web and mobile app development technologies & frameworks using web development tools.	IV	Analysing
CO4	select appropriate front-end, back-end web and mobile app development technologies, frameworks, tools and their components to solve real-world problems.	V	Evaluating
CO5	build a web app and/or mobile app, individually or in a team by combining various state-of-the-art front-end, back-end and/or mobile app development technologies & frameworks for real-world problems.	VI	Creating

List of Experiments / Lab Activities/Topics

List of Topics(Applicable for Interaction mode):

List of Lab Activities:

Module 1: Web Application Framework/Library – Part 1

State-of-the-art Front-End Framework library: One of the following technologies will be considered:Angular, React.js or other state-of-the-art front-end development framework/library.

Experiments:

1. Installing framework and configuring Integrated Development Environment (IDE), and its dependencies.
2. Creating workspace, project and setting up the necessary environment.
3. Implementing the fundamental syntaxes and components of the framework.
4. Building and testing the application.
5. Deploying the application.

Module 2: Web Application Framework/Library – Part 2

State-of-the-art Front-End Framework library: One of the following technologies will be considered:Meteor.js, Vue.js or other state-of-the-art front-end development framework/library.

Experiments:

1. Installing framework and configuring Integrated Development Environment (IDE), and its dependencies.
2. Creating workspace, project and setting up the necessary environment.
3. Implementing the fundamental syntaxes and components of the framework.
4. Building and testing the application.
5. Deploying the application.

Module 3: Server-side Development Framework/Library – Part 1

State-of-the-art server-side Technology: Ruby on Rails, Flask or other state-of-the-art back-end development framework/library.

Experiments:

1. Installing framework and configuring Integrated Development Environment (IDE), and its dependencies.
2. Creating workspace, project and setting up the necessary environment.
3. Implementing the fundamental syntaxes and components of the framework.
4. Implementing server-side validations and authentication for web application.
5. Implementing CRUD operations for web application.
6. Building and testing the application.
7. Deploying the application.

Module 4: Server-side Development Framework/Library – Part 2

State-of-the-art server-side Technology: Django or another state-of-the-art framework/library.

Experiments:

1. Installing framework and configuring Integrated Development Environment (IDE), and its dependencies.
2. Creating workspace, project and setting up the necessary environment.
3. Implementing the fundamental syntaxes and components of the framework.
4. Implementing server-side validations and authentication for web application.
5. Implementing CRUD operations for web application.
6. Building and testing the application.
7. Deploying the application.

Module 5: Mobile App Development

Introduction to App Development, Introduction to Android App Development, Installation and configuration of IDE, Activities, Intents and Intent Filters, UI and Navigation, Camera, Connectivity to database, Web-based content, debugging and testing the app, and publishing the app.

Experiments:

1. Installing and configuring Integrated Development Environment (IDE).
2. Managing the project.
3. Writing the app.
4. Connecting the app to the database.
5. Building and running the app on an emulator and on a hardware device.
6. Configuring, debugging, testing, and profiling the app.
7. Publishing the app on the marketplace.

Module 6: Hosting Web Applications

Building web application and Hosting web application.

Experiments:

1. Choosing a hosting server and selecting a plan for web hosting.
2. Choosing and configuring DNS address.
3. Uploading, configuring and running the website over the internet.

Textbooks	
1	Vasan Subramanian, “Pro MERN Stack: Full Stack Web App Development with Mongo, Express, React, and Node”, Apress, 2nd Edition, 2019, ISBN-13: 978-1484243909
2	Azat Mardan, “Full Stack JavaScript: Learn Backbone.js, Node.js, and MongoDB”, Apress,2nd Edition, 2018, ISBN-13: 978-1484237175
3	Neil Smyth, “Android Studio 3.6 Development Essentials - Java Edition: Developing Android 10 (Q) Apps Using Android Studio 3.6, Java and Android Jetpack”, Payload Media, 2020,ISBN-13: 978-1951442156
References	
1	Dawn Griffiths, David Griffiths, “Head First Android Development”, O’Reilly Media, 2nd Edition, 2017, ISBN: 9781491974056
2	Rick Boyer, “Android 9 Development Cookbook: Over 100 recipes and solutions to solve the most common problems faced by Android developers”, Packt Publishing Limited, 3rd Edition, 2018, ISBN-13: 978-1788991216
3	Felipe Coury, Ari Lerner, Carlos Taborda, “ng-book: The Complete Guide to Angular”, Create Space Independent Publishing Platform, 5th Edition, 2018, ISBN-13: 978-1985170285
Useful Links	
1	www.w3schools.com
2	https://developer.android.com/docs
3	Official framework websites for Documentation/Help

CO-PO Mapping														
	Programme Outcomes (PO)												**PSO**	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2	1												1
CO2	3	2	2	3										2
CO3		3		2										1
CO4		2		2										1
CO5			3	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				
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 2022-23

Course Information	
Programme	B.Tech. (Computer Science and Engineering)
Class, Semester	Third Year B. Tech., Sem VI
Course Code	5OE378
Course Name	Open Elective-3: Fundamentals of IOT
Desired Requisites:	Basic programming knowledge

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	2 Hrs/week	**MSE**	**ISE**	**ESE**	**Total**
Tutorial	-	30	20	50	100
		Credits: 2			

Course Objectives	
1	To illustrate the basic concepts of Internet of Things.
2	To illustrate basic concepts of IIOT.
3	To demonstrate Working of IOT devices.

