

V Semester

AUTOMATA THEORY AND COMPILER DESIGN			
Course Code	21CS51	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03
Course Learning Objectives			
CLO 1. Introduce the fundamental concepts of Automata Theory, Formal Languages and compiler design CLO 2. Principles Demonstrate Application of Automata Theory and Formal Languages in the field of compiler design CLO 3. Develop understanding of computation through Push Down Automata and Turing Machines CLO 4. Introduce activities carried out in different phases of Phases compiler CLO 5. Identify the undecidability problems.			
Teaching-Learning Process (General Instructions)			
These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.			
<ol style="list-style-type: none">1. Lecturer method (L) needs not to be only a traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.2. Use of Video/Animation to explain functioning of various concepts.3. Encourage collaborative (Group Learning) Learning in the class.4. Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyze information rather than simply recall it.6. Introduce Topics in manifold representations.7. Show the different ways to solve the same problem with different approaches and encourage the students to come up with their own creative ways to solve them.8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.			
Module-1			
Introduction to Automata Theory: Central Concepts of Automata theory, Deterministic Finite Automata(DFA), Non- Deterministic Finite Automata(NFA) ,Epsilon- NFA, NFA to DFA Conversion, Minimization of DFA			
Introduction to Compiler Design: Language Processors, Phases of Compilers			
Textbook 1: Chapter1 – 1.5, Chapter2 – 2.2,2.3,2.5 Chapter4 –4.4			
Textbook 2: Chapter1 – 1.1 and 1.2			
Teaching-Learning Process	Chalk and board, Active Learning, Problem based learning		
Module-2			
Regular Expressions and Languages: Regular Expressions, Finite Automata and Regular Expressions, Proving Languages Not to Be Regular			
Lexical Analysis Phase of compiler Design: Role of Lexical Analyzer, Input Buffering , Specification of Token, Recognition of Token.			
Textbook 1: Chapter3 – 3.1, 3.2, Chapter4- 4.1			

Textbook 2: Chapter3- 3.1 to 3.4	
Teaching-Learning Process	Chalk and board, Active Learning, Demonstration
Module-3	
Context Free Grammars: Definition and designing CFGs, Derivations Using a Grammar, Parse Trees, Ambiguity and Elimination of Ambiguity, Elimination of Left Recursion, Left Factoring. Syntax Analysis Phase of Compilers: part-1: Role of Parser , Top-Down Parsing Textbook 1: Chapter 5 – 5.1.1 to 5.1.6, 5.2 (5.2.1, 5.2.2), 5.4 Textbook 2: Chapter 4 – 4.1, 4.2, 4.3 (4.3.2 to 4.3.4) ,4.4	
Teaching-Learning Process	Chalk and board, Problem based learning, Demonstration
Module-4	
Push Down Automata: Definition of the Pushdown Automata, The Languages of a PDA. Syntax Analysis Phase of Compilers: Part-2: Bottom-up Parsing, Introduction to LR Parsing: SLR, More Powerful LR parsers Textbook1: Chapter 6 – 6.1, 6.2 Textbook2: Chapter 4 – 4.5, 4.6, 4.7 (Up to 4.7.4)	
Teaching-Learning Process	Chalk & board, Problem based learning
Module-5	
Introduction to Turing Machine: Problems that Computers Cannot Solve, The Turing machine, problems, Programming Techniques for Turing Machine, Extensions to the Basic Turing Machine Undecidability : A language That Is Not Recursively Enumerable, An Undecidable Problem That Is RE. Other Phases of Compilers: Syntax Directed Translation- Syntax-Directed Definitions, Evaluation Orders for SDD's. Intermediate-Code Generation- Variants of Syntax Trees, Three-Address Code. Code Generation- Issues in the Design of a Code Generator Textbook1: Chapter 8 – 8.1, 8.2,8.3,8.4 Chapter 9 – 9.1,9.2 Textbook2: Chapter 5 – 5.1, 5.2, Chapter 6- 6.1,6.2 Chapter 8- 8.1	
Teaching-Learning Process	Chalk and board, MOOC
Course Outcomes At the end of the course the student will be able to: CO 1. Acquire fundamental understanding of the core concepts in automata theory and Theory of Computation CO 2. Design and develop lexical analyzers, parsers and code generators CO 3. Design Grammars and Automata (recognizers) for different language classes and become knowledgeable about restricted models of Computation (Regular, Context Free) and their relative powers. CO 4. Acquire fundamental understanding of the structure of a Compiler and Apply concepts automata theory and Theory of Computation to design Compilers CO 5. Design computations models for problems in Automata theory and adaptation of such model in the field of compilers	
Assessment Details (both CIE and SEE) The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination	

(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks (duration 01 hour)**

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

1. First assignment at the end of 4th week of the semester
2. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks (duration 01 hours)**

1. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have a less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper has to be designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours**)

1. The question paper will have ten questions. Each question is set for 20 marks.
 2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
 3. The students have to answer 5 full questions, selecting one full question from each module
- Marks scored shall be proportionally reduced to 50 marks

Suggested Learning Resources:

Textbooks

1. John E Hopcroft, Rajeev Motwani, Jeffrey D. Ullman, "Introduction to Automata Theory, Languages and Computation", Third Edition, Pearson.
2. Alfred V.Aho, Monica S.Lam, Ravi Sethi, Jeffrey D. Ullman, "Compilers Principles, Techniques and Tools", Second Edition, Pearson.

Reference:

1. Elain Rich, "Automata, Computability and complexity", 1st Edition, Pearson Education, 2018.
2. K.L.P Mishra, N Chandrashekar, 3rd Edition, "Theory of Computer Science", PHI, 2012.
3. Peter Linz, "An introduction to Formal Languages and Automata", 3rd Edition, Narosa Publishers, 1998.
4. K Muneeswaran, "Compiler Design", Oxford University Press 2013.

Weblinks and Video Lectures (e-Resources):

1. <https://nptel.ac.in/courses/106/106/106106049/#>
2. <https://nptel.ac.in/courses/106/104/106104123/>
3. <https://www.jflap.org/>

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

Group Activities, quizzes, Puzzles and presentations

V Semester

COMPUTER NETWORKS			
Course Code:	21CS52	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:2:0	SEE Marks	50
Total Hours of Pedagogy	40T + 20P	Total Marks	100
Credits	04	Exam Hours	03
Course Objectives: CLO 1. Fundamentals of data communication networks. CLO 2. Software and hardware interfaces CLO 3. Application of various physical components and protocols CLO 4. Communication challenges and remedies in the networks.			
Teaching-Learning Process (General Instructions) These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes. <div><div>1.</div><div>Lecturer method (L) need not to be only traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.</div></div> <div><div>2.</div><div>Use of Video/Animation to explain functioning of various concepts.</div></div> <div><div>3.</div><div>Encourage collaborative (Group Learning) Learning in the class.</div></div> <div><div>4.</div><div>Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.</div></div> <div><div>5.</div><div>Adopt Problem Based Learning (PBL), which fosters students’ Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyze information rather than simply recall it.</div></div> <div><div>6.</div><div>Introduce Topics in manifold representations.</div></div> <div><div>7.</div><div>Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.</div></div> <div><div>8.</div><div>Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.</div></div>			
Module-1			
Introduction to networks: Network hardware, Network software, Reference models,			
Physical Layer: Guided transmission media, Wireless transmission			
Textbook 1: Ch.1.2 to 1.4, Ch.2.2 to 2.3			
Laboratory Component: <div><div>1.</div><div>Implement Three nodes point – to – point network with duplex links between them for different topologies. 1Set the queue size, vary the bandwidth, and find the number of packets dropped for various iterations.</div></div>			
Teaching-Learning Process	Chalk and board, Problem based learning, Demonstration		
Module-2			
The Data link layer: Design issues of DLL, Error detection and correction, Elementary data link protocols, Sliding window protocols.			
The medium access control sublayer: The channel allocation problem, Multiple access protocols.			
Textbook 1: Ch.3.1 to 3.4, Ch.4.1 and 4.2			
Laboratory Component: <div><div>1.</div><div>Implement simple ESS and with transmitting nodes in wire-less LAN by simulation and determine the throughput with respect to transmission of packets</div></div> <div><div>2.</div><div>Write a program for error detecting code using CRC-CCITT (16- bits).</div></div>			

Teaching-Learning Process	Chalk and board, Problem based learning, Demonstration
Module-3	
The Network Layer: Network Layer Design Issues, Routing Algorithms, Congestion Control Algorithms, QoS.	
Textbook 1: Ch 5.1 to 5.4	
Laboratory Component: <ol style="list-style-type: none"> 1. Implement transmission of ping messages/trace route over a network topology consisting of 6 nodes and find the number of packets dropped due to congestion in the network. 2. Write a program to find the shortest path between vertices using bellman-ford algorithm. 	
Teaching-Learning Process	Chalk and board, Problem based learning, Demonstration
Module-4	
The Transport Layer: The Transport Service, Elements of transport protocols, Congestion control, The internet transport protocols.	
Textbook 1: Ch 6.1 to 6.4 and 6.5.1 to 6.5.7	
Laboratory Component: <ol style="list-style-type: none"> 1. Implement an Ethernet LAN using n nodes and set multiple traffic nodes and plot congestion window for different source / destination. 2. Write a program for congestion control using leaky bucket algorithm. 	
Teaching-Learning Process	Chalk and board, Problem based learning, Demonstration
Module-5	
Application Layer: Principles of Network Applications, The Web and HTTP, Electronic Mail in the Internet, DNS—The Internet's Directory Service.	
Textbook 2: Ch 2.1 to 2.4	
Teaching-Learning Process	Chalk and board, Problem based learning, Demonstration
Course Outcomes (Course Skill Set) At the end of the course the student will be able to: <ul style="list-style-type: none"> CO 1. Learn the basic needs of communication system. CO 2. Interpret the communication challenges and its solution. CO 3. Identify and organize the communication system network components CO 4. Design communication networks for user requirements. 	
Assessment Details (both CIE and SEE) The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together	
Continuous Internal Evaluation: Three Unit Tests each of 20 Marks (duration 01 hour) <ol style="list-style-type: none"> 1. First test at the end of 5th week of the semester 2. Second test at the end of the 10th week of the semester 3. Third test at the end of the 15th week of the semester Two assignments each of 10 Marks <ol style="list-style-type: none"> 4. First assignment at the end of 4th week of the semester 5. Second assignment at the end of 9th week of the semester Practical Sessions need to be assessed by appropriate rubrics and viva-voce method. This will contribute to 20 marks .	

- Rubrics for each Experiment taken average for all Lab components – 15 Marks.
- Viva-Voce– 5 Marks (more emphasized on demonstration topics)

The sum of three tests, two assignments, and practical sessions will be out of 100 marks and will be **scaled down to 50 marks**

(to have a less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper has to be designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours**)

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module
Marks scored shall be proportionally reduced to 50 marks

Suggested Learning Resources:

Textbooks:

1. Computer-Networks- Andrew S. Tanenbaum and David J. Wetherall, Pearson Education, 5th-Edition. (www.pearsonhighered.com/tanenbaum)
2. Computer Networking A Top-Down Approach -James F. Kurose and Keith W. RossPearson Education 7th Edition.

Reference Books:

1. Behrouz A Forouzan, Data and Communications and Networking, Fifth Edition, McGraw Hill,Indian Edition
2. Larry L Peterson and Bruce S Davie, Computer Networks, fifth edition, ELSEVIER

Weblinks and Video Lectures (e-Resources):

1. <https://www.digimat.in/nptel/courses/video/106105183/L01.html>
2. <http://www.digimat.in/nptel/courses/video/106105081/L25.html>
3. <https://nptel.ac.in/courses/106105081>
4. VTU e-Shikshana Program

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

Simulation of Personal area network, Home area network, achieve QoS etc.

Note: For the Simulation experiments modify the topology and parameters set for the experiment and take multiple rounds of reading and analyze the results available in log files. Plot necessary graphs and conclude using NS2. Installation procedure of the required software must be demonstrated, carried out in groups, and documented in the report. Non simulation programs can be implemented using Java

V Semester

DATABASE MANAGEMENT SYSTEMS			
Course Code	21CS53	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03
Course Learning Objectives CLO 1. Provide a strong foundation in database concepts, technology, and practice. CLO 2. Practice SQL programming through a variety of database problems. CLO 3. Demonstrate the use of concurrency and transactions in database CLO 4. Design and build database applications for real world problems.			
Teaching-Learning Process (General Instructions) These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes. <ol style="list-style-type: none">1. Lecturer method (L) need not to be only a traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.2. Use of Video/Animation to explain functioning of various concepts.3. Encourage collaborative (Group Learning) Learning in the class.4. Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyze information rather than simply recall it.6. Introduce Topics in manifold representations.7. Show the different ways to solve the same problem with different circuits/logic and encourage the students to come up with their own creative ways to solve them.8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.			
Module-1			
Introduction to Databases: Introduction, Characteristics of database approach, Advantages of using the DBMS approach, History of database applications.			
Overview of Database Languages and Architectures: Data Models, Schemas, and Instances. Three schema architecture and data independence, database languages, and interfaces, The Database System environment.			
Conceptual Data Modelling using Entities and Relationships: Entity types, Entity sets, attributes, roles, and structural constraints, Weak entity types, ER diagrams, Examples			
Textbook 1: Ch 1.1 to 1.8, 2.1 to 2.6, 3.1 to 3.7			
Teaching-Learning Process	Chalk and board, Active Learning, Problem based learning		
Module-2			
Relational Model: Relational Model Concepts, Relational Model Constraints and relational database schemas, Update operations, transactions, and dealing with constraint violations.			
Relational Algebra: Unary and Binary relational operations, additional relational operations (aggregate, grouping, etc.) Examples of Queries in relational algebra.			
Mapping Conceptual Design into a Logical Design: Relational Database Design using ER-to-Relational			

mapping.

Textbook 1:, Ch 5.1 to 5.3, 8.1 to 8.5, 9.1;

Teaching-Learning Process

Chalk and board, Active Learning, Demonstration

Module-3

SQL: SQL data definition and data types, specifying constraints in SQL, retrieval queries in SQL, INSERT, DELETE, and UPDATE statements in SQL, Additional features of SQL.

Advances Queries: More complex SQL retrieval queries, Specifying constraints as assertions and action triggers, Views in SQL, Schema change statements in SQL.
Database

Application Development: Accessing databases from applications, An introduction to JDBC, JDBC classes and interfaces, SQLJ, Stored procedures, Case study: The internet Bookshop.

Textbook 1: Ch 6.1 to 6.5, 7.1 to 7.4; Textbook 2: 6.1 to 6.6;

Teaching-Learning Process

Chalk and board, Problem based learning, Demonstration

Module-4

Normalization: Database Design Theory – Introduction to Normalization using Functional and Multivalued Dependencies: Informal design guidelines for relation schema, Functional Dependencies, Normal Forms based on Primary Keys, Second and Third Normal Forms, Boyce-Codd Normal Form, Multivalued Dependency and Fourth Normal Form, Join Dependencies and Fifth Normal Form. Examples on normal forms.

