



MOOGAMBIGAI CHARITABLE AND EDUCATIONAL TRUST

Rajarajeswari College of Engineering

(An Autonomous Institution under Visvesvaraya Technological University, Belagavi)

#14, Ramohalli Cross, Kumbalagodu, Mysore Road, Bengaluru-560074



Artificial Intelligence & Machine Learning

III & IV Semester Scheme and Syllabus

(2025 Scheme)

VISION

To empower young minds through technology, research and innovation, to produce technically competent and socially responsible professionals in higher education.

MISSION

1. To deliver excellence in education through innovative teaching, impactful research, and continuous skill development, preparing students to meet global challenges with technical expertise and ethical responsibility.
2. To foster a transformative learning environment that integrates technology, research and practical experience, empowering students to become skilled professionals and socially conscious leaders.
3. To cultivate a culture of lifelong learning and professional excellence by encouraging creativity, research, and community engagement, equipping students with the skills to thrive in a dynamic world.
4. To provide a holistic educational experience that combines advanced technology, hands-on research, and community-focused learning, shaping students into competent, ethical professionals who contribute positively to society.

QUALITY POLICY

Rajarajeswari College of Engineering is committed to imparting quality technical education that nurtures competent, ethical professionals with global relevance. We ensure academic excellence through a dynamic, outcome-based curriculum, experienced faculty, and cutting-edge infrastructure. Continuous improvement is driven by innovation, research and strong industry collaboration. We foster holistic development and a progressive environment that supports lifelong learning, teamwork, and professional growth.

CORE VALUES

Academic Excellence, Integrity, Innovation, Global Competence, Continuous Improvement.

Artificial Intelligence & Machine Learning

DEPARTMENT VISION

To bring out the competent and socially responsible engineers in the field of AI&ML Education, Research and Innovation.

DEPARTMENT MISSION

1. To Inculcate, the integration process of concepts in AI&ML domain.
2. To equip AI&ML graduates with skills to meet Industry and Societal challenges by skill enhanced training.
3. To promote Research and ethical culture through interaction for broader application in AIML domain.

PROGRAM OUTCOMES (POs)

PO1: Engineering Knowledge: Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization as specified in WK1 to WK4 respectively to develop to the solution of complex engineering problems.

PO2: Problem Analysis: Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development. (WK1 to WK4)

PO3: Design/Development of Solutions: Design creative solutions for complex engineering problems and design/develop systems /components / processes to meet identified needs with consideration for the public health and safety, whole-life cost, net zero carbon, culture, society and environment as required. (WK5)

PO4: Conduct Investigations of Complex Problems: Conduct investigations of complex engineering problems using research-based knowledge including design of experiments, modeling, analysis & interpretation of data to provide valid conclusions. (WK8).

PO5: Engineering Tool Usage: Create, select and apply appropriate techniques, resources and modern engineering & IT tools, including prediction and modeling recognizing their limitations to solve complex engineering problems. (WK2 and WK6)

PO6: The Engineer and The World: Analyze and evaluate societal and environmental aspects while solving complex engineering problems for its impact on sustainability with reference to economy, health, safety, legal framework, culture and environment. (WK1, WK5, WK7).

PO7: Ethics: Apply ethical principles and commit to professional ethics, human values, diversity and inclusion; adhere to national & international laws. (WK9)

PO8: Individual and Collaborative Team work: Function effectively as an individual, and as a member or leader in diverse/multi-disciplinary teams.

PO9: Communication: Communicate effectively and inclusively within the community and society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations considering cultural, language, and learning differences

PO10: Project Management and Finance: Apply knowledge and understanding of engineering management principles and economic decision-making and apply these to one's own work, as a member and leader in a team, and to manage projects and in multidisciplinary environments.

PO11: Life-Long Learning: Recognize the need for, and have the preparation and ability for i) independent and life-long learning ii) adaptability to new and emerging technologies and iii) critical thinking in the broadest context of technological change.
(WK8)

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

PEO1: Develop competent profession in the field of Artificial Intelligence and Machine Learning towards advanced skills in solving contemporary problems.

PEO2: Pursue their professional on technical and progress towards Research and Entrepreneurship.

PEO3: Progress as skilled in team and adapting leadership qualities and ethical values as per the society.

PROGRAM SPECIFIC OUTCOMES (PSOs)

PSO1: Design and develop AI&ML Solution, through modern engineering tools and Programming Language, Technical skills in presenting modern insights.

PSO2: Ability to adapt continues changing AI&ML domain for innovative challenges.

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MOOGAMBIGAI CHARITABLE AND EDUCATIONAL TRUST
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DEPARTMENT OF ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING
 Scheme of Teaching and Examinations – 2025 Scheme
 Outcome Based Education (OBE) and Choice Based Credit System (CBCS)

III Semester

Academic Year: 2026-27

S.No	Course Category and Course Code		Course Title	TD	Teaching Hours / Semester				Examination				Credits
					Lecture	Tutorial	Practical	TW + SL	CIE Marks	SEE Marks	Total marks	SEE Duration in hours	
1.	ASC	B25MCS301	Probability and Statistics	Maths	42	28	0	50	50	50	100	3	4
2.	PCC	B25CS302	Data Structures and its Applications	AI	28	28	0	34	50	50	100	3	3
3.	IPCC	B25CS303	Digital Design and Computer Organization	AI	42	0	28	50	50	50	100	3	4
4.	PCC	B25CS304	Operating Systems	AI	42	0	0	48	50	50	100	3	3
5.	PCC	B25AI305	OOPs using Java	AI	42	0	0	48	50	50	100	3	3
6.	PCCL	B25CSL306	Data Structures and its Applications Lab	AI	0	0	28	2	50	50	100	3	1
7.	AEC	B25AIL307	OOPs using Java Lab	AI	0	0	28	2	50	50	100	3	1
8.	SDC	B25CSP308	Community/ Societal Project	AI	0	0	0	30	50	50	100	3	1
9.	NCMC	B25MAD309	Additional Mathematics - I	Maths	42	0	0	0	100	-	100	-	PP
10.	NCMC	B25NCK410A/B/C/D/E	National Service Scheme /National Cadet Corps / Physical Education/ Yoga /Music	HSS	2	0	0	0	100	-	-	100	PP
11.	SEC	B25SKL311	Skill Laboratory	Concerned Dept.	0	0	30	0	100	-	100	-	1
TOTAL									700	400	1100		21

ASC: Applied Science Courses, BSC: Basic Science Course, HSMC: Humanities Studies and Management courses, IPCC: Integrated Professional Core Course, PCC: Professional Core Course, PCCL: Professional Core Course laboratory, NCMC: Non-Credit Mandatory Course, AEC: Ability Enhancement Course, SDC: Skill Development Course, L: Lecture, T: Tutorial, P: Practical, S: Self-Learning, CIE: Continuous Internal Evaluation, SEE: Semester End Evaluation, PP/NP: Pass/Not Pass, XX: Programme Code (EC, CS, IS etc.), Y: A/B/C/D, K: Indicates Common Course to all the streams of Engineering

HoD

Dean-Academics

Principal



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IV Semester

Academic Year: 2026-27

S. No	Course Category and Course Code		Course Title	TD	Teaching Hours / Semester				Examination				Credits
					Lecture	Tutorial	Practical	TW + SL	CIE Marks	SEE Marks	Total marks	SEE Duration in hours	
					L	T	P	S					
1.	ASC	B25MCS401	Discrete Mathematical Structures	Maths	42	28	0	50	50	50	100	3	4
2.	PCC	B25CS402	Database Management Systems	AI	42	28	0	50	50	50	100	3	4
3.	IPCC	B25CS403	Design and Analysis of Algorithms	AI	42	0	28	50	50	50	100	3	4
4.	PCC	B25AI404	Principles of Artificial Intelligence	AI	42	0	0	48	50	50	100	3	3
5.	BSC	B25BEK405	Biology for Engineers	AI	28	0	0	32	50	50	100	2	2
6.	PCCL	B25CSL406	Database Management Systems lab	AI	0	0	28	2	50	50	100	3	1
7.	AEC	B25AIL407	Principles of Artificial Intelligence Lab	AI	0	0	28	2	50	50	100	3	1
8.	SDC	B25CSP408	Environmental Science Project	AI	0	0	0	30	50	50	100	3	1
9.	NCMC	B25MAD409	Additional Mathematics - II	Maths	42	0	0	0	100	-	100	-	PP
10.	NCMC	B25NCK410A/B/C/D/E	National Service Scheme/National Cadet Corps/Physical Education/Yoga/ Music	HSS	0	0	0	28	100		100		PP
11.	SEC	B25SKL411	Skill Laboratory	Concerned Dept.	0	0	30	0	100	-	100	-	1
TOTAL									700	400	1100		21