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 how to design and develop Applications in IOT.	III	Apply
CO2	To Illustrate how IOT devices works	III	Apply
CO3	To access different operations using IOT applications.	V	Evaluate
CO4	To produce a program to solve a real-world problem.	VI	Create

Module	**Module Contents**	**Hours**
I	Introduction to Internet of Things Introduction, Physical design of IOT, Logical Design of IOT,IOT Enabling Technology, Sensing, Actuation	4
II	Basics of IOT Networking Introduction to Networking, IOT Network Protocols, Connectivity Technology	5
III	IOT and Communication Protocols Communication Protocols, Sensor Networks, Machine-to-Machine Communications .	5
IV	Interoperability in IoT Introduction to Arduino Programming, Introduction to Python programming, Introduction to Raspberry Pi, Implementation of IoT with Raspberry Pi.	4
V	Industrial IoT Introduction to IIOT,AWS-IOT, Introduction to Lora-wan, Node MCU IOT Platform	4
VI	Case Study Agriculture, Health care, Smart city, Activity Monitoring, Energy, Environment	4

Textbooks

1	S. Misra, A. Mukherjee, and A. Roy, 2020. Introduction to IoT. Cambridge University Press.
2	S. Misra, C. Roy, and A. Mukherjee, 2020. Introduction to Industrial Internet of Things and Industry 4.0. CRC Press.
3	Research Papers

References	
1	Arashdeep Bahga ,Vijay Madisetti Internet of Things an Hands on Approach,University Press.
Useful Links	
1	https://onlinecourses.nptel.ac.in/noc21_cs17

CO-PO Mapping														
	Programme Outcomes (PO)												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1		2	3											2
CO2	1		2											2
CO3	1	2	2											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 2022-23

Course Information	
Programme	B.Tech. (Computer Science and Engineering)
Class, Semester	Third Year B. Tech., Sem VI
Course Code	5OE379
Course Name	Open Elective-4: Artificial Intelligence and Machine Learning
Desired Requisites:	Introductory Programming knowledge, 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	Introduce and apply Principles of Artificial Intelligence.
2	Introduce and apply Principles of Machine Learning.

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 AI and ML Problems and its simple solutions.	III	Apply
CO2	Compare simple solutions for AI and ML problems.	IV	Analyze
CO3	Classify various AI and ML problem solving schemes.	V	Evaluate

Module	**Module Contents**	**Hours**
I	**Introduction to AI and Problem Solving** Introduction, History, Application, Approaches, Problem solving by searching, Constraint satisfaction problems.	7
II	**Knowledge Representation, Logic and Reasoning** Propositional Logic, Inference rules, First Order Logic, Rule based systems, Reasoning with uncertainty, Fuzzy reasoning, Bayes networks.	7
III	**Expert Systems** ES Characteristics, Architecture, Rule based ES, Rule Induction, Introduction to Natural Language Processing.	6
IV	**Introduction to Machine Learning** Introduction to Machine Learning, Concepts of Supervised and Unsupervised Learning,Linear and Multivariate Regression.	6
V	**Classification and Unsupervised learning** Decision Trees, Logistic regression, Unsupervised learning-Clustering, K-means clustering, Dimensionality Reduction-PCA.	7
VI	**Evaluation Measures and Reinforcement learning** Evaluation Measures, ROC curve, Introduction to reinforcement learning, Case Study.	6

Textbooks

1	Elaine Rich and Kelvin Knight, Nair, "Artificial Intelligence," McGraw Hill Publication.
2	Janakiraman et al., "Foundations of Artificial Intelligence and Expert Systems", MacMillan India.
3	Tom M. Mitchell, Machine Learning, McGraw-Hill.

References	
1	NPTEL course on Introduction to AI.
2	NPTEL course on Introduction to Machine Learning.
Useful Links	
1	Artificial Intelligence Search Methods for Problem Solving (SWAYAM): https://onlinecourses.nptel.ac.in/noc21_cs79/preview
2	Introduction to Artificial Intelligence (AI) (Coursera): https://www.coursera.org/learn/introduction-to-ai
3	https://ai.google/education/
4	Machine Learning by Stanford (Andrew Ng) on Coursera: https://www.coursera.org/learn/machine-learning
5	Introduction to Machine Learning – IITM (SWAYAM) https://onlinecourses.nptel.ac.in/noc21_cs70/preview

CO-PO Mapping

	Programme Outcomes (PO)												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3												1	
CO2		3											1	
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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.

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The assessment is based on MSE, ISE and ESE.
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