Normalization Algorithms: Inference Rules, Equivalence, and Minimal Cover, Properties of Relational Decompositions, Algorithms for Relational Database Schema Design, Nulls, Dangling tuples, and alternate Relational Designs, Further discussion of Multivalued dependencies and 4NF, Other dependencies and Normal Forms

Textbook 1: Ch 14.1 to -14.7, 15.1 to 15.6

Teaching-Learning Process

Chalk& board, Problem based learning

Module-5

Transaction Processing: Introduction to Transaction Processing, Transaction and System concepts, Desirable properties of Transactions, Characterizing schedules based on recoverability, Characterizing schedules based on Serializability, Transaction support in SQL.

Concurrency Control in Databases: Two-phase locking techniques for Concurrency control, Concurrency control based on Timestamp ordering, Multiversion Concurrency control techniques, Validation Concurrency control techniques, Granularity of Data items and Multiple Granularity Locking.

Textbook 1: Ch 20.1 to 20.6, 21.1 to 21.7;

Teaching-Learning Process

Chalk and board, MOOC

Course Outcomes

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

- CO 1. Identify, analyze and define database objects, enforce integrity constraints on a database using RDBMS
- CO 2. Use Structured Query Language (SQL) for database manipulation and also demonstrate the basic of query evaluation.
- CO 3. Design and build simple database systems and *relate* the concept of transaction, concurrency control and recovery in database
- CO 4. Develop application to interact with databases, relational algebra expression.
- CO 5. Develop applications using tuple and domain relation expression from queries.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks (duration 01 hour)**

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

4. First assignment at the end of 4th week of the semester
5. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks (duration 01 hours)**

6. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper has to be designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours**)

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.
4. Marks scored shall be proportionally reduced to 50 marks

Suggested Learning Resources:**Textbooks**

1. Fundamentals of Database Systems, Ramez Elmasri and Shamkant B. Navathe, 7th Edition, 2017, Pearson.
2. Database management systems, Ramakrishnan, and Gehrke, 3rd Edition, 2014, McGraw Hill

Reference Books:

1. Abraham Silberschatz, Henry F. Korth and S. Sudarshan's Database System Concepts 6th Edition Tata Mcgraw Hill Education Private Limited

Weblinks and Video Lectures (e-Resources):

1. <https://www.youtube.com/watch?v=3EJlovevfcA>
2. <https://www.youtube.com/watch?v=9TwMRs3qTcU>
3. <https://www.youtube.com/watch?v=ZWl0Xow304I>
4. <https://www.youtube.com/watch?v=4YilEjkNPrQ>
5. <https://www.youtube.com/watch?v=CZTkgMoqVss>
6. <https://www.youtube.com/watch?v=Hl4NZB1XR9c>
7. https://www.youtube.com/watch?v=EGEwkad_lIA
8. <https://www.youtube.com/watch?v=t5hsV9lC1rU>

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

Demonstration of real time Database projects - E-commerce Platform, Inventory Management, Railway System, College Data Management, Library Data Management, Solution for Saving Student Records, Hospital Data Management, Blood Donation Management.

PRINCIPLES OF ARTIFICIAL INTELLIGENCE			
Course Code	21AI54	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03
Course Learning Objectives CLO 1. Gain a historical perspective of AI and its foundations CLO 2. Become familiar with basic principles of AI toward problem solving CLO 3. Get to know approaches of inference, perception, Uncertain Knowledge and Reasoning			
Teaching-Learning Process (General Instructions) These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes. <ol style="list-style-type: none">1. Lecturer method (L) does not mean only traditional lecture method, but different type of teaching methods may be adopted to develop the outcomes.2. Show Video/animation films to explain functioning of various concepts.3. Encourage collaborative (Group Learning) Learning in the class.4. Ask at least three HOTS (Higher order Thinking) questions in the class, which promotes critical thinking.5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyze information rather than simply recall it.6. Topics will be introduced in a multiple representation.7. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.			
Module-1			
Introduction: What is AI? Foundations and History of AI Intelligent Agents: Agents and environment, Concept of Rationality, The nature of environment, The structure of agents. Text book 1: Chapter 1- 1.1, 1.2, 1.3 Chapter 2- 2.1, 2.2, 2.3, 2.4			
Teaching-Learning Process	Chalk and board, Active Learning.		
Module-2			
Problem-solving: Problem-solving agents, Example problems, Searching for Solutions Uninformed Search Strategies: Breadth First search, Depth First Search, Iterative deepening depth first search; Text book 1: Chapter 3- 3.1, 3.2, 3.3, 3.4			
Teaching-Learning Process	Chalk and board, Active Learning, Demonstration		
Module-3			
Informed Search Strategies: Heuristic functions, Greedy best first search, A*search. Heuristic Functions Logical Agents: Knowledge-based agents, The Wumpus world, Logic, Propositional logic, Reasoning patterns in Propositional Logic Text book 1: Chapter 4 – 4.1, 4.2 Chapter 7- 7.1, 7.2, 7.3, 7.4, 7.5			
Teaching-Learning	Chalk and board, Problem based learning, Demonstration		

Process	
Module-4	
First Order Logic: Representation Revisited, Syntax and Semantics of First Order logic, Using First Order logic. Inference in First Order Logic : Propositional Versus First Order Inference, Unification, Forward Chaining, Backward Chaining, Resolution	
Text book 1: Chapter 8- 8.1, 8.2, 8.3 Chapter 9- 9.1, 9.2, 9.3, 9.4, 9.5	
Teaching-Learning Process	Chalk and board, Problem based learning, Demonstration
Module-5	
Uncertain Knowledge and Reasoning: Quantifying Uncertainty: Acting under Uncertainty, Basic Probability Notation, Inference using Full Joint Distributions, Independence, Baye's Rule and its use. Wumpus World Revisited	
Text Book 1: Chapter 13-13.1, 13.2, 13.3, 13.4, 13.5, 13.6	
Teaching-Learning Process	Chalk and board, Active Learning.
Course Outcomes At the end of the course the student will be able to: CO 1. Apply knowledge of agent architecture, searching and reasoning techniques for different applications. CO 2. Analyse Searching and Inferencing Techniques. CO 3. Develop knowledge base sentences using propositional logic and first order logic CO 4. Demonstrating agents, searching and inferencing CO 5. Illustrate the application of probability in uncertain reasoning.	
Assessment Details (both CIE and SEE) The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together Continuous Internal Evaluation: Three Unit Tests each of 20 Marks (duration 01 hour) <ol style="list-style-type: none"> 1. First test at the end of 5th week of the semester 2. Second test at the end of the 10th week of the semester 3. Third test at the end of the 15th week of the semester Two assignments each of 10 Marks <ol style="list-style-type: none"> 4. First assignment at the end of 4th week of the semester 5. Second assignment at the end of 9th week of the semester Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for 20 Marks (duration 01 hours) OR Suitable Programming experiments based on the syllabus contents can be given to the students to submit the same as laboratory work(for example; Implementation of concept learning, implementation of decision tree learning algorithm for suitable data set, etc...) <ol style="list-style-type: none"> 6. At the end of the 13th week of the semester The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and	

will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper has to be designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours**)

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module. Marks scored shall be proportionally reduced to 50 marks

Suggested Learning Resources:

Text Books

1. Stuart J. Russell and Peter Norvig , Artificial Intelligence, 3rd Edition, Pearson,2015

Reference:

1. Elaine Rich, Kevin Knight, Artificial Intelligence, 3rd edition,Tata McGraw Hill,2013
2. George F Lugar, Artificial Intelligence Structure and strategies for complex, Pearson Education, 5th Edition, 2011

Web links and Video Lectures (e-Resources):

1. <https://www.kdnuggets.com/2019/11/10-free-must-read-books-ai.html>
2. <https://www.udacity.com/course/knowledge-based-ai-cognitive-systems--ud409>
3. <https://nptel.ac.in/courses/106/105/106105077/>

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

Role play for strategies – DFS & BFS, Reasoning and Uncertainty problems - reliability of sensor used to detect pedestrians using Bayes Rule , A teacher does not know exactly what a student understand etc.

V Semester

DATABASE MANAGEMENT SYSTEMS LABORATORY WITH MINI PROJECT			
Course Code	21CSL55	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	0:0:2:0	SEE Marks	50
Total Hours of Pedagogy	24	Total Marks	100
Credits	01	Exam Hours	03
Course Learning Objectives: CLO 1. Foundation knowledge in database concepts, technology and practice to groom students into well-informed database application developers. CLO 2. Strong practice in SQL programming through a variety of database problems. CLO 3. Develop database applications using front-end tools and back-end DBMS..			
Sl. No.	PART-A: SQL Programming (Max. Exam Marks. 50) Design, develop, and implement the specified queries for the following problems using Oracle, MySQL, MS SQL Server, or any other DBMS under LINUX/Windows environment. Create Schema and insert at least 5 records for each table. Add appropriate database constraints.		
1	Aim: Demonstrating creation of tables, applying the view concepts on the tables. Program: Consider the following schema for a Library Database: BOOK(Book_id, Title, Publisher_Name, Pub_Year) BOOK_AUTHORS(Book_id, Author_Name) PUBLISHER(Name, Address, Phone) BOOK_COPIES(Book_id, Programme_id, No-of_Copies) BOOK_LENDING(Book_id, Programme_id, Card_No, Date_Out, Due_Date) LIBRARY_PROGRAMME(Programme_id, Programme_Name, Address) Write SQL queries to 1. Retrieve details of all books in the library – id, title, name of publisher, authors, number of copies in each Programme, etc. 2. Get the particulars of borrowers who have borrowed more than 3 books, but from Jan 2017 to Jun 2017. 3. Delete a book in BOOK table. Update the contents of other tables to reflect this data manipulation operation. 4. Partition the BOOK table based on year of publication. Demonstrate its working with a simple query. 5. Create a view of all books and its number of copies that are currently available in the Library. Reference: https://www.youtube.com/watch?v=AaSU-AOguls https://www.youtube.com/watch?v=-EwEvJxS-Fw		
2	Aim: Discuss the various concepts on constraints and update operations. Program: Consider the following schema for Order Database: SALESMAN(Salesman_id, Name, City, Commission) CUSTOMER(Customer_id, Cust_Name, City, Grade, Salesman_id) ORDERS(Ord_No, Purchase_Amt, Ord_Date, Customer_id, Salesman_id) Write SQL queries to Count the customers with grades above Bangalore's average. 2. Find the name and numbers of all salesman who had more than one customer. 3. List all the salesman and indicate those who have and don't have customers in their cities (Use UNION operation.) 4. Create a view that finds the salesman who has the customer with the highest order of a day. 5. Demonstrate the DELETE operation by removing salesman with id 1000. All his orders must also be deleted. Reference: https://www.youtube.com/watch?v=AA-KL1jbMeY		

	https://www.youtube.com/watch?v=7S_tz1z_5bA
3	<p>Aim: Demonstrate the concepts of JOIN operations.</p> <p>Program: Consider the schema for Movie Database: ACTOR(Act_id, Act_Name, Act_Gender) DIRECTOR(Dir_id, Dir_Name, Dir_Phone) MOVIES(Mov_id, Mov_Title, Mov_Year, Mov_Lang, Dir_id) MOVIE_CAST(Act_id, Mov_id, Role) RATING(Mov_id, Rev_Stars)</p> <p>Write SQL queries to</p> <ol style="list-style-type: none"> 1. List the titles of all movies directed by 'Hitchcock'. 2. Find the movie names where one or more actors acted in two or more movies. 3. List all actors who acted in a movie before 2000 and also in a movie after 2015(use JOIN operation). 4. Find the title of movies and number of stars for each movie that has at least one rating and find the highest number of stars that movie received. Sort the result by movie title. 5. Update rating of all movies directed by 'Steven Spielberg' to 5. <p>Reference: https://www.youtube.com/watch?v=hSiCUNVKIAo https://www.youtube.com/watch?v=Eod3aQkFz84</p>
4	<p>Aim: Introduce concepts of PLSQL and usage on the table.</p> <p>Program: Consider the schema for College Database: STUDENT(USN, SName, Address, Phone, Gender) SEMSEC(SSID, Sem, Sec) CLASS(USN, SSID) COURSE(Subcode, Title, Sem, Credits) IAMARKS(USN, Subcode, SSID, Test1, Test2, Test3, FinalIA)</p> <p>Write SQL queries to</p> <ol style="list-style-type: none"> 1. List all the student details studying in fourth semester 'C' section. 2. Compute the total number of male and female students in each semester and in each section. 3. Create a view of Test1 marks of student USN '1BI15CS101' in all Courses. 4. Calculate the FinalIA (average of best two test marks) and update the corresponding table for all students. 5. Categorize students based on the following criterion: If FinalIA = 17 to 20 then CAT = 'Outstanding' If FinalIA = 12 to 16 then CAT = 'Average' If FinalIA < 12 then CAT = 'Weak' <p>Give these details only for 8th semester A, B, and C section students.</p> <p>Reference: https://www.youtube.com/watch?v=horURQewW9c https://www.youtube.com/watch?v=P7-wKbKrAhk</p>
5	<p>Aim: Demonstrate the core concepts on table like nested and correlated nesting queries and also EXISTS and NOT EXISTS keywords.</p> <p>Program: Consider the schema for Company Database: EMPLOYEE(SSN, Name, Address, Sex, Salary, SuperSSN, DNo) DEPARTMENT(DNo, DName, MgrSSN, MgrStartDate) DLOCATION(DNo,DLoc) PROJECT(PNo, PName, PLocation, DNo) WORKS_ON(SSN, PNo, Hours)</p> <p>Write SQL queries to</p> <p>Make a list of all project numbers for projects that involve an employee whose last name is 'Scott', either as a worker or as a manager of the department that controls the project.</p>