ASC: Applied Science Courses, BSC: Basic Science Course, HSMC: Humanities Studies and Management courses, IPCC: Integrated Professional Core Course, PCC: Professional Core Course, PCCL: Professional Core Course laboratory, NCMC: Non-Credit Mandatory Course, AEC: Ability Enhancement Course, SDC: Skill Development Course, L: Lecture, T: Tutorial, P: Practical, S: Self-Learning, CIE: Continuous Internal Evaluation, SEE: Semester End Evaluation, PP/NP: Pass/Not Pass, XX: Programme Code (EC, CS, IS etc.), Y: A/B/C/D, K: Indicates Common Course to all the streams of Engineering



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NSS / NCC / PE / Yoga / Music: All students are required to register for any one of the following courses: National Service Scheme/National Cadet Corps/Physical Education /Yoga/ Music - with the respective course coordinator during the first week of the third semester. **Colleges shall submit Continuous Internal Evaluation (CIE) marks for each semester based on the activities completed by students under the selected course. Students may opt for different activities/options across semesters. For instance, a student participating in PE during 3rd semester may choose NSS in the 4th semester or Yoga. Activities shall be conducted over two semesters (III and IV), and successful completion of the registered course/or courses along with the required CIE score is mandatory for the award of the degree. Institutions must ensure that events are appropriately scheduled and reflected in the semester-wise calendar for NSS, PE, Music, and Yoga activities.**

These courses shall not be considered for the calculation of SGPA or CGPA and for vertical progression. However, completion of course(s) is compulsory for degree eligibility.

The course **B25XX407Y** – Ability Enhancement Course Laboratory can be offered either as a single compulsory course. Alternatively, the course **B25XX407Y** - Ability Enhancement Course Laboratory shall be offered as multiple elective options under the course codes **B25XX407Y** (where Y =A/B/C/D)

Environmental Science Project: The Environmental Science Project is an applied learning component designed to develop students' awareness, understanding, and responsibility toward the environment. It provides an opportunity to study real-world environmental issues and apply scientific and engineering principles to design feasible and sustainable solutions.

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Department of Artificial Intelligence and Machine Learning

Semester-III			
Probability and Statistics			
Category: ASC			
(Common to CSE, CSD, CSE(IC), ISE, AIML)			
Course Code	: B25MCS301	CIE	: 50 Marks
Teaching Hours L : T : P : S	: 42:28:0:50	SEE	: 50 Marks
Total Hours/Semester	: 120	Total	: 100 Marks
Credits	: 4	SEE Duration	: 3 Hrs

Course Learning Objective is

1.	To introduce the concept of random variables, probability distributions, specific discrete and continuous distributions with practical application in Computer Science Engineering and social life situations.
2.	To understand and analyze the probabilistic relationships between multiple random variables and determining relationships like co-variance and correlation.
3.	To Provide the principles of statistical inference sand the basics of hypothesis testing with emphasis on some commonly Encountered hypotheses.
4.	To Determine whether an input has a statistically significant effect on the system's response through ANOVA testing.

Module-1	No. of Hrs
Probability Distributions: Review of Basic Probability Theory. Random Variables (Discrete And Continuous), Probability Mass and Density Functions, Mean And Variance. Binomial, Poisson, Exponential and Normal Distributions - Problems (Derivations For Mean And Standard Deviation For Binomial And Poisson Distributions Only)-Illustrative Examples.	14
Module-2	No. of Hrs
Joint Probability Distribution & Markov Chain: Joint Probability Distribution For Two Discrete Random Variables, Expectation, Covariance and Correlation. Markov Chain: Introduction To Stochastic Process, Probability Vectors, Stochastic Matrices, Regular Stochastic Matrices, Markov Chains, Higher Transition Probabilities, Stationary Distribution of Regular Markov Chains and Absorbing States.	14
Module-3	No. of Hrs
Statistical Inference-I: Introduction, Sampling Distribution, Standard Error, Testing Of Hypothesis, Levels Of Significance, Test of Significance, Confidence Limits, Simple Sampling Of Attributes, Test Of Significance For Large Samples, Comparison Of Large Samples.	14
Module-4	No. of Hrs
Statistical Inference-II: Sampling variables, Central limit theorem and confidence limits for unknown means. Test of significance for means of two small samples, Student's distribution, Chi-square distribution as a test of goodness of fit .F-distribution.	14
Module-5	No. of Hrs
Design of Experiments & ANOVA: Principles of experimentation in design, analysis of completely randomized design, randomized block design. The ANOVA, technique, basic principle of ANOVA, one-way ANOVA, two-way ANOVA, Latin-square design, and analysis of co-variance.	14

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

CO1	Apply fundamental principles of probability to analyze uncertain events and real-world engineering problems.
CO2	Model and an analyze random variables and their probability distributions to interpret stochastic behavior in engineering contexts.
CO3	Apply appropriate probability distribution models for solving practical engineering scenarios.
CO4	Utilize statistical methods and tools for data analysis and decision-making in engineering problem- solving.
CO5	Compute and interpret confidence intervals for population parameters, particularly the mean, to support statistical inference.

Text Books	
1.	Ronalde, Walpole, Raymond HMyers, SharonL Myers&Keying Ye“Probability & Statistics for Engineers & Scientists”, Pearson Education, 9 th edition, 2017.
2.	PeterBruce, Andrew Bruce & Peter Gedeck “Practical Statistics for Data Scientists”O ’Reilly Media, Inc., 2 nd edition 2020.
Reference Text Books	
1.	ErwinKreyszig, “Advanced Engineering Mathematics”, John Wiley&Sons, 9 th Edition, 2006.
2.	B.S. Grewal “Higher Engineering Mathematics”, Khannapublishers, 44 th Ed. 2021.
3.	G Hariabakaran “Probability, Queuing Theory & Reliability Engineering”, Laxmi Publication, LatestEdition,2006
Web links and Video lectures(e-Resources)	



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1. <https://nptel.ac.in/courses/12286025>
2. [VTUEDUSATPROGRAMME- 20](#)
3. [http://www.class-central.com/subject/math\(MOOCs\)](http://www.class-central.com/subject/math(MOOCs))

ASSESSMENT STRUCTURE:

The assessment in each course is divided equally between Continuous Internal Evaluation (CIE) and the Semester End Examination (SEE), with each carrying 50% weightage. To qualify and become eligible to appear for SEE, in the CIE, a student must score at least 40% of 50 marks, i.e., 20 marks. To pass the SEE, a student must score at least 35% of 50 marks, i.e., 18 marks. Notwithstanding the above, a student is considered to have passed the course, provided the combined total of CIE and SEE is at least 40 out of 100 marks.

CONTINUOUS INTERNAL EVALUATION (CIE):

CIE	Type of Assessment	Max. Marks	Max. Marks Scaling Down to	Total Marks
Theory	Internal Assessment1	50	40 (Average of Best two Assessments)	50
	Internal Assessment2	50		
	Internal Assessment3	50		
AAT	Any Two Assessments as per Regulations	20	10	
SEE	Semester End Examination	100	50	50
Grand Total				100

SEMESTER END EXAMINATION (SEE):

1. The Question paper for each course contains two parts, Part – A and Part – B.
2. Part – A consists of **Short Answer Questions** (2 Marks/1 mark) for 20 marks covering the complete syllabus and it is compulsory. Multiple Choice Questions are not allowed.
3. Part – B consists of 10 questions, two questions of 16 marks (with max. of 3 sub questions) from each module with internal choice. Students shall answer five full questions, selecting one full question from each module.

CO-PO Mapping

PO \ CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	-	-	2	-	-	-	-	1	-	2
CO2	3	3	-	-	2	-	-	-	-	1	-	2
CO3	3	3	-	-	2	-	-	-	-	1	-	2
CO4	3	3	-	-	2	-	-	-	-	1	-	2
CO5	3	3	-	-	2	-	-	-	-	1	-	2

Level3-High, Level 2-Moderate, Level1 -Low



Semester III					
Data Structures and its Applications					
Category: PCC					
(Common to CSE, CSD, AIML, CSE(IC), ISE)					
Course Code	:	B25CS302	CIE	:	50 Marks
Teaching Hours L : T : P : S	:	28:28:0:34	SEE	:	50 Marks
Total Hours/Semester	:	90	Total	:	100 Marks
Credits	:	3	SEE Duration	:	3 Hrs

Course Learning Objective is	
1.	To explain fundamentals of data structures and their applications essential for programming/problem solving.
2.	To apply stack, Queue and recursion operations to solve real world problems.
3.	To illustrate linear representation of data structures: Stack, Queues, Lists, Trees and Graphs.
4.	To demonstrate sorting and searching algorithms.
5.	To find suitable data structure during application development/Problem Solving.