	<p>Show the resulting salaries if every employee working on the 'IoT' project is given a 10 percent raise.</p> <p>Find the sum of the salaries of all employees of the 'Accounts' department, as well as the maximum salary, the minimum salary, and the average salary in this department</p> <p>Retrieve the name of each employee who works on all the projects controlled by department number 5 (use NOT EXISTS operator).</p> <p>For each department that has more than five employees, retrieve the department number and the number of its employees who are making more than Rs.6,00,000.</p> <p>Reference: https://www.youtube.com/watch?v=Dk8f3ejqKts</p>
Pedagogy	For the above experiments the following pedagogy can be considered. Problem based learning, Active learning, MOOC, Chalk & Talk
PART B	
	Mini project: For any problem selected, make sure that the application should have five or more tables. Indicative areas include: Organization, health care, Ecommerce etc.
<p>Course Outcomes: At the end of the course the student will be able to: CO 1. Create, Update and query on the database. CO 2. Demonstrate the working of different concepts of DBMS CO 3. Implement, analyze and evaluate the project developed for an application.</p>	
<p>Assessment Details (both CIE and SEE)</p> <p>The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each course. The student has to secure not less than 35% (18 Marks out of 50) in the semester-end examination (SEE).</p> <p>Continuous Internal Evaluation (CIE):</p> <p>CIE marks for the practical course is 50 Marks.</p> <p>The split-up of CIE marks for record/ journal and test are in the ratio 60:40.</p> <p>Each experiment to be evaluated for conduction with an observation sheet and record write-up. Rubrics for the evaluation of the journal/write-up for hardware/software experiments designed by the faculty who is handling the laboratory session and is made known to students at the beginning of the practical session.</p> <p>Record should contain all the specified experiments in the syllabus and each experiment write-up will be evaluated for 10 marks.</p> <p>Total marks scored by the students are scaled down to 30 marks (60% of maximum marks).</p> <p>Weightage to be given for neatness and submission of record/write-up on time.</p> <p>Department shall conduct 02 tests for 100 marks, the first test shall be conducted after the 8th week of the semester and the second test shall be conducted after the 14th week of the semester.</p> <p>In each test, test write-up, conduction of experiment, acceptable result, and procedural knowledge will carry a weightage of 60% and the rest 40% for viva-voce.</p> <p>The suitable rubrics can be designed to evaluate each student's performance and learning ability. Rubrics suggested in Annexure-II of Regulation book</p> <p>The average of 02 tests is scaled down to 20 marks (40% of the maximum marks).</p> <p>The Sum of scaled-down marks scored in the report write-up/journal and average marks of two tests is the total CIE marks scored by the student.</p>	
Semester End Evaluation (SEE):	

- SEE marks for the practical course is 50 Marks.
- SEE shall be conducted jointly by the two examiners of the same institute, examiners are appointed by the University
- All laboratory experiments are to be included for practical examination.
- (Rubrics) Breakup of marks and the instructions printed on the cover page of the answer script to be strictly adhered to by the examiners. **OR** based on the course requirement evaluation rubrics shall be decided jointly by examiners.
- Students can pick one question (experiment) from the questions lot prepared by the internal /external examiners jointly.
- Evaluation of test write-up/ conduction procedure and result/viva will be conducted jointly by examiners.
- General rubrics suggested for SEE are mentioned here, writeup-20%, Conduction procedure and result in -60%, Viva-voce 20% of maximum marks. SEE for practical shall be evaluated for 100 marks and scored marks shall be scaled down to 50 marks (however, based on course type, rubrics shall be decided by the examiners)
- *Students can pick one experiment from the questions lot of PART A with an equal choice to all the students in a batch. For PART B, the project group (Maximum of 4 students per batch) should demonstrate the mini-project.*
- *Weightage of marks for PART A is 60% and for PART B is 40%. General rubrics suggested to be followed for part A and part B.*
- Change of experiment is allowed only once and Marks allotted to the procedure part to be made zero (Not allowed for Part B).
- The duration of SEE is 03 hours

Rubrics suggested in Annexure-II of Regulation book

Textbooks:

1. Fundamentals of Database Systems, Ramez Elmasri and Shamkant B. Navathe, 7th Edition, 2017, Pearson.
2. Database management systems, Ramakrishnan, and Gehrke, 3rd Edition, 2014, McGraw Hill

Suggested Weblinks/ E Resource

<https://www.tutorialspoint.com/sql/index.htm>

V Semester

ANGULAR JS AND NODE JS (Practical based)			
Course Code:	21CSL581	CIE Marks	50
Teaching Hours/Week	0:0:2:0	SEE Marks	50
Total No. of Hours	12T + 12P	Total Marks	100
Credits	01	Exam Hours	02
Course Objectives: The student should be made to: CLO 1. To learn the basics of Angular JS. CLO 2. To understand the Angular JS Modules. CLO 3. To implement Forms, inputs and Services CLO 4. To implement Directives and Databases CLO 5. To understand basics of Node JS.			
Teaching-Learning Process (General Instructions) These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes. <ol style="list-style-type: none">1. Lecturer method (L) need not to be only a traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.2. Use of Video/Animation to explain functioning of various concepts.3. Encourage collaborative (Group Learning) Learning in the class.4. Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyze information rather than simply recall it.6. Introduce Topics in manifold representations.7. Show the different ways to solve the same problem with different logic and encourage the students to come up with their own creative ways to solve them.8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.			
Module-1			
Introduction To Angular JS: Introduction – Features – Angular JSModel-View-Controller – Expression – Directives and Controllers.			
Teaching-Learning Process	Chalk and board, Active Learning, practical based learning		
Module-2			
Angular JS Modules: Arrays –Working with ng-model – Working with Forms – Form Validation – Error Handling with Forms – Nested Forms with ng-form – Other Form Controls.			
Teaching-Learning Process	Chalk and board, Active Learning, practical based learning		
Module-3			
Directives& Building Databases: Part I- Filters – Using Filters in Controllers and Services – Angular JS Services – Internal Angular JS Services – Custom Angular JS Services			
Teaching-Learning Process	Chalk and board, Active Learning, practical based learning		
Module-4			
Directives& Building Databases: Part-II- Directives – Alternatives to Custom Directives – Understanding the Basic options – Interacting with Server –HTTP Services – Building Database, Front End and BackEnd			
Teaching-Learning Process	Chalk and board, Active Learning, practical based learning		
Module-5			
Introduction to NODE .JS: Introduction –Using the Terminals – Editors –Building a Webserver with Node – The HTTPModule – Views and Layouts.			

Teaching-Learning Process	Chalk and board, Active Learning, practical based learning
Course Outcomes (Course Skill Set) At the end of the course the student will be able to: CO 1. Describe the features of Angular JS. CO 2. Recognize the form validations and controls. CO 3. Implement Directives and Controllers. CO 4. Evaluate and create database for simple application. CO 5. Plan and build webservers with node using Node .JS.	
Assessment Details (both CIE and SEE) The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each course. The student has to secure not less than 35% (18 Marks out of 50) in the semester-end examination (SEE). Continuous Internal Evaluation (CIE): <i>NOTE: List of experiments to be prepared by the faculty based on the syllabus mentioned above</i> CIE marks for the practical course is 50 Marks . The split-up of CIE marks for record/ journal and test are in the ratio 60:40 . <ul style="list-style-type: none"> Each experiment to be evaluated for conduction with observation sheet and record write-up. Rubrics for the evaluation of the journal/write-up for hardware/software experiments designed by the faculty who is handling the laboratory session and is made known to students at the beginning of the practical session. Record should contain all the specified experiments in the syllabus and each experiment write-up will be evaluated for 10 marks. Total marks scored by the students are scaled down to 30 marks (60% of maximum marks). Weightage to be given for neatness and submission of record/write-up on time. Department shall conduct 02 tests for 100 marks, the first test shall be conducted after the 8th week of the semester and the second test shall be conducted after the 14th week of the semester. In each test, test write-up, conduction of experiment, acceptable result, and procedural knowledge will carry a weightage of 60% and the rest 40% for viva-voce. The suitable rubrics can be designed to evaluate each student's performance and learning ability. Rubrics suggested in Annexure-II of Regulation book The average of 02 tests is scaled down to 20 marks (40% of the maximum marks). The Sum of scaled-down marks scored in the report write-up/journal and average marks of two tests is the total CIE marks scored by the student.	
Semester End Evaluation (SEE): <ul style="list-style-type: none"> SEE marks for the practical course is 50 Marks. SEE shall be conducted jointly by the two examiners of the same institute, examiners are appointed by the University All laboratory experiments are to be included for practical examination. (Rubrics) Breakup of marks and the instructions printed on the cover page of the answer script to be strictly adhered to by the examiners. OR based on the course requirement evaluation rubrics shall be decided jointly by examiners. Students can pick one question (experiment) from the questions lot prepared by the internal /external examiners jointly. Evaluation of test write-up/ conduction procedure and result/viva will be conducted jointly by examiners. 	

- General rubrics suggested for SEE are mentioned here, writeup-20%, Conduction procedure and result in -60%, Viva-voce 20% of maximum marks. SEE for practical shall be evaluated for 100 marks and scored marks shall be scaled down to 50 marks (however, based on course type, rubrics shall be decided by the examiners)
- The duration of SEE is 02 hours

Rubrics suggested in Annexure-II of Regulation book

Suggested Learning Resources:

Textbooks

1. Adam Freeman - ProAngular JS, Apress, First Edition, 2014.
2. ShyamSeshadri, Brad Green –“AngularJS: Up and Running: Enhanced Productivity with Structured Web Apps”, Apress, O'Reilly Media, Inc.
3. AgusKurniawan–“AngularJS Programming by Example”, First Edition, PE Press, 2014.

Reference Books

1. Brad Dayley, “Learning Angular JS”, Addison-Wesley Professional, First Edition, 2014.
2. Steve Hoberman, “Data Modeling for MongoDB”, Technics Publication, First Edition, 2014..

Weblinks and Video Lectures (e-Resources):

1. Introduction to Angular JS : <https://www.youtube.com/watch?v=HEbphzK-0xE>
2. Angular JS Modules : <https://www.youtube.com/watch?v=gWmOKmgnQkU>
3. Directives& Building Databases: https://www.youtube.com/watch?v=R_okHflzgm0
4. Introduction to NODE .JS: <https://www.youtube.com/watch?v=8u1o-OmOeGQ>
5. <https://www.youtube.com/watch?v=7F1nLajs4Eo>
6. <https://www.youtube.com/watch?v=t7x7c-x90FU>

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

- Demonstration of simple projects

V Semester

C# AND .NET FRAMEWORK			
Course Code:	21CS582	CIE Marks	50
Teaching Hours/Week	1:0:0:0	SEE Marks	50
Total No. of Hours	12	Total Marks	100
Credits	01	Exam Hours	01
Course Objectives:			
CLO 1. Understand the basics of C# and .NET			
CLO 2. Learn the variables and constants of C#			
CLO 3. Know the object-oriented aspects and applications.			
CLO 4. Learn the basic structure of .NET framework.			
CLO 5. Learn to create a simple project of .NET Core			
Teaching-Learning Process (General Instructions)			
These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.			
<div><div>1.</div><div>Lecturer method (L) need not to be only a traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.</div></div> <div><div>2.</div><div>Use of Video/Animation to explain functioning of various concepts.</div></div> <div><div>3.</div><div>Encourage collaborative (Group Learning) Learning in the class.</div></div> <div><div>4.</div><div>Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.</div></div> <div><div>5.</div><div>Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyze information rather than simply recall it.</div></div> <div><div>6.</div><div>Introduce Topics in manifold representations.</div></div> <div><div>7.</div><div>Show the different ways to solve the same problem with different circuits/logic and encourage the students to come up with their own creative ways to solve them.</div></div> <div><div>8.</div><div>Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.</div></div>			
Module-1			
Introduction to C#			
Part-I: Understanding C#, .NET, overview of C#, Variables, Data Types, Operators, Expressions, Branching, Looping, Methods, implicit and explicit casting.			
Teaching-Learning Process	Active learning		
Module-2			
Part-II: Constants, Arrays, Array Class, Array List, String, String Builder, Structure, Enumerations, boxing and unboxing.			
Teaching-Learning Process	Active learning		
Module-3			
Object Oriented Concepts-I:			
Class, Objects, Constructors and its types, inheritance, properties, indexers, index overloading, polymorphism.			
Teaching-Learning Process	Active learning		
Module-4			
Object Oriented Concepts-II:			

Sealed class and methods, interface, abstract class, abstract and interface, operator overloading, delegates, events, errors and exception, Threading.	
Teaching-Learning Process	Active learning
Module-5	
Introduction to .NET FRAMEWORK: Assemblies, Versioning, Attributes, reflection, viewing meta data, remoting, security in .NET, Environment Setup of .NET Core and create a small project.	
Teaching-Learning Process	Active learning
Course Outcomes (Course Skill Set) At the end of the course the student will be able to: CO 1. Able to explain how C# fits into the .NET platform. CO 2. Describe the utilization of variables and constants of C# CO 3. Use the implementation of object-oriented aspects in applications. CO 4. Analyze and Set up Environment of .NET Core. CO 5. Evaluate and create a simple project application.	
Assessment Details (both CIE and SEE) The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together Continuous Internal Evaluation: Three Unit Tests each of 20 Marks (duration 01 hour) <ol style="list-style-type: none"> 1. First test at the end of 5th week of the semester 2. Second test at the end of the 10th week of the semester 3. Third test at the end of the 15th week of the semester Two assignments each of 10 Marks <ol style="list-style-type: none"> 4. First assignment at the end of 4th week of the semester 5. Second assignment at the end of 9th week of the semester Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for 20 Marks (duration 01 hours) <ol style="list-style-type: none"> 6. At the end of the 13th week of the semester The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be scaled down to 50 marks (to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course). CIE methods /question paper has to be designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course. Semester End Examination: Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (duration 01 hours) SEE paper will be set for 50 questions of each of 01 marks. The pattern of the question paper is MCQ. The time allotted for SEE is 01 hours	

Suggested Learning Resources:**Textbooks**

1. Herbert Schildt, "The Complete Reference: C# 4.0", Tata McGraw Hill, 2012.
2. Christian Nagel et al. "Professional C# 2012 with .NET 4.5", Wiley India, 2012.

Reference Books

1. Andrew Troelsen, "Pro C# 2010 and the .NET 4 Platform, Fifth edition, A Press, 2010.
2. Ian Griffiths, Matthew Adams, Jesse Liberty, "Programming C# 4.0", Sixth Edition, O'Reilly, 2010.

Weblinks and Video Lectures (e-Resources):

1. Introduction to C# : <https://www.youtube.com/watch?v=ItoIFCT9P90>
2. Object Oriented Concepts : <https://www.youtube.com/watch?v=LP3llcExPK0>
3. .NET FRAMEWORK : <https://www.youtube.com/watch?v=h7huHkvPoEE>

Tutorial Link:

1. <https://www.tutorialsteacher.com/csharp>
2. <https://www.w3schools.com/cs/index.php>
3. <https://www.javatpoint.com/net-framework>

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

Real world problem solving using group discussion.