Module– 1	No. of Hrs
Introduction: Data Structures, Classifications (Primitive & Non-Primitive), Data structure Operations, Review of Arrays, Structures, Self-Referential Structures, and Unions. Pointers and Dynamic Memory Allocation Functions. Representation of Linear Arrays in Memory, dynamically allocated arrays. Array Operations: Traversing, inserting, deleting, searching, and sorting. Multidimensional Arrays, Polynomials and Sparse Matrices. Strings: Basic Terminology, Storing, Operations and Pattern Matching algorithms. Programming Examples.	11
Module– 2	No. of Hrs
Stacks: Definition, Stack Operations, Array Representation of Stacks, Stacks using Dynamic Arrays, Stack Applications: Polish notation, Infix to postfix conversion, evaluation of postfix expression. Recursion - Factorial, GCD, Fibonacci Sequence, Tower of Hanoi, Ackerman's function. Queues: Definition, Array Representation, Queue Operations, Circular Queues, Circular queues using Dynamic arrays, Dequeues, Priority Queues, A Mazing Problem. Multiple Stacks and Queues. Programming Examples.	11
Module– 3	No. of Hrs
Linked Lists: Definition, Representation of linked lists in Memory, Memory allocation; Garbage Collection. Linked list operations: Traversing, Searching, Insertion, and Deletion. Doubly Linked lists, Circular linked lists, and header linked lists. Linked Stacks and Queues. Applications of Linked lists – Polynomials, Sparse matrix representation. Programming Examples.	12
Module– 4	No. of Hrs
Trees: Terminology, Binary Trees, Properties of Binary trees, Array and linked Representation of Binary Trees, Binary Tree Traversals - Inorder, postorder, preorder; Additional Binary tree operations. Threaded binary trees, Binary Search Trees – Definition, Insertion, Deletion, Traversal, Searching, Application of Trees-Evaluation of Expression, Programming Examples	11

Module– 5	No. of Hrs
Graphs: Definitions, Terminologies, Matrix and Adjacency List Representation of Graphs, Elementary Graph operations, Traversal methods: Breadth First Search and Depth First Search. Sorting and Searching: Insertion Sort, Radix sort, Address Calculation Sort. Hashing: Hash Table organizations, Hashing Functions, Static and Dynamic Hashing. Files and Their Organization: Data Hierarchy, File Attributes, Text Files and Binary Files, Basic File Operations, File Organizations and Indexing.	11



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Course Outcomes: At the end of the course, the students will be able to	
CO1	Use different types of data structures, operations and algorithms
CO2	Apply searching and sorting operations on files
CO3	Use stack, Queue, Lists, Trees and Graphs in problem solving
CO4	Implement all data structures in a high-level language for problem solving.
CO5	Identify the alternative implementations of data structure to solve real world problems

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

References Text Books	
1.	Gilberg&Forouzan, Data Structures: A Pseudo-code approach with C, 2 nd Edition, Cengage Learning, 2014.
2.	Reema Thareja, Data Structures using C, 3 rd Ed, Oxford press, 2012.
3.	Jean-Paul Tremblay & Paul G. Sorenson, An Introduction to Data Structures with Applications, 2 nd Edition, McGraw Hill, 2013.

ASSESSMENT STRUCTURE:

The assessment in each course is divided equally between Continuous Internal Evaluation (CIE) and the Semester End Examination (SEE), with each carrying 50% weightage. To qualify and become eligible to appear for SEE, in the CIE, a student must score at least 40% of 50 marks, i.e., 20 marks. To pass the SEE, a student must score at least 35% of 50 marks, i.e., 18 marks. Notwithstanding the above, a student is considered to have passed the course, provided the combined total of CIE and SEE is at least 40 out of 100 marks.

CONTINUOUS INTERNAL EVALUATION (CIE):

CIE	Type of Assessment	Max. Marks	Max. Marks Scaling Down to	Total Marks
Theory	Internal Assessment1	50	40 (Average of Best two Assessments)	50
	Internal Assessment2	50		
	Internal Assessment3	50		
AAT	Any Two Assessments as per regulations	20	10	
SEE	Semester End Examination	100	50	50
Total Marks				100

SEMESTER END EXAMINATION (SEE):

- The Question paper for each course contains two parts, Part – A and Part – B.
- Part – A consists of **Short Answer Questions** (2 Marks/1 mark) for 20 marks covering the complete syllabus and it is compulsory. Multiple Choice Questions are not allowed.
- Part – B consists of 10 questions, two questions of 16 marks (with max. of 3 sub questions) from each module with internal choice. Students shall answer five full questions, selecting one full question from each module.

CO-PO Mapping

PO \ CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	1	-	1	1	-	-	1	-	1	2
CO2	2	2	-	1	1	1	-	1	-	2	2
CO3	1	1	-	1	1	-	-	1	-	2	1
CO4	1	1	-	1	1	1	-	1	-	1	1
CO5	1	1	-	1	1	-	-	1	-	1	1



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Semester-III					
Digital Design and Computer Organization					
Category: IPCC					
(Common to CSE, AIML, CSD, ISE)					
Course Code	:	B25CS303	CIE	:	50 Marks
Teaching Hours L : T : P : S	:	42:0:28:50	SEE	:	50 Marks
Total Hours/Semester	:	120	Total	:	100 Marks
Credits	:	4	SEE Duration	:	3 Hrs

Course Learning Objective is	
1	To demonstrate the functionalities of binary logic system.
2	To explain the working of combinational and sequential logic system.
3	To realize HDL Verilog programmes.
4	To realize the basic structure of computer system.
5	To illustrate the working of I/O operations and processing unit.

Module- 1	No. of Hrs.
Introduction: Binary Logic, Basic Theorems and Properties of Boolean Algebra, Boolean Functions, Digital Logic Gates, Introduction, The Map Method, Four-Variable Map, Don't-Care Conditions, NAND and NOR Implementation, Other Hardware Description Language – Verilog Model of a simple circuit.	9
Module- 2	No. of Hrs.
Combinational Logic: Introduction, Combinational Circuits, Design Procedure, Binary Adder-Subtractor, Decoders, Encoders, Multiplexers. HDL Models of Combinational Circuits – Adder, Multiplexer, Encoder. Sequential Logic: Introduction, Sequential Circuits, Storage Elements: Latches, Flip-Flops.	9
Module- 3	No. of Hrs.
Basic Structures of Computer: Functional Units, Basic Operational Concepts, Bus structure, Performance – Processor Clock, Basic Performance Equation, Clock Rate, Performance Measurement. Machine Instructions and Programs: Memory Location and Addresses, Memory Operations, Instruction and Instruction sequencing, Addressing Modes	8
Module- 4	No. of Hrs.
Input/output Organization: Accessing I/O Devices, Interrupts – Interrupt Hardware, Enabling and Disabling Interrupts, Handling Multiple Devices, Direct Memory Access: Bus Arbitration, Speed, size and Cost of memory systems. Cache Memories – Mapping Functions	8
Module- 5	No. of Hrs.
Basic Processing Unit: Some Fundamental Concepts: Register Transfers, Performing ALU operations, fetching a word from Memory, Storing a word in memory. Execution of a Complete Instruction. Pipelining: Basic concepts, Role of Cache memory, Pipeline Performance.	8

Course Outcomes: At the end of the course, the students will be able to	
CO1	Apply the K-Map techniques to simplify various Boolean expressions.
CO2	Design different types of combinational and sequential circuits along with Verilog programs.
CO3	Describe the fundamentals of machine instructions, addressing modes and Processor performance.
CO4	Explain the approaches involved in achieving communication between processor and I/O devices
CO5	Analyse internal Organization of Memory and Impact of cache/Pipelining on Processor Performance.



LABORATORY

Sl. No	Name of the experiments
1.	Given a 4-variable logic expression, simplify it using appropriate technique and simulate the same using basic gates.
2.	Design a 4 bit full adder and subtractor and simulate the same using basic gates.
3.	Design a 2 bit half adder and subtractor and simulate the same using NAND and NOR gates
4.	Given a 4-variable logic expression, simplify it using appropriate technique and simulate the same using Verilog HDL
5.	Design Verilog HDL to implement simple circuits using structural, Data flow and Behavioural model.
6.	Design Verilog HDL to implement Binary Adder-Subtractor – Half and Full Adder, Half and Full Subtractor.
7.	Design Verilog HDL to implement Decimal adder.
8.	Design Verilog program to implement Different types of multiplexer like 2:1, 4:1 and 8:1.
9.	Design Verilog program to implement types of De-Multiplexer.
10.	Design Verilog program for implementing various types of Flip-Flops such as SR, JK and D.

Text Books

1.	M. Morris Mano & Michael D. Ciletti, Digital Design With an Introduction to Verilog Design, 5 th edition, Pearson Education
2.	Carl Hamacher, ZvonkoVranesic, SafwatZaky, Computer Organization, 5 th Edition, Tata McGraw Hill.

References

1.	Carl Hamacher, ZvonkoVranesic, SafwatZaky, NaraigManjikian, “Computer Organization and Embedded Systems”, 6 th Edition, Tata McGraw-Hill, 2012.
2.	William Stallings, “Computer Organization and Architecture – Designing for Performance”, 10 th Edition, Pearson Education, 2016.
3.	M. Morris Mano, “Digital Logic and Computer Design”, Pearson Education, 2016.

ASSESSMENT STRUCTURE:

The assessment in each course is divided equally between Continuous Internal Evaluation (CIE) and the Semester End Examination (SEE), with each carrying 50% weightage. To qualify and become eligible to appear for SEE, in the CIE, a student must score at least 40% of 50 marks, i.e., 20 marks. To pass the SEE, a student must score at least 35% of 50 marks, i.e., 18 marks. Notwithstanding the above, a student is considered to have passed the course, provided the combined total of CIE and SEE is at least 40 out of 100 marks.

CONTINUOUS INTERNAL EVALUATION (CIE):

CIE	Type of Assessment	Max. Marks	Max. Marks Scaling Down to	Total Marks
Theory	Internal Assessment1	50	40 (Average of Best two Assessments)	50/2 = 25
	Internal Assessment2	50		
	Internal Assessment3	50		
AAT	Any One Assessments as per regulations	20	10	
Laboratory	Lab Conduction & Record	Evaluating each expt. for 10 marks	10	25
	Internal Test	50	15	
SEE	Semester End Examination	100	50	50
Total Marks				100



SEMESTER END EXAMINATION (SEE):

1. The Question paper for each course contains two parts, Part – A and Part – B.
2. Part – A consists of **Short Answer Questions** (2 Marks/1 mark) for 20 marks covering the complete syllabus and it is compulsory. Multiple Choice Questions are not allowed.
3. Part – B consists of 10 questions, two questions of 16 marks (with max. of 3 sub questions) from each module with internal choice. Students shall answer five full questions, selecting one full question from each module.
4. The laboratory component of the **integrated course** shall be CIE only. However, in SEE, the questions from the practical component shall be included.
5. The maximum marks from the practical component to be included in the SEE question paper is **16 marks**.
6. Question papers to be set as per the Blooms Taxonomy levels.

CO-PO Mapping

PO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	1	-	-	-	3	1	-	-	1	2
CO2	2	2	-	-	-	2	1	-	-	2	2
CO3	1	1	-	-	-	1	2	-	-	2	1
CO4	1	1	-	-	-	1	2	-	-	1	1
CO5	1	1	-	-	-	1	2	-	-	1	1



Semester-III					
Operating Systems					
Category: PCC					
(Common to AIML, CSD, ISE, CSE)					
Course Code	:	B25CS304	CIE	:	50 Marks
Teaching Hours L : T : P : S	:	42:0:0:48	SEE	:	50 Marks
Total Hours/Semester	:	90	Total	:	100 Marks
Credits	:	3	SEE Duration	:	3 Hrs

Course Learning Objective is	
1.	To introduce the fundamental concepts of operating systems, their functions, and types
2.	To explain process management, scheduling algorithms, and inter-process communication.
3.	To describe memory management techniques, including paging, segmentation, and virtual memory
4.	To illustrate file systems, storage management, and input-output operations
5.	To explore synchronization mechanisms, deadlocks, and security aspects in operating systems
6.	To provide insights into modern operating systems such as Linux, Windows, and mobile OS.

Module– 1	No. of Hrs
Introduction to Operating Systems: Definition, Purpose, and Evolution of Operating Systems, Types of Operating Systems: Batch, Time-sharing, Distributed, Real-Time, and Mobile OS, Operating System Structure: Monolithic, Layered, Microkernel, and Hybrid, System Calls and Operating System Services	9
Module– 2	No. of Hrs
Process Management & CPU Scheduling Processes: Concept, Process Control Block (PCB), Process States, Threads: Single vs. Multithreading, User vs. Kernel Threads, CPU Scheduling: Scheduling Criteria, Preemptive & Nonpreemptive Scheduling, Scheduling Algorithms: FCFS, SJF, Priority Scheduling, Round Robin, Multi-Level Queue Scheduling, Inter process Communication (IPC) and Synchronization, Deadlocks: Detection, Prevention, Avoidance (Banker's Algorithm), Recovery	9
Module– 3	No. of Hrs
Memory Management: Memory Allocation: Contiguous & Non-Contiguous Allocation, Paging and Segmentation, Virtual Memory: Demand Paging, Page Replacement Algorithms (FIFO, LRU, Optimal), Thrashing and Working Set Model	9
Module– 4	No. of Hrs
File System & Storage Management File Concepts: File Attributes, File Types, File Access Methods, File System Structure: Directory Structure, File Allocation Methods (Contiguous, Linked, Indexed), Disk Scheduling Algorithms: FCFS, SSTF, SCAN, C-SCAN, LOOK, File Protection & Security	9
Module– 5	No. of Hrs
I/O Systems, Security, and Case Studies: I/O Hardware, Device Drivers, Interrupt Handling, Security and Protection in Operating Systems, Authentication and Access Control Mechanisms, Case Study: UNIX/Linux, Windows, Android Operating System	9

Course Outcomes: At the end of the course, the students will be able to	
CO1	Understand the basic structure, functionalities, and design principles of an operating system.
CO2	Analyze process scheduling techniques and inter-process communication mechanisms.
CO3	Implement memory management techniques such as paging, segmentation, and virtual memory.
CO4	Evaluate file system structures, disk scheduling algorithms, and storage management strategies
CO5	Apply synchronization techniques to avoid race conditions and deadlocks.

Text Books	
1.	Abraham Silberschatz, Peter B. Galvin, Greg Gagne- “Operating System Concepts, 10 th Edition, Wiley, 2018”
2.	William Stallings – “Operating Systems: Internals and Design Principles, 9 th Edition, Pearson, 2018”.



Reference Books

1	Andrew S. Tanenbaum – “Modern Operating Systems, 4 th Edition, Pearson, 2015”.
2	Dhananjay M. Dhamdhere – “Operating Systems: A Concept-Based Approach, 3 rd Edition, McGraw-Hill, 2017”
3	Gary Nutt – “Operating Systems, 3 rd Edition, Pearson, 2004”

ASSESSMENT STRUCTURE:

The assessment in each course is divided equally between Continuous Internal Evaluation (CIE) and the Semester End Examination (SEE), with each carrying 50% weightage. To qualify and become eligible to appear for SEE, in the CIE, a student must score at least 40% of 50 marks, i.e., 20 marks. To pass the SEE, a student must score at least 35% of 50 marks, i.e., 18 marks. Notwithstanding the above, a student is considered to have passed the course, provided the combined total of CIE and SEE is at least 40 out of 100 marks.

CONTINUOUS INTERNAL EVALUATION (CIE):

CIE	Type of Assessment	Max. Marks	Max. Marks Scaling Down to	Total Marks
Theory	Internal Assessment1	50	40 (Average of Best two Assessments)	50
	Internal Assessment2	50		
	Internal Assessment3	50		
AAT	Any Two Assessments as per regulations	20	10	
SEE	Semester End Examination	100	50	50
Grand Total				100

SEMESTER END EXAMINATION (SEE):

1. The Question paper for each course contains two parts, Part – A and Part – B.
2. Part – A consists of **Short Answer Questions** (2 Marks/1 mark) for 20 marks covering the complete syllabus and it is compulsory. Multiple Choice Questions are not allowed.
3. Part – B consists of 10 questions, two questions of 16 marks (with max. of 3 sub questions) from each module with internal choice. Students shall answer five full questions, selecting one full question from each module.

CO-PO Mapping

PO \ CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	1	-	-	-	-	-	-	-	2
CO2	2	1	2	1	3	-	-	-	-	-	1
CO3	2	1	2	1	2	-	-	-	-	-	1
CO4	2	2	-	-	1	-	-	-	-	-	2
CO5	1	1	2	1	-	-	-	-	-	-	1



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Semester- III					
OOPs using Java					
Category: PCC					
Course Code	:	B25AI305	CIE	:	50 Marks
Teaching Hours L : T : P : S	:	42:0:0:48	SEE	:	50 Marks
Total Hours/Semester	:	90	Total	:	100 Marks
Credits	:	3	SEE Duration	:	3Hrs

Course Learning Objective is	
1.	To understand basic constructs of Java programming.
2.	To learn core OOP concepts in Java.
3.	To apply inheritance, interfaces, and packages.
4.	To handle exceptions and multithreading.
5.	To develop GUI applications and database connectivity using Swing and JDBC.