VI Semester

SOFTWARE ENGINEERING & PROJECT MANAGEMENT			
Course Code	21CS61	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	2:2:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03
Course Learning Objectives CLO 1. Outline software engineering principles and activities involved in building large software programs. Identify ethical and professional issues and explain why they are of concern to Software Engineers. CLO 2. Describe the process of requirement gathering, requirement classification, requirement specification and requirements validation. CLO 3. Infer the fundamentals of object oriented concepts, differentiate system models, use UML diagrams and apply design patterns. CLO 4. Explain the role of DevOps in Agile Implementation. CLO 5. Discuss various types of software testing practices and software evolution processes. CLO 6. Recognize the importance Project Management with its methods and methodologies. CLO 7. Identify software quality parameters and quantify software using measurements and metrics. List software quality standards and outline the practices involved			
Teaching-Learning Process (General Instructions) These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes. <ol style="list-style-type: none"> 1. Lecturer method (L) need not to be only a traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes. 2. Use of Video/Animation to explain functioning of various concepts. 3. Encourage collaborative (Group Learning) Learning in the class. 4. Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking. 5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyze information rather than simply recall it. 6. Introduce Topics in manifold representations. 7. Show the different ways to solve the same problem with different circuits/logic and encourage the students to come up with their own creative ways to solve them. 8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding. 			
Module-1			
Introduction: The evolving role of software, Software, The changing nature of software, Software engineering, A Process Framework, Process Patterns, Process Assessment, Personal and Team Process Models, Process Technology, Product and Process.			
Textbook 1: Chapter 1: 1.1 to 1.3			
Process Models: Prescriptive models, Waterfall model, Incremental process models, Evolutionary process models, Specialized process models.			
Textbook 1: Chapter 2: 2.1, 2.2, 2.4 to 2.7			
Requirements Engineering: Requirements Engineering Task, Initiating the Requirements Engineering process, Eliciting Requirements, Developing use cases, Building the analysis model, Negotiating Requirements, Validating Requirements, Software Requirement Document (Sec 4.2)			
Textbook 1: Chapter 3: 3.1 to 3.6, Textbook 5: Chapter 4: 4.2			

Teaching-Learning Process	Chalk and board, Active Learning, Problem based learning
Module-2	
Introduction, Modelling Concepts and Class Modelling: What is Object orientation? What is OO development? OO Themes; Evidence for usefulness of OO development; OO modelling history. Modelling as Design technique: Modelling, abstraction, The Three models. Class Modelling: Object and Class Concept, Link and associations concepts, Generalization and Inheritance, A sample class model, Navigation of class models, Introduction to RUP(Textbook: 5 Sec 2.4) and UML diagrams	
Textbook 2: Chapter 1,2,3	
Building the Analysis Models: Requirement Analysis, Analysis Model Approaches, Data modeling Concepts, Object Oriented Analysis, Scenario-Based Modeling, Flow-Oriented Modeling, class Based Modeling, Creating a Behavioral Model.	
Textbook 1: Chapter 8: 8.1 to 8.8	
Teaching-Learning Process	Chalk and board, Active Learning, Demonstration
Module-3	
Software Testing: A Strategic Approach to Software Testing, Strategic Issues, Test Strategies for Conventional Software, Test Strategies for Object -Oriented Software, Validation Testing, System Testing, The Art of Debugging.	
Textbook 1: Chapter 13: 13.1 to 13.7	
Agile Methodology & DevOps: Before Agile – Waterfall, Agile Development,	
Self-Learning Section: What is DevOps?, DevOps Importance and Benefits, DevOps Principles and Practices, 7 C's of DevOps Lifecycle for Business Agility, DevOps and Continuous Testing, How to Choose Right DevOps Tools?, Challenges with DevOps Implementation.	
Textbook 4: Chapter 2: 2.1 to 2.9	
Teaching-Learning Process	Chalk and board, Active Learning, Demonstration
Module-4	
Introduction to Project Management: Introduction, Project and Importance of Project Management, Contract Management, Activities Covered by Software Project Management, Plans, Methods and Methodologies, Some ways of categorizing Software Projects, Stakeholders, Setting Objectives, Business Case, Project Success and Failure, Management and Management Control, Project Management life cycle, Traditional versus Modern Project Management Practices.	
Textbook 3: Chapter 1: 1.1 to 1.17	
Teaching-Learning Process	Chalk and board, Active Learning, Demonstration
Module-5	
Activity Planning: Objectives of Activity Planning, When to Plan, Project Schedules, Sequencing and Scheduling Activities, Network Planning Models, Forward Pass– Backward Pass, Identifying critical path, Activity Float, Shortening Project Duration, Activity on Arrow Networks.	
Textbook 3: Chapter 6: 6.1 to 6.16	
Software Quality: Introduction, The place of software quality in project planning, Importance of software quality, software quality models, ISO 9126, quality management systems, process capability models, techniques to enhance software quality, quality plans.	
Textbook 3: Chapter 13: (13.1 to 13.6 , 13.9, 13.11, 13.14),	

Teaching-Learning Process	Chalk and board, Active Learning, Demonstration
Course Outcomes At the end of the course the student will be able to: <ul style="list-style-type: none"> CO 1. Understand the activities involved in software engineering and analyze the role of various process models CO 2. Explain the basics of object-oriented concepts and build a suitable class model using modelling techniques CO 3. Describe various software testing methods and to understand the importance of agile methodology and DevOps CO 4. Illustrate the role of project planning and quality management in software development CO 5. Understand the importance of activity planning and different planning models 	
Assessment Details (both CIE and SEE) The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together Continuous Internal Evaluation: Three Unit Tests each of 20 Marks (duration 01 hour) <ul style="list-style-type: none"> 1. First test at the end of 5th week of the semester 2. Second test at the end of the 10th week of the semester 3. Third test at the end of the 15th week of the semester Two assignments each of 10 Marks <ul style="list-style-type: none"> 4. First assignment at the end of 4th week of the semester 5. Second assignment at the end of 9th week of the semester Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for 20 Marks (duration 01 hours) <ul style="list-style-type: none"> 6. At the end of the 13th week of the semester The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be scaled down to 50 marks (to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course). CIE methods /question paper has to be designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course. Semester End Examination: Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (duration 03 hours) <ul style="list-style-type: none"> 1. The question paper will have ten questions. Each question is set for 20 marks. 2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), should have a mix of topics under that module. 3. The students have to answer 5 full questions, selecting one full question from each module 4. Marks scored shall be proportionally reduced to 50 marks 	
Suggested Learning Resources:	
Textbooks <ul style="list-style-type: none"> 1. Roger S. Pressman: Software Engineering-A Practitioners approach, 7th Edition, Tata McGraw Hill. 2. Michael Blaha, James Rumbaugh: Object Oriented Modelling and Design with UML, 2nd Edition, Pearson Education, 2005. 3. Bob Hughes, Mike Cotterell, Rajib Mall: Software Project Management, 6th Edition, McGraw Hill 	

<p>Education, 2018.</p> <p>4. Deepak Gaikwad, Viral Thakkar, DevOps Tools From Practitioner's Viewpoint, Wiley.</p> <p>5. Ian Sommerville: Software Engineering, 9th Edition, Pearson Education, 2012.</p> <p>Reference:</p> <p>1. Pankaj Jalote: An Integrated Approach to Software Engineering, Wiley India.</p>
<p>Weblinks and Video Lectures (e-Resources):</p> <p>1. https://onlinecourses.nptel.ac.in/noc20_cs68/preview</p> <p>2. https://www.youtube.com/watch?v=WxkP5KR_Emk&list=PLrjkTql3jnm9b5nr-ggx7Pt1G4UAHeFlj</p> <p>3. http://elearning.vtu.ac.in/econtent/CSE.php</p> <p>4. http://elearning.vtu.ac.in/econtent/courses/video/CSE/15CS42.html</p> <p>5. https://nptel.ac.in/courses/128/106/128106012/ (DevOps)</p>
<p>Activity Based Learning (Suggested Activities in Class)/ Practical Based learning</p> <p>Case study, Field visit</p>

VI Semester

DATA SCIENCE AND ITS APPLICATIONS			
Course Code	21AD62	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:2:0	SEE Marks	50
Total Hours of Pedagogy	40 T + 20 P	Total Marks	100
Credits	04	Exam Hours	03
Course Learning Objectives: CLO 1. Demonstrate the proficiency with statistical analysis of data to derive insight from results and interpret the data findings visually CLO 2. Utilize the CLO 3. skills in data management by obtaining, cleaning and transforming the data. CLO 4. Make use of machine learning models to solve the business-related challenges CLO 5. Experiment with decision trees, neural network layers and data partition. CLO 6. Demonstrate how social clustering shape individuals and groups in contemporary society.			
Teaching-Learning Process (General Instructions) These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes. <ol style="list-style-type: none"> Lecturer method (L) does not mean only traditional lecture method, but different type of teaching methods may be adopted to develop the outcomes. Show Video/animation films to explain functioning of various concepts. Encourage collaborative (Group Learning) Learning in the class. Ask at least three HOTS (Higher order Thinking) questions in the class, which promotes critical thinking. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyze information rather than simply recall it. Topics will be introduced in a multiple representation. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding. 			
Module-1: Introduction What is Data Science? Visualizing Data , matplotlib, Bar Charts, Line Charts, Scatterplots, Linear Algebra , Vectors, Matrices, Statistics , Describing a Single Set of Data, Correlation, Simpson's Paradox, Some Other Correlational Caveats, Correlation and Causation, Probability , Dependence and Independence, Conditional Probability, Bayes's Theorem, Random Variables, Continuous Distributions, The Normal Distribution, The Central Limit Theorem. Chapters 1, 3, 4, 5 and 6			
Laboratory Component: <ol style="list-style-type: none"> Installation of Python/R language, Visual Studio code editors can be demonstrated along with Kaggle data set usage. Write programs in Python/R and Execute them in either Visual Studio Code or PyCharm Community Edition or any other suitable environment. A study was conducted to understand the effect of number of hours the students spent studying on their performance in the final exams. Write a code to plot line chart with number of hours spent studying on x-axis and score in final exam on y-axis. Use a red '*' as the point character, label the axes and give the plot a title. 			

Number of hrs spent studying (x)	10	9	2	15	10	16	11	16
Score in the final exam (0 - 100) (y)	95	80	10	50	45	98	38	93

4. For the given dataset mtcars.csv (www.kaggle.com/ruiromanini/mtcars), plot a histogram to check the frequency distribution of the variable 'mpg' (Miles per gallon)

Teaching-Learning Process	<ol style="list-style-type: none"> 1. Demonstration of different charts 2. PPT Presentation for Theorems and different distributions 3. Live coding and execution for visualization with simple examples
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Module-2: Hypothesis and Inference

Statistical Hypothesis Testing, Example: Flipping a Coin, p-Values, Confidence Intervals, p-Hacking, Example: Running an A/B Test, Bayesian Inference, **Gradient Descent**, The Idea Behind Gradient Descent Estimating the Gradient, Using the Gradient, Choosing the Right Step Size, Using Gradient Descent to Fit Models, Minibatch and Stochastic Gradient Descent, **Getting Data**, stdin and stdout, Reading Files, Scraping the Web, Using APIs, Example: Using the Twitter APIs, **Working with Data**, Exploring Your Data, Using NamedTuples, Dataclasses, Cleaning and Munging, Manipulating Data, Rescaling, An Aside: tqdm, Dimensionality Reduction.

Chapters 7, 8, 9 and 10

Laboratory Component:

1. Consider the books dataset BL-Flickr-Images-Book.csv from Kaggle (<https://www.kaggle.com/adeyoyintemidayo/publication-of-books>) which contains information about books. Write a program to demonstrate the following.
 - Import the data into a DataFrame
 - Find and drop the columns which are irrelevant for the book information.
 - Change the Index of the DataFrame
 - Tidy up fields in the data such as date of publication with the help of simple regular expression.
 - Combine str methods with NumPy to clean columns

Teaching-Learning Process	<ol style="list-style-type: none"> 1. Demonstration of Hypothesis test. 2. PPT Presentation to explore and manipulate data. 3. Live coding of concepts with simple examples 4. Case Study: Extraction of data from Books dataset
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Module-3: Machine Learning

Modeling, What Is Machine Learning?, Overfitting and Underfitting, Correctness, The Bias-Variance Tradeoff, Feature Extraction and Selection, **k-Nearest Neighbors**, The Model, Example: The Iris Dataset, The Curse of Dimensionality, **Naive Bayes**, A Really Dumb Spam Filter, A More Sophisticated Spam Filter, Implementation, Testing Our Model, Using Our Model, **Simple Linear Regression**, The Model, Using

Gradient Descent, Maximum Likelihood Estimation, **Multiple Regression**, The Model, Further Assumptions of the Least Squares Model, Fitting the Model, Interpreting the Model, Goodness of Fit, Digression: The Bootstrap, Standard Errors of Regression Coefficients, Regularization, **Logistic Regression**, The Problem, The Logistic Function, Applying the Model, Goodness of Fit, Support Vector Machines.

Chapters 11, 12, 13, 14, 15 and 16

Laboratory Component:

1. Train a regularized logistic regression classifier on the iris dataset (<https://archive.ics.uci.edu/ml/machine-learning-databases/iris/> or the inbuilt iris dataset) using sklearn. Train the model with the following hyperparameter $C = 1e4$ and report the best classification accuracy.
2. Train an SVM classifier on the iris dataset using sklearn. Try different kernels and the associated hyperparameters. Train model with the following set of hyperparameters RBF-kernel, $\gamma=0.5$, one-vs-rest classifier, no-feature-normalization. Also try $C=0.01, 1, 10$, $C=0.01, 1, 10$. For the above set of hyperparameters, find the best classification accuracy along with total number of support vectors on the test data

Teaching-Learning Process

1. Demonstration of Models
2. PPT Presentation for techniques
3. Live coding of all concepts with simple examples

Module-4: Decision Trees

What Is a Decision Tree?, Entropy, The Entropy of a Partition, Creating a Decision Tree, Putting It All Together, Random Forests, **Neural Networks**, Perceptrons, Feed-Forward Neural Networks, Backpropagation, Example: Fizz Buzz, **Deep Learning**, The Tensor, The Layer Abstraction, The Linear Layer, Neural Networks as a Sequence of Layers, Loss and Optimization, Example: XOR Revisited, Other Activation Functions, Example: Fizz Buzz Revisited, Softmaxes and Cross-Entropy, Dropout, Example: MNIST, Saving and Loading Models, **Clustering**, The Idea, The Model, Example: Meetups, Choosing k, Example: Clustering Colors, Bottom-Up Hierarchical Clustering

Chapters 17, 18, 19 and 20

Laboratory Component:

1. Consider the following dataset. Write a program to demonstrate the working of the decision tree based ID3 algorithm.

Price	Maintenance	Capacity	Airbag	Profitable
Low	Low	2	No	Yes
Low	Med	4	Yes	Yes
Low	Low	4	No	Yes
Low	Med	4	No	No
Low	High	4	No	No
Med	Med	4	No	No
Med	Med	4	Yes	Yes
Med	High	2	Yes	No
Med	High	5	No	Yes
High	Med	4	Yes	Yes
high	Med	2	Yes	Yes
High	High	2	Yes	No
high	High	5	yes	Yes

2. Consider the dataset spiral.txt (<https://bit.ly/2Lm75Ly>). The first two columns in the dataset corresponds to the co-ordinates of each data point. The third column corresponds to the actual cluster label. Compute the rand index for the following methods:

<ul style="list-style-type: none"> • K – means Clustering • Single – link Hierarchical Clustering • Complete link hierarchical clustering. • Also visualize the dataset and which algorithm will be able to recover the true clusters. 	
Teaching-Learning Process	<ol style="list-style-type: none"> 1. Demonstration using Python/ R Language 2. PPT Presentation for decision tree, Neural Network, Deep learning and clustering 3. Live coding for the concepts with simple examples 4. Project Work: Algorithm implementation
Module-5: Natural Language Processing	
<p>Word Clouds, n-Gram Language Models, Grammars, An Aside: Gibbs Sampling, Topic Modeling, Word Vectors, Recurrent Neural Networks, Example: Using a Character-Level RNN, Network Analysis, Betweenness Centrality, Eigenvector Centrality, Directed Graphs and PageRank, Recommender Systems, Manual Curation, Recommending What's Popular, User-Based Collaborative Filtering, Item-Based Collaborative Filtering, Matrix Factorization.</p> <p>Chapters 21, 22 and 23</p>	
<p>Laboratory Component:</p> <p>Mini Project – Simple web scrapping in social media</p>	
Teaching-Learning Process	<ol style="list-style-type: none"> 1. Demonstration of models 2. PPT Presentation for network analysis and Recommender systems 3. Live coding with simple examples
<p>Course outcome (Course Skill Set)</p> <p>At the end of the course the student will be able to:</p> <p>CO 1. Identify and demonstrate data using visualization tools.</p> <p>CO 2. Make use of Statistical hypothesis tests to choose the properties of data, curate and manipulate data.</p> <p>CO 3. Utilize the skills of machine learning algorithms and techniques and develop models.</p> <p>CO 4. Demonstrate the construction of decision tree and data partition using clustering.</p> <p>CO 5. Experiment with social network analysis and make use of natural language processing skills to develop data driven applications.</p>	
<p>Assessment Details (both CIE and SEE)</p> <p>The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together</p> <p>Continuous Internal Evaluation:</p> <p>Three Unit Tests each of 20 Marks (duration 01 hour)</p> <ol style="list-style-type: none"> 1. First test at the end of 5th week of the semester 2. Second test at the end of the 10th week of the semester 3. Third test at the end of the 15th week of the semester <p>Two assignments each of 10 Marks</p> <ol style="list-style-type: none"> 4. First assignment at the end of 4th week of the semester 5. Second assignment at the end of 9th week of the semester 	

Practical Sessions need to be assessed by appropriate rubrics and viva-voce method. This will contribute to **20 marks**.