Module- 1	No. of Hours
An Overview of Java: Object Oriented Programming Concepts of Java, Characteristics of Java, Real-time applications of Java, Fundamental Programming Structures in Java, Primitive Data Types, Variables, Literals, and Keywords. Type Conversion and Casting, Automatic Type Promotion in Expressions, Arrays. Operators: Arithmetic Operators, Relational Operators, Boolean Operators, Logical Operators, Assignment Operator, Ternary Operator, Operator Precedence using Parentheses. Control and Iterative Statements: Introduction to if statements, Switch statement. While, do-While, For Loops, and Nested Loops, break, goto, and continue statements.	9
Module- 2	No. of Hours
Introducing Classes: Class Fundamentals, Declaring Objects, Assigning Object Reference Variables, Introducing Methods, Constructors, this Keyword, and Garbage Collection. Methods and Classes: Method Overloading, Objects as Parameters, Argument Passing, Returning Objects, Recursion, Access Control, understanding static, final, Nested and Inner Classes.	9
Module- 3	No. of Hours
Inheritance: Basics, Types, Access specifiers, using super, creating a Multilevel Hierarchy, Method Overriding, Dynamic Method Dispatch, Using Abstract Classes, Using final with Inheritance, Local Variable Type Inference and Inheritance. Interfaces: Introduction, Default Interface Methods, Use static Methods in an Interface, Private Interface Methods. Packages: Introduction, Packages and Member Access, Importing Packages.	8
Module- 4	No. of Hours
Exceptions Handling: Fundamentals, Exception Types, Using try and catch, Multiple catch Clauses, Nested try Statements, throw, throws, finally, Java's Built-in Exceptions, Creating Your Own Exception Subclasses. Multi-Threaded Programming: Java Thread Model, The Main Thread, Creating a Thread, Creating Multiple Threads, Using is Alive () and join (), Thread Priorities, Synchronization, Inter thread Communication, Suspending, Resuming, and Stopping Threads, Obtaining a Thread's State.	8
Module- 5	No. of Hours
Graphics programming: Basics of Applets, working with 2D shapes, using color, fonts, images, and basics of event handling. Swing: Introduction, layout management, and Swing Components. JDBC: Introduction, JDBC Product Components, JDBC Architecture - Case studies.	8

Course Outcomes: At the end of the course, the students will be able to	
CO1	Understand the object-oriented programming concepts
CO2	Design a class involving data members and methods for the given scenario.
CO3	Apply the concepts of inheritance and interfaces in solving real world problems.
CO4	Use the concept of exception handling and multi-threading in solving complex problem.



CO5	Design an application with AWT and swing components.
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Text Books	
1.	Java - The Complete Reference, Herbert Schildt, Tata McGraw-Hill, 8 th Edition, 2011.
2.	Core Java: Volume I – Fundamentals Cay S. Horstmann and Gary Cornell, 9 th Edition, Sun Microsystems Press, 2013.
3.	Java SE 8 for Programmers Paul Deitel, Harvey Deitel / Pearson / 3 rd Edition / 2015

Reference Text Books	
1.	Understanding Object-oriented programming with Java Timothy Budd / Pearson Education / 2000
2.	The Java Programming Language-A primer Ken Arnold, James Gosling, David Holmes, , 4 th Edition, Prentice Hall

Web links and Video lectures (e-Resources)	
•	https://docs.oracle.com/javase/tutorial/?utm_source=chatgpt.com
•	https://nptel.ac.in/courses/106105191?utm_source=chatgpt.com
•	https://www.geeksforgeeks.org/java/java/
•	https://www.udemy.com/course/java-the-complete-java-developer-course/?utm_source=chatgpt.com
•	https://www.youtube.com/playlist?list=PLsyeobzWx17pe_LiTFNyr55kwJPWbgxB5

ASSESSMENT STRUCTURE:

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	Internal Assessment2	50		
	Internal Assessment3	50		
AAT	Any Two Assessments as per regulations	20	10	
SEE	Semester End Examination	100	50	50
Total Marks				100

SEMESTER END EXAMINATION (SEE):

- The Question paper for each course contains two parts, Part – A and Part – B.
- Part – A consists of **Short Answer Questions** (2 Marks/1 mark) for 20 marks covering the complete syllabus and it is compulsory. Multiple Choice Questions are allowed.
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CO-PO Mapping:

PO \ CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
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CO2	2	3	1	-	1	-	-	-	-	2	-
CO3	1	2	2	2	2	-	-	-	2	1	2
CO4	2	2	3	1	3	-	-	-	-	2	2
CO5	1	2	3	-	2	-	-	-	1	2	-

Level 3 - High, Level 2 – Moderate, Level 1 - Low



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Semester-III					
Data Structures and its Applications Lab					
Category: PCCL					
(Common to CSE, CSD, ISE, AIML)					
Course Code	:	B25CSL306	CIE	:	50 Marks
Teaching Hours L : T : P : S	:	0 : 0 : 28 : 2	SEE	:	50 Marks
Total Hours/Semester	:	30	Total	:	100 Marks
Credits	:	1	SEE Duration	:	3 Hrs

Course Learning Objective is	
1.	To implement linear data structures such as arrays, stacks, queues, linked lists.
2.	To apply suitable data structures for solving various computational problems effectively and efficiently.
3.	To implement nonlinear data structures such as trees, and graphs.
4.	To apply nonlinear data structure to provide the solution for the given problem.
5.	To familiarize students with file handling and explore applications of data structures in real-world scenarios.

Sl. No	List of Experiments
1.	Develop a Program in C for the following: a) Declare a calendar as an array of 7 elements (A dynamically Created array) to represent 7 days of a week. Each Element of the array is a structure having three fields. The first field is the name of the Day (A dynamically allocated String), The second field is the date of the Day (A integer), the third field is the description of the activity for a particular day (A dynamically allocated String). b) Write functions create(), read() and display(); to create the calendar, to read the data from the keyboard and to print weeks activity details report on screen.
2.	Develop a Program in C for the following operations on Strings. a. Read a main String (STR), a Pattern String (PAT) and a Replace String (REP) b. Perform Pattern Matching Operation: Find and Replace all occurrences of PAT in STR with REP if PAT exists in STR. Report suitable messages in case PAT does not exist in STR Support the program with functions for each of the above operations. Don't use Built-in functions.
3.	Develop a menu driven Program in C for the following operations on STACK of Integers (Array Implementation of Stack with maximum size MAX) a. Push an Element on to Stack b. Pop an Element from Stack c. Demonstrate how Stack can be used to check Palindrome d. Demonstrate Overflow and Underflow situations on Stack e. Display the status of Stack f. Exit Support the program with appropriate functions for each of the above operations
4.	Develop a Program in C for converting an Infix Expression to Postfix Expression. Program should support for both parenthesized and free parenthesized expressions with the operators: +, -, *, /, % (Remainder), ^ (Power) and alphanumeric operands.
5.	Develop a Program in C for the following Stack Applications a. Evaluation of Suffix expression with single digit operands and operators: +, -, *, /, %, ^ . b. Solving Tower of Hanoi problem with n disks



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6.	Develop a menu driven Program in C for the following operations on Circular QUEUE of Characters (Array Implementation of Queue with maximum size MAX) a. Insert an Element on to Circular QUEUE b. Delete an Element from Circular QUEUE c. Demonstrate Overflow and Underflow situations on Circular QUEUE d. Display the status of Circular QUEUE e. Exit Support the program with appropriate functions for each of the above operations
7.	Develop a menu driven Program in C for the following operations on Singly Linked List (SLL) of Student Data with the fields: USN, Name, Programme, Sem, PhNo a. Create a SLL of N Students Data by using front insertion. b. Display the status of SLL and count the number of nodes in it c. Perform Insertion / Deletion at End of SLL d. Perform Insertion / Deletion at Front of SLL(Demonstration of stack) e. Exit
8.	Develop a menu driven Program in C for the following operations on Doubly Linked List (DLL) of Employee Data with the fields: SSN, Name, Dept, Designation, Sal, PhNo a. Create a DLL of N Employees Data by using end insertion. b. Display the status of DLL and count the number of nodes in it c. Perform Insertion and Deletion at End of DLL d. Perform Insertion and Deletion at Front of DLL e. Demonstrate how this DLL can be used as Double Ended Queue. f. Exit
9.	Develop a Program in C for the following operations on Singly Circular Linked List (SCLL) with header nodes a. Represent and Evaluate a Polynomial $P(x,y,z) = 6x^2y^2z - 4yz^5 + 3x^3yz + 2xy^5z - 2xyz^3$ b. Find the sum of two polynomials POLY1(x,y,z) and POLY2(x,y,z) and store the result in POLYSUM(x,y,z) Support the program with appropriate functions for each of the above operations
10.	Develop a menu driven Program in C for the following operations on Binary Search Tree (BST) of Integers. a. Create a BST of N Integers: 6, 9, 5, 2, 8, 15, 24, 14, 7, 8, 5, 2 b. Traverse the BST in Inorder, Preorder and Post Order c. Search the BST for a given element (KEY) and report the appropriate message d. Exit
11.	Develop a Program in C for the following operations on Graph(G) of Cities a. Create a Graph of N cities using Adjacency Matrix. b. Print all the nodes reachable from a given starting node in a digraph using DFS/BFS
12.	Given a File of N employee records with a set K of Keys (4-digit) which uniquely determine the records in file F. Assume that file F is maintained in memory by a Hash Table (HT) of m memory locations with L as the set of memory addresses (2-digit) of locations in HT. Let the keys in K and addresses in L are Integers. Develop a Program in C that uses Hash function $H: K \rightarrow L$ as $H(K) = K \bmod m$ (remainder method), and implement hashing technique to map a given key K to the address space L. Resolve the collision (if any) using linear probing.