- Rubrics for each Experiment taken average for all Lab components – 15 Marks.
- Viva-Voce– 5 Marks (more emphasized on demonstration topics)

The sum of three tests, two assignments, and practical sessions will be out of 100 marks and will be **scaled down to 50 marks**

(to have a less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper has to be designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours**)

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module
4. Marks scored shall be proportionally reduced to 50 marks

Suggested Learning Resources:

Text Books

1. Joel Grus, "Data Science from Scratch", 2nd Edition, O'Reilly Publications/Shroff Publishers and Distributors Pvt. Ltd., 2019. ISBN-13: 978-9352138326

Reference Books

1. Emily Robinson and Jacqueline Nolis, "Build a Career in Data Science", 1st Edition, Manning Publications, 2020. ISBN: 978-1617296246.
2. Aurélien Geron, "Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow: Concepts, Tools, and Techniques to Build Intelligent Systems", 2nd Edition, O'Reilly Publications/Shroff Publishers and Distributors Pvt. Ltd., 2019. ISBN-13: 978-1492032649.
3. François Chollet, "Deep Learning with Python", 1st Edition, Manning Publications, 2017. ISBN-13: 978-1617294433
4. Jeremy Howard and Sylvain Gugger, "Deep Learning for Coders with fastai and PyTorch", 1st Edition, O'Reilly Publications/Shroff Publishers and Distributors Pvt. Ltd., 2020. ISBN-13: 978-1492045526
5. Sebastian Raschka and Vahid Mirjalili, "Python Machine Learning: Machine Learning and Deep Learning with Python, scikit-learn, and TensorFlow 2", 3rd Edition, Packt Publishing Limited, 2019. ISBN-13: 978-1789955750

Web links and Video Lectures (e-Resources):

1. Using Python : <https://www.python.org>
2. R Programming : <https://www.r-project.org/>
3. Python for Natural Language Processing : <https://www.nltk.org/book/>
4. Data set: <https://bit.ly/2Lm75Ly>
5. Data set: <https://archive.ics.uci.edu/ml/datasets.html>
6. Data set : www.kaggle.com/ruiromanini/mtcars
7. Pycharm : <https://www.jetbrains.com/pycharm/>

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|---|
| <ol style="list-style-type: none">8. https://nptel.ac.in/courses/106/106/106106179/9. https://nptel.ac.in/courses/106/106/106106212/10. http://nlp-iiith.vlabs.ac.in/List%20of%20experiments.html |
| Activity Based Learning (Suggested Activities in Class)/ Practical Based learning |
| <ol style="list-style-type: none">1. Real world problem solving - Applying the machine learning techniques and developing models |

VI Semester

MACHINE LEARNING			
Course Code	21AI63	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03
Course Learning Objectives			
CLO 1. Define machine learning and understand the basic theory underlying machine learning. CLO 2. Differentiate supervised, unsupervised and reinforcement learning CLO 3. Understand the basic concepts of learning and decision trees. CLO 4. Understand Bayesian techniques for problems appear in machine learning CLO 5. Perform statistical analysis of machine learning techniques.			
Teaching-Learning Process (General Instructions)			
These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.			
<div><div></div><div><div>1. Lecturer method (L) needs not to be only traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.</div><div>2. Use of Video/Animation to explain functioning of various concepts.</div><div>3. Encourage collaborative (Group Learning) Learning in the class.</div><div>4. Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.</div><div>5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyse information rather than simply recall it.</div><div>6. Introduce Topics in manifold representations.</div><div>7. Show the different ways to solve the same problem with different circuits/logic and encourage the students to come up with their own creative ways to solve them.</div><div>8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.</div></div></div>			
Module-1			
Introduction: Machine learning Landscape: what is ML?, Why, Types of ML, main challenges of ML			
Concept learning and Learning Problems – Designing Learning systems, Perspectives and Issues – Concept Learning – Find S-Version Spaces and Candidate Elimination Algorithm –Remarks on VS- Inductive bias.			
Text book 2: Chapter 1, Text book 1:Chapter 1 and 2			
Teaching-Learning Process	Chalk and board, Active Learning, Problem based learning		
Module-2			
End to end Machine learning Project: Working with real data, Look at the big picture, Get the data, Discover and visualize the data, Prepare the data, select and train the model, Fine tune your model.			
Classification : MNIST, training a Binary classifier, performance measure, multiclass classification, error analysis, multi label classification, multi output classification			
Text book 2: Chapter 2, Chapter 3			
Teaching-Learning	Chalk and board, Active Learning		

Process	
Module-3	
Training Models: Linear regression, gradient descent, polynomial regression, learning curves, regularized linear models, logistic regression Support Vector Machine: linear, Nonlinear , SVM regression and under the hood Text book 2: Chapter 4, Chapter 5	
Teaching-Learning Process	Chalk and board, Problem based learning, Demonstration
Module-4	
Decision Trees Training and Visualizing DT, making prediction, estimating class, the CART training, computational complexity, GINI impurity, Entropy, regularization Hyper parameters, Regression, instability Ensemble learning and Random Forest: Voting classifiers, Bagging and pasting, Random patches, Random forests, Boosting, stacking Text book 2: Chapter 6, Chapter 7	
Teaching-Learning Process	Chalk& board, Problem based learning
Module-5	
Bayes Theorem – Concept Learning – Maximum Likelihood – Minimum Description Length Principle – Bayes Optimal Classifier – Gibbs Algorithm – Naïve Bayes Classifier– example-Bayesian Belief Network – EM Algorithm Text book 1: Chapter 6	
Teaching-Learning Process	Chalk and board, MOOC
Course Outcomes At the end of the course the student will be able to: CO 1. Understand the concept of Machine Learning and Concept Learning. CO 2. Apply the concept of ML and various classification methods in a project. CO 3. Analyse various training models in ML and the SVM algorithm to be implemented. CO 4. Apply the ML concept in a decision tree structure and implementation of Ensemble learning and Random Forest. CO 5. Apply Bayes techniques and explore more about the classification in ML.	
Assessment Details (both CIE and SEE) The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together. Continuous Internal Evaluation: Three Unit Tests each of 20 Marks (duration 01 hour) <ol style="list-style-type: none"> 1. First test at the end of 5th week of the semester 2. Second test at the end of the 10th week of the semester 3. Third test at the end of the 15th week of the semester 	

Two assignments each of **10 Marks**

4. First assignment at the end of 4th week of the semester
5. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks (duration 01 hours)**

6. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(To have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper has to be designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours**)

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

The students have to answer 5 full questions, selecting one full question from each module.

Suggested Learning Resources:

Textbooks

1. Tom M. Mitchell, Machine Learning, McGraw-Hill Education, 2013
2. Aurelien Geron, Hands-on Machine Learning with Scikit-Learn & TensorFlow, O'Reilly, Shroff Publishers and Distributors Pvt. Ltd 2019

Reference:

1. Ethem Alpaydin, Introduction to Machine Learning, PHI Learning Pvt. Ltd, 2nd Ed., 2013
2. T. Hastie, R. Tibshirani, J. H. Friedman, The Elements of Statistical Learning, Springer, 1st edition, 2001
3. Machine Learning using Python, Manaranjan Pradhan, U Dinesh Kumar, Wiley, 2019
4. Machine Learning, Saikat Dutt, Subramanian Chandramouli, Amit Kumar Das, Pearson, 2020

Web links and Video Lectures (e-Resources):

1. https://www.youtube.com/playlist?list=PL1xHD4vteKYVpaliy295pg6_SY5qznc77
2. <https://nptel.ac.in/courses/106/106/106106139/>

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

VI Semester

BUSINESS INTELLIGENCE			
Course Code	21AI641	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03
Course Learning Objectives:			
CLO 1. Explain the Decision Support systems and Business Intelligence framework.			
CLO 2. Illustrate the significance of computerized Decision Support, and understand the mathematical modeling behind decision support.			
CLO 3. Explain Data warehousing, its architecture and Extraction, Transformation, and Load (ETL) Processes.			
CLO 4. Explore knowledge management; explain its activities, approaches and its implementation.			
CLO 5. Describe the Expert systems , areas suitable for application of experts system			
Teaching-Learning Process (General Instructions)			
These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.			
1. Lecturer method (L) does not mean only traditional lecture method, but different type of teaching methods may be adopted to develop the outcomes.			
2. Show Video/animation films to explain functioning of various concepts.			
3. Encourage collaborative (Group Learning) Learning in the class.			
4. Ask at least three HOTS (Higher order Thinking) questions in the class, which promotes critical thinking.			
5. Adopt Problem Based Learning (PBL), which fosters students’ Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyze information rather than simply recall it.			
6. Topics will be introduced in a multiple representation.			
7. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.			
8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.			
Module-1			
Decision Support and Business Intelligence: Opening Vignette, Changing Business Environments and Computerized Decision Support, Managerial Decision Making, Computerized Support for Decision Making, An Early Framework for Computerized Decision Support, The Concept of Decision Support Systems (DSS), A framework for Business Intelligence (BI), A Work System View of Decision Support.			
Text Book 1: Chapter 1			
Teaching-Learning Process	Chalk and board, Active Learning, Demonstration		
Module-2			
Computerized Decision Support: Decision Making, Models, Phases of the Decision-Making Process, The Intelligence Phase, The Design Phase, The Choice Phase, The Implementation Phase, How Decisions Are Supported.			
Modeling and Analysis: Structure of Mathematical Models for Decision Support, Certainty, Uncertainty, and Risk, Management Support Systems, Multiple Goals, Sensitivity Analysis, What-If Analysis, and Goal			

Seeking.	
Text Book 1: Chapter 2	
Teaching-Learning Process	Chalk and board, Active Learning, Demonstration
Module-3	
Data Warehousing: Data Warehousing Definitions and Concepts, Data Warehousing Process Overview, Data Warehousing Architectures, Data Integration and the Extraction, Transformation, and Load (ETL) Processes.	
Text Book 1: Chapter 5	
Teaching-Learning Process	Chalk and board, Active Learning, Demonstration
Module-4	
Knowledge Management: Introduction to Knowledge Management, Organizational Learning and Transformation, Knowledge Management Activities, Approaches to Knowledge Management, Information Technology (IT) In Knowledge Management, Knowledge Management Systems Implementation.	
Text Book 1: Chapter 11	
Teaching-Learning Process	Chalk and board, Active Learning, Demonstration
Module-5	
Expert Systems: Basic Concepts of Expert Systems, Applications of Expert Systems, Structure of Expert Systems, Knowledge Engineering, Problem Areas Suitable for Expert Systems, Development of Expert Systems, Benefits, Limitations, and Critical Success Factors of Expert Systems.	
Text Book 1: Chapter 12	
Teaching-Learning Process	Chalk and board, Active Learning, Demonstration
Course outcome (Course Skill Set) At the end of the course the student will be able to: <ul style="list-style-type: none"> CO 1. Apply the basics of data and business to understand Decision Support systems and Business Intelligence framework. CO 2. Describe the significance of Computerized Decision Support, apply the basics of mathematics to Understand the mathematical modeling behind decision support. CO 3. Explain Data warehousing, its architecture and Extraction, Transformation, and Load (ETL) Processes. CO 4. Analyze the importance of knowledge management and explain its activities, approaches and Its implementation CO 5. Describe the Expert systems and analyze its development, discuss areas suitable for application of experts system. 	
Assessment Details (both CIE and SEE) The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal	

Evaluation) and SEE (Semester End Examination) taken together

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks (duration 01 hour)**

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

4. First assignment at the end of 4th week of the semester
5. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks (duration 01 hours)**

6. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper has to be designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours**)

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module
Marks scored shall be proportionally reduced to 50 marks

Suggested Learning Resources:

Text Book

1. Business Intelligence, A managerial Perspective on Analytics. Sharda, R, Delen D, Turban E. Pearson. 2014

Reference Books

1. Data Mining Techniques. For Marketing, Sales and Customer Relationship Management Berry M.&Linoff G. Wiley Publishing Inc 2004
2. Data Science for Business, Foster Provost and Tom Fawcett, O'Reilly Media, Inc 2013

Web links and Video Lectures (e-Resources):

5. <https://www.youtube.com/watch?v=3DTFmMNIgI>
6. <https://www.youtube.com/watch?v=Hg8zBJ1DhLQ>

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

VI Semester

ADVANCED JAVA PROGRAMMING			
Course Code	21CS642	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03
Course Learning Objectives			
CLO 1. Understanding the fundamental concepts of Enumerations and Annotations			
CLO 2. Apply the concepts of Generic classes in Java programs			
CLO 3. Demonstrate the fundamental concepts of String operations			
CLO 4. Design and develop web applications using Java servlets and JSP			
CLO 5. Apply database interaction through Java database Connectivity			
Teaching-Learning Process (General Instructions)			
These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.			
<ol style="list-style-type: none">1. Lecturer method (L) need not to be only a traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.2. Use of Video/Animation to explain functioning of various concepts.3. Encourage collaborative (Group Learning) Learning in the class.4. Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyze information rather than simply recall it.6. Introduce Topics in manifold representations.7. Show the different ways to solve the same program8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.			
Module-1			
Enumerations, Autoboxing and Annotations:			
Enumerations, Enumeration fundamentals, the values() and valueOf() methods, Java enumerations are class types, enumerations inherits Enum, example, type wrappers, Autoboxing, Autoboxing methods, Autoboxing/Unboxing occurs in Expressions, Autoboxing/Unboxing, Boolean and character values, Autoboxing/Unboxing helps prevent errors, A word of warning			
Annotations, Annotation basics, specifying retention policy, obtaining annotations at run time by use of reflection, Annotated element interface, Using default values, Marker Annotations, Single member annotations, Built in annotations			
Textbook 1: Chapter12			
Teaching-Learning Process	Chalk and board, Online demonstration, Problem based learning		
Module-2			
Generics: What are Generics, A Simple Generics Example, A Generic Class with Two Type Parameters, The General Form of a Generic Class, Bounded Types, Using Wildcard Arguments, Bounded Wildcards, Creating a Generic Method, Generic Interfaces, Raw types and Legacy code, Generic Class Hierarchies, Erasure, Ambiguity errors, Some Generic Restrictions			
Textbook 1: Chapter 14			
Teaching-Learning Process	Chalk and board, Online Demonstration		
Module-3			
String Handling: The String Constructors, String Length, Special String Operations, Character Extraction,			

String Comparison, Searching Strings, Modifying a String, Data Conversion Using `valueOf()`, Changing the case of characters within a String, String Buffer, String Builder

Textbook 1: Chapter 15

Teaching-Learning Process	Chalk and board, Online Demonstration
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Module-4

Background; The life cycle of a servlet; A simple servlet; the `servlet` API; The `javax.servlet` package Reading servlet parameter; the `javax.servlet.http` package; Handling HTTP Requests and Responses; using Cookies; Session Tracking, Java Server Pages (JSP); JSP tags, Variables and Objects, Methods, Control statements, Loops, Request String, Parsing other information, User sessions, Cookies, Session Objects

Textbook 1: Chapter 31

Textbook 2: Chapter 11

Teaching-Learning Process	Chalk and board, Online Demonstration
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Module-5

The concept of JDBC; JDBC Driver Types; JDBC packages; A brief overview of the JDBC Process; Database Connection; Associating the JDBC/ODBC Bridge with the Database; Statement Objects; ResultSet; Transaction Processing; Metadata, Data Types; Exceptions.

Textbook 2: Chapter 6

Teaching-Learning Process	Chalk and board, Online Demonstration
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Course Outcomes

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

- CO 1. Understanding the fundamental concepts of Enumerations and Annotations
- CO 2. Apply the concepts of Generic classes in Java programs
- CO 3. Demonstrate the concepts of String operations in Java
- CO 4. Develop web based applications using Java servlets and JSP
- CO 5. Illustrate database interaction and transaction processing in Java

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks (duration 01 hour)**

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

4. First assignment at the end of 4th week of the semester
5. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks (duration 01 hours)**

6. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper has to be designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours**)

1. The question paper will have ten questions. Each question is set for 20 marks
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module. Marks scored shall be proportionally reduced to 50 marks

Suggested Learning Resources:

Textbooks

1. Herbert Schildt: JAVA the Complete Reference. 9th Edition, Tata McGraw-Hill
2. Jim Keogh, The Complete Reference J2EE, Tata McGraw-Hill

Reference Books:

1. Y. Daniel Liang: Introduction to JAVA Programming, 7th Edition, Pearson Education, 2007.

Weblinks and Video Lectures (e-Resources):

1. <https://nptel.ac.in/courses/106/105/106105191/>
2. <https://nptel.ac.in/courses/106/105/106105225/>

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

- Programming exercises

VI Semester

NATURAL LANGUAGE PROCESSING			
Course Code	21AI643	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03
Course Learning Objectives			
CLO 1. Analyse the natural language text. CLO 2. Define the importance of natural language. CLO 3. Understand the concepts Text mining. CLO 4. Illustrate information retrieval techniques.			
Teaching-Learning Process (General Instructions)			
These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.			
<ol style="list-style-type: none">1. Lecturer method (L) need not to be only a traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.2. Use of Video/Animation to explain functioning of various concepts.3. Encourage collaborative (Group Learning) Learning in the class.4. Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyze information rather than simply recall it.6. Introduce Topics in manifold representations.7. Show the different ways to solve the same program8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.			
Module-1			
Overview and language modeling: Overview: Origins and challenges of NLP-Language and Grammar-Processing Indian Languages- NLP Applications-Information Retrieval. Language Modeling: Various Grammar- based Language Models-Statistical Language Model.			
Textbook 1: Ch. 1,2			
Teaching-Learning Process	Chalk and board, Online demonstration, Problem based learning		
Module-2			
Word level and syntactic analysis: Word Level Analysis: Regular Expressions-Finite-State Automata-Morphological Parsing-Spelling Error Detection and correction-Words and Word classes-Part-of Speech Tagging. Syntactic Analysis: Context-free Grammar-Constituency- Parsing-Probabilistic Parsing.			
Textbook 1: Ch. 3,4			
Teaching-Learning Process	Chalk and board, Online Demonstration		
Module-3			
Extracting Relations from Text: From Word Sequences to Dependency Paths: Introduction, Subsequence Kernels for Relation Extraction, A Dependency-Path Kernel for Relation Extraction and Experimental Evaluation.			
Mining Diagnostic Text Reports by Learning to Annotate Knowledge Roles: Introduction, Domain Knowledge and Knowledge Roles, Frame Semantics and Semantic Role Labeling, Learning to Annotate Cases with Knowledge Roles and Evaluations.			

A Case Study in Natural Language Based Web Search: InFact System Overview, The GlobalSecurity.org Experience.

Textbook 2: Ch. 3,4,5

Teaching-Learning Process	Chalk and board, Online Demonstration
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Module-4

Evaluating Self-Explanations in iSTART: Word Matching, Latent Semantic Analysis, and Topic Models: Introduction, iSTART: Feedback Systems, iSTART: Evaluation of Feedback Systems,

Textual Signatures: Identifying Text-Types Using Latent Semantic Analysis to Measure the Cohesion of Text Structures: Introduction, Cohesion, Coh-Metrix, Approaches to Analyzing Texts, Latent Semantic Analysis, Predictions, Results of Experiments.

Automatic Document Separation: A Combination of Probabilistic Classification and Finite-State Sequence Modeling: Introduction, Related Work, Data Preparation, Document Separation as a Sequence Mapping Problem, Results.

Evolving Explanatory Novel Patterns for Semantically-Based Text Mining: Related Work, A Semantically Guided Model for Effective Text Mining.

Textbook 2: Ch. 6,7,8,9

Teaching-Learning Process	Chalk and board, Online Demonstration
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Module-5

INFORMATION RETRIEVAL AND LEXICAL RESOURCES: Information Retrieval: Design features of Information Retrieval Systems-Classical, Non classical, Alternative Models of Information Retrieval – valuation Lexical Resources: World Net-Frame Net- Stemmers-POS Tagger- Research Corpora.

Textbook 1: Ch. 9,12

Teaching-Learning Process	Chalk and board, Online Demonstration
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Course Outcomes

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

- CO 1. Analyse the natural language text.
- CO 2. Define the importance of natural language.
- CO 3. Understand the concepts Text mining.
- CO 4. Illustrate information retrieval techniques.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks (duration 01 hour)**

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

4. First assignment at the end of 4th week of the semester
5. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks (duration 01 hours)**

6. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper has to be designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours**)

1. The question paper will have ten questions. Each question is set for 20 marks
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module
Marks scored shall be proportionally reduced to 50 marks

Suggested Learning Resources:

Textbooks

1. Tanveer Siddiqui, U.S. Tiwary, "Natural Language Processing and Information Retrieval", Oxford University Press, 2008.
2. Anne Kao and Stephen R. Poteet (Eds), "Natural Language Processing and Text Mining", Springer-Verlag London Limited 2007.

Reference Books:

1. Daniel Jurafsky and James H Martin, "Speech and Language Processing: An introduction to Natural Language Processing, Computational Linguistics and Speech Recognition", 2nd Edition, Prentice Hall, 2008.
2. James Allen, "Natural Language Understanding", 2nd edition, Benjamin/Cummings publishing company, 1995.
3. Gerald J. Kowalski and Mark.T. Maybury, "Information Storage and Retrieval systems", Kluwer academic Publishers, 2000.

Weblinks and Video Lectures (e-Resources):

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

VI Semester

COMPUTER GRAPHICS AND FUNDAMENTALS OF IMAGE PROCESSING			
Course Code	21AI644	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03
Course Objectives: CLO 1. Overview of Computer Graphics along with its applications. CLO 2. Exploring 2D and 3D graphics mathematics along with OpenGL API's. CLO 3. Use of Computer graphics principles for animation and design of GUI's . CLO 4. Introduction to Image processing and Open CV. CLO 5. Image segmentation using Open CV.			
Teaching-Learning Process (General Instructions) These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes. <ol style="list-style-type: none">1. Lecturer method (L) need not to be only traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.2. Use of Video/Animation to explain functioning of various concepts.3. Encourage collaborative (Group Learning) Learning in the class.4. Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyse information rather than simply recall it.6. Introduce Topics in manifold representations.7. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.			
Module-1			
Overview: Computer Graphics hardware and software and OpenGL: Computer Graphics: Video Display Devices, Raster-Scan Systems Basics of computer graphics, Application of Computer Graphics.OpenGL: Introduction to OpenGL,coordinate reference frames, specifying two-dimensional world coordinate reference frames in OpenGL, OpenGL point functions, OpenGL line functions, point attributes, line attributes, curve attributes, OpenGL point attribute functions, OpenGL line attribute functions, Line drawing algorithms(DDA, Bresenham's).			
Textbook 1: Chapter -1,2,3, 5(1 and 2 only) Self-study topics : Input devices, hard copy devices, coordinate representation, graphics functions, fill area primitives, polygon fill areas, pixel arrays, Parallel Line algorithms			
Teaching-Learning Process	Chalk&board,Active Learning Virtual Lab		
Module-2			
2D and 3D graphics with OpenGL: 2D Geometric Transformations: Basic 2D Geometric Transformations, matrix representations and homogeneous coordinates, 2D Composite transformations, other 2D transformations, raster methods for geometric transformations, OpenGL raster transformations, OpenGL geometric transformations function,			
3D Geometric Transformations: Translation, rotation, scaling, composite 3D transformations, other 3D transformations, OpenGL geometric transformations functions			

Textbook 1: Chapter -6, 8 Self-study topics: Transformation between 2D coordinate system, OpenGL geometric-transformation, Transformation between 3D coordinate system.	
Teaching-Learning Process	Chalk & board, Active Learning, Problem based learning Virtual Lab:
Module-3	
Interactive Input Methods and Graphical User Interfaces: Graphical Input Data ,Logical Classification of Input Devices, Input Functions for Graphical Data , Interactive Picture-ConstructionTechniques, Virtual-Reality Environments, OpenGL Interactive Input-DeviceFunctions, OpenGL Menu Functions , Designing a Graphical User Interface.	
Computer Animation : Design of Animation Sequences, Traditional Animation Techniques, General Computer-AnimationFunctions, Computer-Animation Languages, Character Animation, Periodic Motions, OpenGL Animation Procedures.	
Textbook 1: Chapter -11, 18 Self-study topics: Raster methods for computer animation, Key frame systems, Motion specification.	
Teaching-Learning Process	Chalk & board, MOOC, Active Learning
Module-4	
Introduction to Image processing: overview, Nature of IP, IP and its related fields, Digital Image representation, types of images.	
Digital Image Processing Operations: Basic relationships and distance metrics, Classification of Image processing Operations.	
Text book 2: Chapter 3 <i>(Below topics is for experiential learning only , No questions in SEE)</i> Computer vision and OpenCV: What is computer vision, Evolution of computer vision, Application of Computer vision, Feature of OpenCV, OpenCV library modules, OpenCV environment, Reading, writing and storing images using OpenCV. OpenCV drawing Functions. OpenCV Geometric Transformations.	
<u>(Note : Computer vision and OpenCV for experimental learning or Activity Based Learning using web sources, Preferred for assignments. No questions in SEE)</u> Web Source: https://www.tutorialspoint.com/opencv/	
Teaching-Learning Process	Chalk& board, Problem based learning Lab practice for OpenCV for basic geometric objects and basic image operation
Module-5	
Image Segmentation: Introduction, classification, detection of discontinuities, Edge detection (up to canny edge detection(included)). Text Book 2: Chapter 9: 9.1 to 9.4.4.4	
<i>(Below topics is for experiential learning only , No questions in SEE)</i> Image processing with Open CV: Resizing , Rotation/ Flipping, Blending, Creating region of Interest (ROI), Image Thresholding, Image Blurring and smoothing, Edge Detection, Image contours and Face Detection on images using OpenCV.	
<u>(Note :Image Processing withOpenCV for experimental learning or Activity Based</u>	

Learning using web sources, Preferred for assignments. No questions in SEE)

Web source: <https://medium.com/analytics-vidhya/introduction-to-computer-vision-opencv-in-python-fb722e805e8b>

Teaching-Learning Process	Chalk & board, MOOC Lab practice on image processing. Virtual Lab:
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Course Outcomes:

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

- CO 1. Construct geometric objects using Computer Graphics principles and OpenGL APIs.
- CO 2. Use OpenGL APIs and related mathematics for 2D and 3D geometric Operations on the objects.
- CO 3. Design GUI with necessary techniques required to animate the created objects
- CO 4. Apply OpenCV for developing Image processing applications.
- CO 5. Apply Image segmentation techniques along with programming, using OpenCV, for developing simple applications.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks (duration 01 hour)**

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

4. First assignment at the end of 4th week of the semester
5. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks (duration 01 hours)**

6. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(To have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours**)

3. The question paper will have ten questions. Each question is set for 20 marks.
4. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

The students have to answer 5 full questions, selecting one full question from each module. Marks scored shall be proportionally reduced to 50 marks

Suggested Learning Resources:

Text Books

1. Donald D Hearn, M Pauline Baker and Warren Carithers: Computer Graphics with OpenGL 4th Edition, Pearson, 2014
2. S. Sridhar, Digital Image Processing, second edition, Oxford University press 2016.

Reference Books

1. Edward Angel: Interactive Computer Graphics- A Top Down approach with OpenGL, 5th edition. Pearson Education, 2008
2. James D Foley, Andries Van Dam, Steven K Feiner, John F Huges Computer graphics with OpenGL: Pearson education

Web links and Video Lectures (e-Resources):

1. <https://nptel.ac.in/courses/106/106/106106090/>
2. <https://nptel.ac.in/courses/106/102/106102063/>
3. <https://nptel.ac.in/courses/106/103/106103224/>
4. <https://nptel.ac.in/courses/106/102/106102065/>
5. <https://www.tutorialspoint.com/opencv/> (Tutorial, Types of Images, Drawing Functions)

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

Mini project on computer graphics using Open GL/Python/Open CV.