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

CO1	Apply the concepts of pointers and structures in problem solving
CO2	Use different types of linked lists to solve problems
CO3	Demonstrate stack and queue data structures to solve problems.
CO4	Use the Binary search tree and graph data structures to solve problems.
CO5	Illustrate the operations performed on tree data structures, hash functions for problem solving.



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ASSESSMENT STRUCTURE FOR LABORATORY:

- The assessment for each course is equally divided between Continuous Internal Evaluation (CIE) and the Semester End Examination (SEE), with each component carrying 50% weightage.
- For both CIE and SEE, the student is required to conduct one experiment each from both Part A and Part B.
- To qualify and become eligible to appear for SEE, in the CIE component, a student must secure a minimum of 40% of 50 marks, i.e., 20 marks.
- In SEE component, Part A must be evaluating as 40% and Part B will be evaluating as 60%.
- To pass the SEE component, a student must secure a minimum of 35% of 50 marks, i.e., 18 marks. A student is deemed to have successfully completed the course if the combined total of CIE and SEE is at least 40 out of 100 marks.

CIE	Type of Assessment	Max. Marks	Max. Marks Scaling Down to	Total Marks
Laboratory	Lab Conduction & Record	Evaluate each expt. for 10 marks.	15	50
	Laboratory Test 1	50	15	
	Laboratory Test 2	50	20	
SEE	Semester End Examination	100	50	50
Total Marks				100

CO-PO Mapping

PO \ CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	1	2	2	1	-	-	-	2	1	2	2
CO2	3	3	1	1	-	-	-	1	1	1	3
CO3	2	1	3	1	-	-	-	1	1	2	3
CO4	3	1	3	3	-	-	-	1	2	3	3
CO5	3	2	1	1	2	-	-	3	3	3	1

Level 3 - High, Level 2 - Moderate, Level 1 - Low



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Semester-III				
OOPs using Java Lab				
Category: AEC				
Course Code	:	B25AIL307	CIE	: 50 Marks
Teaching Hours L : T : P : S	:	0:0:28:2	SEE	: 50 Marks
Total Hours/Semester	:	30	Total	: 100 Marks
Credits	:	1	SEE Duration	: 2 Hrs

Course Learning Objective is

1.	To understand the basic constructs of Java programming.
2.	To comprehend core Object-Oriented Programming (OOP) concepts in Java.
3.	To apply inheritance, interfaces, and package concepts.
4.	To implement exception handling and multithreading in Java.
5.	To develop GUI applications and database connectivity using Swing and JDBC.

Sl. No	List of Experiments
1.	a) Write a Java program to develop a calculator and to find the factorial of a given number. b) Write a Java program to compute the sum of all prime numbers between 1 and using control structures.
2.	a) Write a program to implement matrix addition and multiplication using 2D arrays. b) Create a class with method overloading to calculate the area of a rectangle, circle, and square.
3.	A class called Employee, which models an employee with an ID, name, and salary, is designed as shown in the following class diagram. The method raise Salary (percent) increases the salary by the given percentage. Develop the Employee class and a suitable main method for demonstration.
4.	Develop a JAVA program to create an outer class with a function display. Create another class inside the outer class named inner with a function called display, and call the two functions in the main class.
5.	Develop a JAVA program to create an abstract class Shape with abstract methods calculate Area () and Calculate Perimeter (). Create subclasses Circle and Triangle that extend the Shape class and implement the respective methods to calculate the area and perimeter of each shape.
6.	a) Demonstrate multilevel and multiple inheritance using suitable classes and interfaces. b) Use super () to invoke the parent class constructor and access parent class members.
7.	Create a user-defined package, define a class in the package, and access it from another program
8.	Develop a JAVA program to raise a custom exception (user-defined exception) for division By Zero using try, catch, throw, and finally.
9.	Write a program to illustrate the creation of threads using the Runnable class. (Start method starts each of the newly created threads. Inside the run method, there is a sleep () for suspending the thread for 500 milliseconds.
10.	a) Write a Java program to demonstrate an applet with color and shape. b) Write the program to demonstrate AWT and Swing in Java.

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

CO1	Understand the object-oriented programming concepts
CO2	Design a class involving data members and methods for the given scenario.
CO3	Apply the concepts of inheritance and interfaces in solving real-world problems.
CO4	Use the concept of exception handling and multi-threading in solving complex problems.
CO5	Design an application with AWT and Swing components.



ASSESSMENT STRUCTURE FOR LABORATORY:

- The assessment for each course is equally divided between Continuous Internal Evaluation (CIE) and the Semester End Examination (SEE), with each component carrying 50% weightage.
- For both CIE and SEE, the student is required to conduct one experiment each from both Part A and Part B.
- To qualify and become eligible to appear for SEE, in the CIE component, a student must secure a minimum of 40% of 50 marks, i.e., 20 marks.
- In SEE component, Part A must be evaluating as 40% and Part B will be evaluating as 60%.
- To pass the SEE component, a student must secure a minimum of 35% of 50 marks, i.e., 18 marks. A student is deemed to have successfully completed the course if the combined total of CIE and SEE is at least 40 out of 100 marks.

Component	Type of Assessment	Max. Marks	Max. Marks Scaling Down to	Total Marks
Laboratory	Lab Conduction & Record	Evaluate each expt. for 10 marks.	15	50
	Laboratory Test 1	50	15	
	Laboratory Test 2	50	20	
SEE	Semester End Examination	100	50	50
Total Marks				100



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Semester-IV					
Discrete Mathematical Structures					
Category: ASC					
(Common to AIML, ISE, CSD, CSE)					
Course Code	:	B25MCS401	CIE	:	50 Marks
Teaching Hours L:T:P:S	:	42:28:0:50	SEE	:	50 Marks
Total Hours/Semester	:	120	Total	:	100 Marks
Credits	:	4	SEE Duration	:	3Hrs

Course Learning Objective is

1.	To enhance logical thinking and problem-solving abilities in students.
2.	To analyzing and solving combinatorial problems using logical reasoning and creativity.
3.	To solve problems using counting techniques and combinatorics.
4.	To analyze and solve problems involving graph connectivity.
5.	To analyze and solve problems involving tree structures.

Module-1	No. of hours
Set Theory: Fundamentals of Set Theory, Set Operations, Laws of Set Theory, Counting And Venn Diagrams, Cartesian Product, Relations, Types of Relations, Functions, Types of Functions, Function of Composition, Inverse Functions. Mathematical Induction.	14
Module-2	No. of hours
Mathematical Logic: Logic And Counting: Fundamentals of Logic, Propositional Logic, Logical Connectives And Truth Tables, Logic Equivalence, Tautology And Contradiction, Contingency, Methods of Proof And Disproof.	14
Module-3	No. of hours
Elementary Combinatorics: Basis of counting, Combinations & Permutations, with repetitions, Constrained Repetitions, Binomial coefficients, Binomial Multinomial theorems, The principles of Inclusion-Exclusion, Pigeon-hole Principles and its applications.	14
Module-4	No. of hours
Graph Theory: Introduction, representing graphs, operations on graphs, Directed graphs, graph Isomorphism, Paths, Cycles, Euler Graph, Hamilton graph, Planar graphs.	14
Module-5	No. of hours
Trees and Lattices Theory: Introduction, applications of Trees, Spanning trees, Minimum Spanning trees, Prim's And Kruskal's Algorithms. Lattices Theory: Lattices and Algebraic systems, Principles of duality, basic properties.	14

Course Outcomes: At the end of the course, the students will be able to	
CO1	Apply concepts of set theory, relations, functions, and mathematical induction to solve Mathematical and engineering problems.
CO2	Apply counting techniques and mathematical logic to analyze and solve real-life problems.
CO3	Apply fundamental combinatorial methods to solve counting and arrangement problems.
CO4	Use basic concepts of graph theory to model and analyze theoretical and practical problems.
CO5	Analyze the problems involving tree structures in discrete mathematical contexts.

Text Books	
1.	Ralph P. Grimaldi: Discrete and Combinatorial Mathematics, 5 th Edition, Pearson Education.
2.	Richard Bronson, Schaum's Outline of Matrix Operations, McGraw-Hill publications, 2 nd Edition.

Reference Text Books	
1.	Gregory Hartman, Fundamentals of Matrix Algebra, 3 rd Edition.
2.	Gary Haggard, John Schlipf, Discrete Mathematics for Computer Science, Thomson Books.



Web links and Video lectures(e-Resources)

- <https://nptel.ac.in/courses/12286025>
- [VTUEDUSATPROGRAMME– 20](#)
- [http://www.class-central.com/subject/math\(MOOCs\)](http://www.class-central.com/subject/math(MOOCs))

ASSESSMENT STRUCTURE:

The assessment in each course is divided equally between Continuous Internal Evaluation (CIE) and the Semester End Examination (SEE), with each carrying 50% weightage. To qualify and become eligible to appear for SEE, in the CIE, a student must score at least 40% of 50 marks, i.e., 20 marks. To pass the SEE, a student must score at least 35% of 50 marks, i.e., 18 marks. Notwithstanding the above, a student is considered to have passed the course, provided the combined total of CIE and SEE is at least 40 out of 100 marks.

CONTINUOUS INTERNAL EVALUATION (CIE):

CIE	Type of Assessment	Max. Marks	Max. Marks Scaling Down to	Total Marks
Theory	Internal Assessment1	50	40 (Average of Best two Assessments)	50
	Internal Assessment2	50		
	Internal Assessment3	50		
AAT	Any Two Assessments as per Regulations	20	10	
SEE	Semester End Examination	100	50	50
Total Marks				100

SEMESTER END EXAMINATION (SEE):

- The Question paper for each course contains two parts, Part – A and Part – B.
- Part – A consists of **Short Answer Questions** (2 Marks/1 mark) for 20 marks covering the complete syllabus and it is compulsory. Multiple Choice Questions are not allowed.
- Part – B consists of 10 questions, two questions of 16 marks (with max. of 3 sub questions) from each module with internal choice. Students shall answer five full questions, selecting one full question from each module.

CO-PO Mapping:

PO \ CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	-	-	-	1	-	-	-	-	-
CO2	2	3	-	1	-	-	1	-	-	-	-
CO3	2	1	-	-	-	-	-	1	-	-	-
CO4	1	1	-	-	-	-	-	-	-	-	-
CO5	1	1	-	-	-	-	-	-	-	-	-

Level3-High, Level2-Moderate, Level1 -Low



MOOGAMBIGAI CHARITABLE AND EDUCATIONAL TRUST
Rajarajeswari College of Engineering
 (An Autonomous Institution under Visvesvaraya Technological University, Belagavi)
Department of Artificial Intelligence and Machine Learning

Semester-IV					
Database Management Systems					
Category: PCC					
(Common to AIML, ISE, CSD, CSE, CSE(IC))					
Course Code	:	B25CS402	CIE	:	50 Marks
Teaching Hours L : T : P : S	:	42:28:0:50	SEE	:	50 Marks
Total Hours/Semester	:	120	Total	:	100 Marks
Credits	:	4	SEE Duration	:	3 Hrs

Course Learning Objective is	
1.	To introduce the fundamental concepts of database systems and data models, particularly the relational model.
2.	To understand and apply relational algebra and relational calculus for query formulation.
3.	To develop SQL queries for data definition, manipulation, and control.
4.	To understand the concepts of normalization and apply it to improve database design and eliminate anomalies.
5.	To gain knowledge of transaction processing, concurrency control, and recovery techniques to ensure data integrity and consistency.

Module- 1	No. of Hrs
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 and structural constraints, Weak entity types, ER diagrams.	14
Module- 2	No. of Hrs
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) Examples of Queries in relational algebra. Mapping Conceptual Design into a Logical Design: Relational Database Design using ER-to-Relational mapping.	14
Module- 3	No. of Hrs
SQL-Advance Queries: Views in SQL, Nested and co-related queries, Exists & Not Exists, joins & outer joins, specifying constraints as assertions and action Triggers, Check constraints. Comparisons using Null values & three-Valued logic. SQL: Specifying constraints in SQL, retrieval queries in SQL, INSERT, DELETE, and UPDATE statements in SQL, Additional features of SQL.	14
Module- 4	No. of Hrs
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, First, Second and Third Normal Forms, Boyce-Codd Normal Form, Multivalued Dependency and Fourth Normal Form, Join Dependencies and Fifth Normal Form.	14
Module- 5	No. of Hrs
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.	14



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

CO1	Design entity relationship for the given scenario.
CO2	Design the relational model and mapping conceptual design in to a logical design.
CO3	Apply various structured Query Language (SQL) statements for database manipulation.
CO4	Analyze various normalization forms for the given application.
CO5	Understand the concepts of transaction management and recovery mechanisms.

Text Books

1.	Fundamentals of Database Systems, RamezElmasri and Shamkant B. Navathe, 7 th Edition, 2017, Pearson.
2.	Database management systems, Ramakrishnan, and Gehrke, 3 rd Edition, 2014, McGraw Hill
3.	Elmasri and Navathe, —Fundamentals of Database Systems, 7 th Edition, Pearson education, 2016

References Text Books

1.	Abraham Silberschatz, Henry F. Korth and S. Sudarshan's Database System Concepts 6 th Edition Tata McGraw Hill Education Private Limited
2.	G. K. Gupta —Database Management Systems, 3 rd Edition, McGraw – Hill, 2018
3.	Dr. P.S. Deshpande, SQL and PL/SQL for Oracle 10g, Black Book, Dreamtech Press, 2012

ASSESSMENT STRUCTURE:

The assessment in each course is divided equally between Continuous Internal Evaluation (CIE) and the Semester End Examination (SEE), with each carrying 50% weightage. To qualify and become eligible to appear for SEE, in the CIE, a student must score at least 40% of 50 marks, i.e., 20 marks. To pass the SEE, a student must score at least 35% of 50 marks, i.e., 18 marks. Notwithstanding the above, a student is considered to have passed the course, provided the combined total of CIE and SEE is at least 40 out of 100 marks.

CONTINUOUS INTERNAL EVALUATION (CIE):

CIE	Type of Assessment	Max. Marks	Max. Marks Scaling Down to	Total Marks
Theory	Internal Assessment1	50	40 (Average of Best two Assessments)	50
	Internal Assessment2	50		
	Internal Assessment3	50		
AAT	Any Two Assessments as per regulations	10+10	10	
SEE	Semester End Examination	100	50	50
Total Marks				100

SEMESTER END EXAMINATION (SEE):

1. The Question paper for each course contains two parts, Part – A and Part – B.
2. Part – A consists of **Short Answer Questions** (2 Marks/1 mark) for 20 marks covering the complete syllabus and it is compulsory. Multiple Choice Questions are not allowed.
3. Part – B consists of 10 questions, two questions of 16 marks (with max. of 3 sub questions) from each module with internal choice. Students shall answer five full questions, selecting one full question from each module.

CO-PO Mapping

PO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	1	-	-	-	3	1	-	-	1	2
CO2	2	2	-	-	-	2	1	-	-	2	2
CO3	1	1	-	-	-	1	2	-	-	2	1
CO4	1	1	-	-	-	1	2	-	-	1	1



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Department of Artificial Intelligence and Machine Learning

Semester-IV					
Design and Analysis of Algorithms					
Category: IPCC					
(Common to- AIML, ISE, CSD, CSE, CSE(IC))					
Course Code	:	B25CS403	CIE	:	50 Marks
Teaching Hours L : T : P: S	:	42:0:28:50	SEE	:	50 Marks
Total Hours/Semester	:	120	Total	:	100 Marks
Credits	:	4	SEE Duration	:	3 Hrs

Course Learning Objective is	
1.	To learn the methods for analyzing algorithms and evaluating their performance.
2.	To demonstrate the efficiency of algorithms using asymptotic notations.
3.	To solve problems using various algorithm design methods, including brute force, greedy, divide and conquer, decrease and conquer, transform and conquer, dynamic programming, backtracking, and branch and bound.
4.	To learn the concepts of P and NP complexity classes.
5.	To apply algorithmic techniques in real-world problem solving and enhance logical and analytical thinking.