VI Semester

INTRODUCTION TO DATA STRUCTURES			
Course Code	21CS651	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03
Course Learning Objectives			
CLO 1. Introduce elementary data structures.			
CLO 2. Analyze Linear Data Structures: Stack, Queues, Lists			
CLO 3. Analyze Non Linear Data Structures: Trees			
CLO 4. Assess appropriate data structure during program development/Problem Solving.			
Teaching-Learning Process (General Instructions)			
These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.			
<div><div>1.</div><div>Lecturer method (L) need not to be only a traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.</div></div> <div><div>2.</div><div>Use of Video/Animation to explain functioning of various concepts.</div></div> <div><div>3.</div><div>Encourage collaborative (Group Learning) Learning in the class.</div></div> <div><div>4.</div><div>Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.</div></div> <div><div>5.</div><div>Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyze information rather than simply recall it.</div></div> <div><div>6.</div><div>Introduce Topics in manifold representations.</div></div> <div><div>7.</div><div>Show the different ways to solve the same problem with different circuits/logic and encourage the students to come up with their own creative ways to solve them.</div></div> <div>Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.</div>			
Module-1			
Introduction:			
Introduction to arrays: one-dimensional arrays, two dimensional arrays, initializing two dimensional arrays, Multidimensional arrays.			
Introduction to Pointers: Pointer concepts, accessing variables through pointers, Dynamic memory allocation, pointers applications.			
Introduction to structures and unions: Declaring structures, Giving values to members, structure initialization, arrays of structures, nested structure, unions, size of structures.			
Textbook 1: Ch 8.3 to 8.15,Ch 12.3 to 12.19			
Textbook 2:Ch 2.1 to2.13,2.51 ,2.80 to 2.98			
Teaching-Learning Process	Chalk and board, Active Learning		
Module-2			
Linear Data Structures-Stacks and queues:			
Introduction, Stack representation in Memory, Stack Operations, Stack Implementation, Applications of Stack. Introduction, Queues-Basic concept, Logical representation of Queues, Queue Operations and its types, Queue Implementation, Applications of Queue.			
Textbook 2: Ch 6.1 to 6.14 ,Ch 8.1,8.2			
Teaching-Learning Process	Chalk and board, Active Learning, Problem Based Learning		
Module-3			
Linear Data Structures-Linked List:			
Introduction, Linked list Basic concept, Logical representation of Linked list, Self-Referential structure, Singly-linked List Operations and Implementation, Circular Linked List, applications of Linked list.			

Textbook 1: Ch 15.1,15.3,15.4,15.8	
Textbook 2: Ch 9.2.9.5	
Teaching-Learning Process	Chalk and board, Active Learning, Problem based learning
Module-4	
Non Linear Data Structures – Trees	
Introduction, Basic concept, Binary Tree and its types, Binary Tree Representation, Binary Tree Traversal, Binary Search tree, Expression Trees.	
Textbook1: Ch 16.1,16.2	
Textbook2:Ch 10.1,10.2,10.4,10.6.3	
Teaching-Learning Process	Chalk& board, Active Learning, Problem based learning
Module-5	
Sorting and Searching	
Sorting: Introduction, Bubble sort, Selection sort, Insertion sort	
Searching: Introduction, Linear search, Binary search.	
Textbook1: Ch 17.1,17.2.2, 17.2.4, 17.3.1,17.3.2	
Textbook2: Ch 11.1,11.2,11.3,11.7,11.10.1,11.10.2	
Teaching-Learning Process	Chalk and board, Active Learning, Problem based learning
Course Outcomes	
At the end of the course the student will be able to:	
CO 1. Express the fundamentals of static and dynamic data structure.	
CO 2. Summarize the various types of data structure with their operations.	
CO 3. Interpret various searching and sorting techniques.	
CO 4. Choose appropriate data structure in problem solving.	
CO 5. Develop all data structures in a high level language for problem solving.	
Assessment Details (both CIE and SEE)	
The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together	
Continuous Internal Evaluation:	
Three Unit Tests each of 20 Marks (duration 01 hour)	
1. First test at the end of 5 th week of the semester	
2. Second test at the end of the 10 th week of the semester	
3. Third test at the end of the 15 th week of the semester	
Two assignments each of 10 Marks	
4. First assignment at the end of 4 th week of the semester	
5. Second assignment at the end of 9 th week of the semester	
Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for 20 Marks (duration 01 hours)	
6. At the end of the 13 th week of the semester	
The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be scaled down to 50 marks	
(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).	
CIE methods /question paper has to be designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.	
Semester End Examination:	
Theory SEE will be conducted by University as per the scheduled timetable, with common question	

papers for the subject (**duration 03 hours**)

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module. Marks scored shall be proportionally reduced to 50 marks

Suggested Learning Resources:

Textbooks

1. C Programming and data structures, E Balaguruswamy 4th Edition, 2007, McGraw Hill
2. Systematic approach to Data structures using C, A M Padma Reddy, 7th Edition 2007, Sri Nandi Publications.

References

1. Ellis Horowitz and Sartaj Sahni, Fundamentals of Data Structures in C, 2nd Ed, Universities Press, 2014.
2. Seymour Lipschutz, Data Structures Schaum's Outlines, Revised 1st Ed, McGraw Hill, 2014.

Weblinks and Video Lectures (e-Resources):

1. https://www.youtube.com/watch?v=DFpWCl_49i0
2. <https://www.youtube.com/watch?v=x7t-ULoAZM>
3. <https://www.youtube.com/watch?v=I37kGX-nZEI>
4. <https://www.youtube.com/watch?v=XuCbpw6Bj1U>
5. <https://www.youtube.com/watch?v=R9PTBwOzceo>
6. <https://www.youtube.com/watch?v=qH6yxkw0u78>

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

Demonstration of projects developed using Linear/Non-linear data structures

VI Semester

INTRODUCTION TO DATABASE MANAGEMENT SYSTEMS			
Course Code	21CS652	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03
Course Learning Objectives CLO 1. Understand the basic concepts and the applications of database systems. CLO 2. Understand the relational database design principles. CLO 3. Master the basics of SQL and construct queries using SQL. CLO 4. Familiar with the basic issues of transaction processing and concurrency control.			
Teaching-Learning Process (General Instructions) These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes. <ol style="list-style-type: none">1. Lecturer method (L) need not be only a traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.2. Use of Video/Animation to explain the functioning of various concepts.3. Encourage collaborative (Group Learning) Learning in the class.4. Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develops design thinking skills such as the ability to design, evaluate, generalize, and analyze information rather than simply recall it.6. Introduce Topics in manifold representations.7. Show the different ways to solve the same problem with different circuits/logic and encourage the students to come up with their own creative ways to solve them.8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.			
Module-1			
Introduction to Databases: Introduction, Characteristics of database approach, Advantages of using the DBMS approach, History of database applications.			
Overview of Database Languages and Architectures: Data Models, Schemas, and Instances. Three schema architecture and data independence, database languages, and interfaces, The Database System environment.			
Conceptual Data Modelling using Entities and Relationships: Entity types, Entity sets, attributes, roles, and structural constraints, Weak entity types, ER diagrams,Examples			
Textbook 1: Ch 1.1 to 1.8, 2.1 to 2.6, 3.1 to 3.7			
Teaching-Learning Process	Chalk and board, Active Learning, Problem based learning		
Module-2			
Relational Model: Relational Model Concepts, Relational Model Constraints and relational database schemas, Update operations, transactions, and dealing with constraint violations.			
Relational Algebra: Relational algebra: introduction, Selection and projection, set operations, renaming, Joins, Division, syntax, semantics. Operators, grouping and ungrouping, relational comparison. Examples of Queries in relational algebra.			
Mapping Conceptual Design into a Logical Design: Relational Database Design using ER-to-Relational mapping.			
Textbook 1:,ch5.1 to 5.3, 8.1 to 8.5, 9.1;			

Teaching-Learning Process	Chalk and board, Active Learning, Demonstration
Module-3	
SQL: SQL data definition and data types, specifying constraints in SQL, retrieval queries in SQL, INSERT, DELETE, and UPDATE statements in SQL, Additional features of SQL. Advances Queries: More complex SQL retrieval queries, Specifying constraints as assertions and action triggers, Views in SQL, Schema change statements in SQL.Database	
Textbook 1: Ch 6.1 to 6.5, 7.1 to 7.4; Textbook 2: 6.1 to 6.6;	
Teaching-Learning Process	Chalk and board, Problem based learning, Demonstration
Module-4	
Normalization: Database Design Theory – Introduction to Normalization using Functional and Multivalued Dependencies: Informal design guidelines for relation schema, Functional Dependencies, Normal Forms based on Primary Keys, Second and Third Normal Forms, Boyce-Codd Normal Form, Multivalued Dependency and Fourth Normal Form, Join Dependencies and Fifth Normal Form. Examples on normal forms.	
Textbook 1: Ch 14.1 to -14.7, 15.1 to 15.6	
Teaching-Learning Process	Chalk& board, Problem based learning
Module-5	
Transaction management and Concurrency –Control Transaction management: ACID properties, serializability and concurrency control, Lock based concurrency control (2PL, Deadlocks), Time stamping methods, optimistic methods, database recovery management.	
Textbook 1: Ch 20.1 to 20.6, 21.1 to 21.7;	
Teaching-Learning Process	Chalk and board, MOOC
Course Outcomes At the end of the course the student will be able to: CO 1. Identify, analyze and define database objects, enforce integrity constraints on a database using RDBMS CO 2. Use Structured Query Language (SQL) for database manipulation. CO 3. Design and build simple database systems CO 4. Develop application to interact with databases.	
Assessment Details (both CIE and SEE) The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together Continuous Internal Evaluation: Three Unit Tests each of 20 Marks (duration 01 hour) <ol style="list-style-type: none"> 1. First test at the end of 5th week of the semester 2. Second test at the end of the 10th week of the semester 3. Third test at the end of the 15th week of the semester Two assignments each of 10 Marks <ol style="list-style-type: none"> 4. First assignment at the end of 4th week of the semester 5. Second assignment at the end of 9th week of the semester Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for 20 Marks (duration 01 hours) <ol style="list-style-type: none"> 6. At the end of the 13th week of the semester 	

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper has to be designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours**)

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module. Marks scored shall be proportionally reduced to 50 marks

Suggested Learning Resources:

Textbooks

1. Fundamentals of Database Systems, RamezElmasri and Shamkant B. Navathe, 7th Edition, 2017, Pearson.
2. Database management systems, Ramakrishnan, and Gehrke, 3rd Edition, 2014, McGraw Hill

Weblinks and Video Lectures (e-Resources):

1. <https://www.youtube.com/watch?v=3EJlovevfcA>
2. <https://www.youtube.com/watch?v=9TwMRs3qTcU>
3. <https://www.youtube.com/watch?v=ZWl0Xow304I>
4. <https://www.youtube.com/watch?v=4YilEjkNPrQ>
5. <https://www.youtube.com/watch?v=CZTkgMoqVss>
6. <https://www.youtube.com/watch?v=Hl4NZB1XR9c>
7. https://www.youtube.com/watch?v=EGEwkad_IIA
8. <https://www.youtube.com/watch?v=t5hsV9lC1rU>

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

Real world problem solving: Developing and demonstration of models / projects based on DBMS application

VI Semester

INTRODUCTION TO CYBER SECURITY			
Course Code	21CS653	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03
Course Learning Objectives CLO 1. To familiarize cybercrime terminologies and ACTs CLO 2. Understanding cybercrime in mobiles and wireless devices along with the tools for Cybercrime and prevention CLO 3. Understand the motive and causes for cybercrime, cybercriminals, and investigators CLO 4. Understanding criminal case and evidence, detection standing criminal case and evidence.			
Teaching-Learning Process (General Instructions) These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes. <ol style="list-style-type: none">1. Lecturer method (L) need not to be only a traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.2. Use of Video/Animation to explain functioning of various concepts.3. Encourage collaborative (Group Learning) Learning in the class.4. Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyze information rather than simply recall it.6. Introduce Topics in manifold representations.7. Show the different ways to solve the same problem with different circuits/logic and encourage the students to come up with their own creative ways to solve them.8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.			
Module-1			
Introduction to Cybercrime: Cybercrime: Definition and Origins of the Word, Cybercrime and Information Security, Who are Cybercriminals? Classifications of Cybercrimes, Cybercrime: The Legal Perspectives, Cybercrimes: An Indian Perspective, Cybercrime and the Indian ITA 2000. Textbook1:Ch1 (1.1 to 1.8).			
Teaching-Learning Process	Chalk and board, Active Learning		
Module-2			
Cyber offenses: How Criminals Plan Them: Introduction, How Criminals Plan the Attacks, Social Engineering, Cyber stalking, Cybercafe and Cybercrimes. Botnets: The Fuel for Cybercrime, Attack Vector Textbook1: Ch2 (2.1 to 2.7).			
Teaching-Learning Process	Chalk and board, Active Learning		
Module-3			
Tools and Methods Used in Cybercrime: Introduction, Proxy Servers and Anonymizers, Phishing, Password Cracking, Key loggers and Spywares, Virus and Worms, Trojan Horses and Backdoors, Steganography, DoS and DDoS Attacks, Attacks on Wireless Networks.			

Textbook1: Ch4 (4.1 to 4.9, 4.12).	
Teaching-Learning Process	Chalk and board, Case studies
Module-4	
<p>Understanding the people on the scene: Introduction, understanding cyber criminals, understanding cyber victims, understanding cyber investigators.</p> <p>The Computer Investigation process: investigating computer crime.</p> <p>Understanding Cybercrime Prevention: Understanding Network Security Concepts, Understanding Basic Cryptography Concepts, Making the Most of Hardware and Software Security</p>	
Textbook 2:Ch3,Ch 4, Ch 7.	
Teaching-Learning Process	Chalk& board, Case studies
Module-5	
<p>Cybercrime Detection Techniques: Security Auditing and Log Firewall Logs, Reports, Alarms, and Alerts, Commercial Intrusion Detection Systems, Understanding E-Mail Headers Tracing a Domain Name or IP Address.</p> <p>Collecting and preserving digital Evidence: Introduction, understanding the role of evidence in a criminal case, collecting digital evidence, preserving digital evidence, recovering digital evidence, documenting evidence.</p>	
TextBook 2:Ch 9, Ch 10.	
Teaching-Learning Process	Chalk and board, Case studies
<p>Course Outcomes</p> <p>At the end of the course the student will be able to:</p> <ul style="list-style-type: none"> CO 1. Describe the cyber crime terminologies CO 2. Analyze cybercrime in mobiles and wireless devices along with the tools for Cybercrime and prevention CO 3. Analyze the motive and causes for cybercrime, cybercriminals, and investigators CO 4. Apply the methods for understanding criminal case and evidence, detection standing criminal case and evidence. 	
<p>Assessment Details (both CIE and SEE)</p> <p>The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together</p> <p>Continuous Internal Evaluation:</p> <p>Three Unit Tests each of 20 Marks (duration 01 hour)</p> <ol style="list-style-type: none"> 1. First test at the end of 5th week of the semester 2. Second test at the end of the 10th week of the semester 3. Third test at the end of the 15th week of the semester <p>Two assignments each of 10 Marks</p> <ol style="list-style-type: none"> 4. First assignment at the end of 4th week of the semester 5. Second assignment at the end of 9th week of the semester <p>Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for 20 Marks (duration 01 hours)</p> <ol style="list-style-type: none"> 6. At the end of the 13th week of the semester <p>The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be scaled down to 50 marks</p> <p>(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the</p>	

methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper has to be designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours**)

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module
Marks scored shall be proportionally reduced to 50 marks

Suggested Learning Resources:

Textbooks

1. SunitBelapure and Nina Godbole, "Cyber Security: Understanding Cyber Crimes, Computer Forensics And Legal Perspectives", Wiley India Pvt Ltd, ISBN: 978-81- 265-21791, 2013
2. Debra Little John Shinder and Michael Cross, "Scene of the cybercrime", 2nd edition, Syngress publishing Inc, Elsevier Inc, 2008

Reference Books:

1. Robert M Slade, "Software Forensics", Tata McGraw Hill, New Delhi, 2005.
2. Bernadette H Schell, Clemens Martin, "Cybercrime", ABC – CLIO Inc, California, 2004.
3. Nelson Phillips and EnfingerSteuart, "Computer Forensics and Investigations", Cengage Learning, New Delhi, 2009.
4. Kevin Mandia, Chris Proise, Matt Pepe, "Incident Response and Computer Forensics", Tata McGraw -Hill, New Delhi, 2006.

Weblinks and Video Lectures (e-Resources):

1. <https://www.youtube.com/watch?v=czDzUP1HclQ>
2. <https://www.youtube.com/watch?v=qS4Viqnjkc8>
3. https://www.trendmicro.com/en_nz/ciso/21/h/cybercrime-today-and-the-future.html

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

Real world problem solving: Demonstration of projects related to Cyber security.

VI Semester

PROGRAMMING IN JAVA			
Course Code	21CS654	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03
Course Learning Objectives CLO 1. Learn fundamental features of object oriented language and JAVA. CLO 2. To create, debug and run simple Java programs. CLO 3. Learn object oriented concepts using programming examples. CLO 4. Study the concepts of importing of packages and exception handling mechanism. CLO 5. Discuss the String Handling examples with Object Oriented concepts.			
Teaching-Learning Process (General Instructions) These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes. <ol style="list-style-type: none">1. Lecturer method (L) need not to be only a traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.2. Use of Video/Animation to explain functioning of various concepts.3. Encourage collaborative (Group Learning) Learning in the class.4. Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyze information rather than simply recall it.6. Introduce Topics in manifold representations.7. Show the different ways to solve the same problem with different circuits/logic and encourage the students to come up with their own creative ways to solve them.8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.			
Module-1			
An Overview of Java: Object-Oriented Programming, A First Simple Program, A Second Short Program, Two Control Statements, Using Blocks of Code, Lexical Issues, The Java Class Libraries. Data Types, Variables, and Arrays: Java Is a Strongly Typed Language, The Primitive Types, Integers, Floating-Point Types, Characters, Booleans, A Closer Look at Literals, Variables, Type Conversion and Casting, Automatic Type Promotion in Expressions, Arrays, A Few Words About Strings Textbook 1:Ch 2,Ch 3.			
Teaching-Learning Process		Chalk and board, Problem based learning.	
Module-2			
Operators: Arithmetic Operators, The Bitwise Operators, Relational Operators, Boolean Logical Operators, The Assignment Operator, The ? Operator, Operator Precedence, Using Parentheses, Control Statements: Java's Selection Statements, Iteration Statements, Jump Statements. Textbook 1:Ch 4,Ch 5.			
Teaching-Learning Process		Chalk and board, Active Learning, Demonstration	
Module-3			
Introducing Classes: Class Fundamentals, Declaring Objects, Assigning Object Reference Variables, Introducing Methods, Constructors, The this Keyword, Garbage Collection, The finalize() Method, A Stack Class. A Closer Look at Methods and Classes: Overloading Methods, Using Objects as Parameters, A Closer			

Look at Argument Passing, Returning Objects, Recursion, Introducing Access Control, Understanding static, Introducing final, Arrays Revisited. **Inheritance:** Inheritance, Using super, Creating a Multilevel Hierarchy, When Constructors Are Called, Method Overriding.

Textbook 1: Ch 6, Ch 7.1-7.9, Ch 8.1-8.5

Teaching-Learning Process	Chalk and board, Problem based learning, Demonstration
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Module-4

Packages and Interfaces: Packages, Access Protection, Importing Packages, Interfaces.

Exception Handling: Exception-Handling Fundamentals, Exception Types, Uncaught Exceptions, Using try and catch, Multiple catch Clauses, Nested try Statements, throw, throws, finally, Java's Built-in Exceptions, Creating Your Own Exception Subclasses, Chained Exceptions, Using Exceptions

Textbook 1: Ch 9, Ch 10.

Teaching-Learning Process	Chalk & board, Problem based learning, Demonstration
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Module-5

Enumerations : Enumerations, Type Wrappers.

String Handling: The String Constructors, String Length, Special String Operations, Character Extraction, String Comparison, Searching Strings, Modifying a String, Data Conversion Using valueOf(), Changing the Case of Characters Within a String, Additional String Methods, StringBuffer, StringBuilder.

Textbook 1: Ch 12.1, 12.2, Ch 15.

Teaching-Learning Process	Chalk and board, Problem based learning, Demonstration
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Course Outcomes

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

- CO 1. Develop JAVA programs using OOP principles and proper program structuring.
- CO 2. Develop JAVA program using packages, inheritance and interface.
- CO 3. Develop JAVA programs to implement error handling techniques using exception handling
- CO 4. Demonstrate string handling concepts using JAVA.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks (duration 01 hour)**

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

4. First assignment at the end of 4th week of the semester
5. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks (duration 01 hours)**

6. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper has to be designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours**)

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module
3. The students have to answer 5 full questions, selecting one full question from each module
Marks scored shall be proportionally reduced to 50 marks

Suggested Learning Resources:**Textbooks**

1. Herbert Schildt, Java The Complete Reference, 7th Edition, Tata McGraw Hill, 2007. (Chapters 2, 3, 4, 5, 6, 7, 8, 9, 10, 12, 15)

Reference Books:

1. Mahesh Bhave and Sunil Patekar, "Programming with Java", First Edition, Pearson Education, 2008, ISBN: 9788131720806.
2. Rajkumar Buyya, SThamarasiselvi, xingchen chu, Object oriented Programming with java, Tata McGraw Hill education private limited.
3. E Balagurusamy, Programming with Java A primer, Tata McGraw Hill companies.
4. Anita Seth and B L Juneja, JAVA One step Ahead, Oxford University Press, 2017.

Weblinks and Video Lectures (e-Resources):**Activity Based Learning (Suggested Activities in Class)/ Practical Based learning**

Real world problem solving: Demonstration of projects developed using JAVA

VI Semester

MACHINE LEARNING LABORATORY			
Course Code	21AIL66	CIE Marks	50
Teaching Hours/Week(L:T:P:S)	0:0:2:0	SEE Marks	50
Total Hours of Pedagogy	24	Total Marks	100
Credits	1	Exam Hours	03
Course Learning Objectives: CLO 2. To learn and understand the Importance Machine learning Algorithms CLO 3. Compare and contrast the learning techniques like ANN approach, Bayesian learning and reinforcement learning. CLO 4. Able to solve and analyse the problems on ANN, Instance based learning and Reinforcement learning techniques. CLO 5. To impart the knowledge of clustering and classification Algorithms for predictions and evaluating Hypothesis.			
	Prerequisite		
	<ul style="list-style-type: none"> Students should be familiarized about Python installation and setting Python environment Usage and installation of Anaconda should be introduced https://www.anaconda.com/products/individual Should have the knowledge about Probability theory, Statistics theory and linear Algebra. Should have the knowledge of numpy, pandas, scikit-learn and scipy library packages. 		
Sl. No.	PART A – List of problems for which student should develop program and execute in the Laboratory		
1	Aim: Illustrate and Demonstrate the working model and principle of Find-S algorithm. Program: For a given set of training data examples stored in a .CSV file, implement and demonstrate the Find-S algorithm to output a description of the set of all hypotheses consistent with the training examples. Text Book 1: Ch2		
2	Aim: Demonstrate the working model and principle of candidate elimination algorithm. Program: For a given set of training data examples stored in a .CSV file, implement and demonstrate the Candidate-Elimination algorithm to output a description of the set of all hypotheses consistent with the training examples. Text Book 1: Ch2 Reference: https://www.youtube.com/watch?v=tfpAm4kxGQI		
3	Aim: To construct the Decision tree using the training data sets under supervised learning concept. Program: Write a program to demonstrate the working of the decision tree based ID3 algorithm. Use an appropriate data set for building the decision tree and apply this knowledge to classify a new sample. Text Book 1: Ch 3		
4	Aim: To understand the working principle of Artificial Neural network with feed forward and feed backward principle. Program: Build an Artificial Neural Network by implementing the Backpropagation algorithm and test the same using appropriate data sets. Text Book 1: Ch 4		

5	<p>Aim: Demonstrate the text classifier using Naïve bayes classifier algorithm.</p> <p>Program: Write a program to implement the naive Bayesian classifier for a sample training data set stored as a .CSV file. Compute the accuracy of the classifier, considering few test data sets.</p> <p>Text Book 1: Ch6</p>
6	<p>Aim: Demonstrate and Analyse the results sets obtained from Bayesian belief network Principle.</p> <p>Program:- Write a program to construct a Bayesian network considering medical data. Use this model to demonstrate the diagnosis of heart patients using standard Heart Disease Data Set. You can use Python ML library classes/API.</p> <p>Text Book 1: Ch 6</p>
7	<p>Aim: Implement and demonstrate the working model of K-means clustering algorithm with Expectation Maximization Concept.</p> <p>Program: Apply EM algorithm to cluster a set of data stored in a .CSV file. Use the same data set for clustering using k-Means algorithm. Compare the results of these two algorithms and comment on the quality of clustering. You can add Python ML library classes/API in the program.</p> <p>Text Book 1: Ch 8</p>
8	<p>Aim: Demonstrate and analyse the results of classification based on KNN Algorithm.</p> <p>Program: Write a program to implement k-Nearest Neighbour algorithm to classify the iris data set. Print both correct and wrong predictions. Java/Python ML library classes can be used for this problem.</p> <p>Text Book 1: Ch 8</p>
9	<p>Aim: Understand and analyse the concept of Regression algorithm techniques.</p> <p>Program: Implement the non-parametric Locally Weighted Regression algorithm in order to fit data points. Select appropriate data set for your experiment and draw graphs.</p> <p>Text Book 1: Ch8</p>
10	<p>Aim: Implement and demonstrate classification algorithm using Support vector machine Algorithm.</p> <p>Program: Implement and demonstrate the working of SVM algorithm for classification.</p> <p>Text Book 2: Ch6</p>
Pedagogy	For the above experiments the following pedagogy can be considered. Problem based learning, Active learning, MOOC, Chalk & Talk
PART B	
	A problem statement for each batch is to be generated in consultation with the co-examiner and student should develop an algorithm, program and execute the Program for the given problem with appropriate outputs.
<p>Course Outcomes: At the end of the course the student will be able to:</p> <p>CO 1. Understand the Importance of different classification and clustering algorithms.</p> <p>CO 2. Demonstrate the working of various algorithms with respect to training and test data sets.</p> <p>CO 3. Illustrate and analyze the principles of Instance based and Reinforcement learning techniques.</p> <p>CO 4. Elicit the importance and Applications of Supervised and unsupervised machine learning.</p> <p>CO 5. Compare and contrast the Bayes theorem principles and Q learning approach.</p>	
<p>Assessment Details (both CIE and SEE)</p> <p>The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student</p>	

shall be deemed to have satisfied the academic requirements and earned the credits allotted to each course. The student has to secure not less than 35% (18 Marks out of 50) in the semester-end examination (SEE).

Continuous Internal Evaluation (CIE):

CIE marks for the practical course is **50 Marks**.

The split-up of CIE marks for record/ journal and test are in the ratio **60:40**.

- Each experiment to be evaluated for conduction with observation sheet and record write-up. Rubrics for the evaluation of the journal/write-up for hardware/software experiments designed by the faculty who is handling the laboratory session and is made known to students at the beginning of the practical session.
- Record should contain all the specified experiments in the syllabus and each experiment write-up will be evaluated for 10 marks.
- Total marks scored by the students are scaled down to 30 marks (60% of maximum marks).
- Weightage to be given for neatness and submission of record/write-up on time.
- Department shall conduct 02 tests for 100 marks, the first test shall be conducted after the 8th week of the semester and the second test shall be conducted after the 14th week of the semester.
- In each test, test write-up, conduction of experiment, acceptable result, and procedural knowledge will carry a weightage of 60% and the rest 40% for viva-voce.
- The suitable rubrics can be designed to evaluate each student's performance and learning ability. Rubrics suggested in Annexure-II of Regulation book
- The average of 02 tests is scaled down to **20 marks** (40% of the maximum marks). The Sum of scaled-down marks scored in the report write-up/journal and average marks of two tests is the total CIE marks scored by the student.

Semester End Evaluation (SEE):

- SEE marks for the practical course is 50 Marks.
- SEE shall be conducted jointly by the two examiners of the same institute, examiners are appointed by the University
- All laboratory experiments are to be included for practical examination.
- (Rubrics) Breakup of marks and the instructions printed on the cover page of the answer script to be strictly adhered to by the examiners. **OR** based on the course requirement evaluation rubrics shall be decided jointly by examiners.
- Students can pick one question (experiment) from the questions lot prepared by the internal /external examiners jointly.
- Evaluation of test write-up/ conduction procedure and result/viva will be conducted jointly by examiners.
- General rubrics suggested for SEE are mentioned here, writeup-20%, Conduction procedure and result in -60%, Viva-voce 20% of maximum marks. SEE for practical shall be evaluated for 100 marks and scored marks shall be scaled down to 50 marks (however, based on course type, rubrics shall be decided by the examiners)
- *Students can pick one experiment from the questions lot of PART A with equal choice to all the students in a batch. For PART B examiners should frame a question for each batch, student should*

develop an algorithm, program, execute and demonstrate the results with appropriate output for the given problem.


- *Weightage of marks for PART A is 80% and for PART B is 20%. General rubrics suggested to be followed for part A and part B.*
- *Change of experiment is allowed only once and Marks allotted to the procedure part to be made zero (Not allowed for Part B).*
- *The duration of SEE is 03 hours*
- *Rubrics suggested in Annexure-II of Regulation book*

Text Books:

1. Tom M Mitchell, "Machine Learning", 1st Edition, McGraw Hill Education, 2017.
2. Nello Cristianini, John Shawe-Taylor, An Introduction to Support Vector Machines and Other Kernel-based Learning Methods, Cambridge University Press, 2013
3. Allen B. Downey, "Think Python: How to Think Like a Computer Scientist", 2nd Edition, Green Tea Press, 2015. (Available under CC-BY-NC license at <http://greenteapress.com/thinkpython2/thinkpython2.pdf>)

Suggested Web Links / E Resource

1. <https://www.kaggle.com/general/95287>
2. <https://web.stanford.edu/~hastie/Papers/ESLII.pdf>


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