Module- 1	No. of Hrs
Introduction: What is an Algorithm? Fundamentals of Algorithmic Problem Solving. Fundamentals of the analysis of algorithm efficiency: Analysis Framework, Asymptotic Notations and Basic Efficiency Classes, Mathematical Analysis of Non recursive Algorithms, Mathematical Analysis of Recursive Algorithms. Brute force approaches: Selection Sort and Bubble Sort, Sequential Search and Brute Force String Matching.	9
Module- 2	No. of Hrs
Brute force approaches: Exhaustive Search (Travelling Salesman problem and Knapsack Problem). Decrease-and-conquer: Insertion Sort, Topological Sorting. Divide and conquer: Merge Sort, Quick Sort, Binary Tree Traversals, Multiplication of Large Integers and Strassen's Matrix Multiplication.	9
Module- 3	No. of Hrs
Transform and Conquer: Balanced Search Trees, Heaps and Heapsort. Space-time tradeoffs: Sorting by Counting: Comparison counting sort. Input Enhancement in String Matching: Horspool's Algorithm.	8
Module- 4	No. of Hrs
Dynamic programming: Three basic examples, The Knapsack Problem and Memory Functions, Warshall's and Floyd's Algorithms. The greedy method: Prim's Algorithm, Kruskal's Algorithm, Dijkstra's Algorithm, Huffman Trees and Codes	8
Module- 5	No. of Hrs
Limitations of algorithmic power: Decision Trees, P, NP, and NP-Complete Problems. Coping with limitations of algorithmic power: Backtracking (n-Queens problem, Subset-sum problem), Branch-and-Bound (Knapsack problem), Approximation algorithms for NPHard problems (Knapsack problem).	8

Course Outcomes: At the end of the course, the students will be able to	
CO1	Apply asymptotic notational method to analyze the performance of the algorithms in terms of time complexity.
CO2	Demonstrate divide & conquer approaches and decrease & conquer approaches to solve computational problems.
CO3	Make use of transform & conquer and dynamic programming design approaches to solve the given real world or complex computational problems.
CO4	Apply greedy and input enhancement methods to solve graph & string based computational problems.
CO5	Analyze various classes (P, NP and NP Complete) of problems.



LABORATORY

Sl. No	List of Experiments
1.	Design and implement C/C++ Program to sort a given set of n integer elements using Selection Sort method and compute its time complexity.
2.	Design and implement C/C++ Program to sort a given set of n integer elements using Quick Sort method and obtain its Time complexity
3.	Design and implement C/C++ Program to sort a given set of n integer elements using Merge Sort method and compute its time complexity.
4.	Design and implement C/C++ Program to obtain the Topological ordering of vertices in a given digraph
5.	Design and implement C/C++ Program to solve 0/1 Knapsack problem using Dynamic Programming method.
6.	a) Design and implement C/C++ Program to solve All-Pairs Shortest Paths problem using Floyd's algorithm. b) Design and implement C/C++ Program to find the transitive closure using Warshal's algorithm.
7.	Design and implement C/C++ Program to find Minimum Cost Spanning Tree of a given connected undirected graph using Kruskal's algorithm.
8.	Design and implement C/C++ Program to find Minimum Cost Spanning Tree of a given connected undirected graph using Prim's algorithm
9.	Design and implement C/C++ Program to find shortest paths from a given vertex in a weighted connected graph to other vertices using Dijkstra's algorithm
10.	Design and implement C/C++ Program to find a subset of a given set $S = \{s_1, s_2, \dots, s_n\}$ of n positive integers whose sum is equal to a given positive integer d.
11.	Design and implement C/C++ Program to solve discrete Knapsack and continuous Knapsack problems using greedy approximation method.
12.	Design and implement C/C++ Program for N Queen's problem using Backtracking.

Textbooks

- | | |
|----|---|
| 1. | Introduction to the Design and Analysis of Algorithms, By AnanyLevitin, 3rd Edition (Indian), 2017, Pearson |
|----|---|

References Textbooks

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|----|--|
| 1. | Computer Algorithms/C++, Ellis Horowitz, SatrajSahni and Rajasekaran, 2nd Edition, 2014, Universities Pres |
| 2. | Introduction to Algorithms, Thomas H. Cormen, Charles E. Leiserson, Ronal L. Rivest, Clifford Stein, 3rd Edition, PHI. |
| 3. | Design and Analysis of Algorithms, S. Sridhar, Oxford (Higher Education) |



ASSESSMENT STRUCTURE:

The assessment in each course is divided equally between Continuous Internal Evaluation (CIE) and the Semester End Examination (SEE), with each carrying 50% weightage. To qualify and become eligible to appear for SEE, in the CIE, a student must score at least 40% of 50 marks, i.e., 20 marks. To pass the SEE, a student must score at least 35% of 50 marks, i.e., 18 marks. Notwithstanding the above, a student is considered to have passed the course, provided the combined total of CIE and SEE is at least 40 out of 100 marks.

CONTINUOUS INTERNAL EVALUATION (CIE):

CIE	Type of Assessment	Max. Marks	Max. Marks Scaling Down to	Total Marks
Theory	Internal Assessment1	50	40 (Average of Best two Assessments)	50/2 = 25
	Internal Assessment2	50		
	Internal Assessment3	50		
AAT	Any One Assessments as per Regulations	10+10	10	
Laboratory	Lab Conduction & Record	Evaluating each expt. for 10 marks	10	25
	Lab Internal Test	50	15	
SEE	Semester End Examination	100	50	50
Total Marks				100

SEMESTER END EXAMINATION (SEE):

1. The Question paper for each course contains two parts, Part – A and Part – B.
2. Part – A consists of **Short Answer Questions** (2 Marks/1 mark) for 20 marks covering the complete syllabus and it is compulsory. Multiple Choice Questions are not allowed.
3. Part – B consists of 10 questions, two questions of 16 marks (with max. of 3 sub questions) from each module with internal choice. Students shall answer five full questions, selecting one full question from each module.
4. The laboratory component of the **integrated course** shall be CIE only. However, in SEE, the questions from the practical component shall be included.
5. The maximum marks from the practical component to be included in the SEE question paper is **16 marks**.
6. Question papers to be set as per the Blooms Taxonomy levels.

CO-PO Mapping

PO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	1	-	2	1	-	-	1	-	1	2
CO2	2	2	-	2	1	-	-	1	-	2	2
CO3	1	1	-	2	1	-	-	-	-	2	1
CO4	1	1	-	2	1	-	-	-	-	1	1
CO5	1	1	-	2	1	-	-	-	-	1	1



Semester-IV					
Principles of Artificial Intelligence					
Category: PCC					
Course Code	:	B25AI404	CIE	:	50 Marks
Teaching Hours L : T : P : S	:	42:0:0:48	SEE	:	50 Marks
Total Hours/Semester	:	90	Total	:	100 Marks
Credits	:	3	SEE Duration	:	3Hrs

Course Learning Objective is	
1.	To introduce fundamental concepts and applications of Artificial Intelligence.
2.	To enable problem-solving using search techniques.
3.	To develop knowledge representation and logical reasoning skills.
4.	To understand uncertainty handling using probabilistic models.
5.	To explore intelligent decision-making systems.

Module- 1	No. of Hours
Introduction to Artificial Intelligence: Overview of Artificial Intelligence, historical development, and scope of AI in modern applications. Characteristics of intelligent systems and the interdisciplinary nature of AI. Concept of intelligent agents, agent structure, and agent-environment interaction. Classification of agents, including simple reflex, model-based, goal-based, and utility-based agents. Performance measures, rationality, and task environment specification using the PEAS framework.	9
Module- 2	No. of Hours
Problem Formulation and Uninformed Search: Problem formulation and representation as state space search. Components include the initial state, goal state, operators, and path cost. Uninformed search techniques include Breadth First Search, Depth First Search, Depth Limited Search, Iterative Deepening Search, and Uniform Cost Search. Analysis of completeness, optimality, time and space complexity of search strategies.	9
Module- 3	No. of Hours
Informed Search and Optimization Techniques: Informed (heuristic) search strategies including Greedy Best First Search and A* algorithm. Design and properties of heuristic functions. Admissibility and consistency of heuristics. Local search methods including hill climbing, simulated annealing, and genetic algorithms. Application of optimization techniques in problem-solving.	8
Module- 4	No. of Hours
Knowledge Representation and Logical Reasoning: Knowledge-based systems and representation of knowledge. Propositional logic including syntax, semantics, and inference rules. First Order Logic including predicates, quantifiers, and relations. Inference mechanisms including forward chaining and backward chaining. Resolution principle and its applications in automated reasoning and problem solving.	8
Module- 5	No. of Hours
Uncertainty and Probabilistic Reasoning: Uncertainty in AI and fundamentals of probability theory. Conditional probability and independence. Bayesian inference and belief updating using Bayes' theorem. Bayesian networks for probabilistic representation. Introduction to Hidden Markov Models and reasoning under uncertainty in dynamic environments.	8

Course Outcomes: At the end of the course, the students will be able to	
CO1	Explain fundamental concepts of Artificial Intelligence and intelligent agents
CO2	Apply appropriate search algorithms for solving AI problems
CO3	Represent knowledge and perform logical reasoning
CO4	Analyze uncertainty using probabilistic reasoning models
CO5	Design simple intelligent systems for decision making

Text Books	
1.	Stuart J. Russell and Peter Norvig, Artificial Intelligence, 3 rd Edition, Pearson, 2015
2.	Elaine Rich, Kevin Knight, Artificial Intelligence, 3 rd edition, Tata McGraw Hill, 2013
Reference Text Books	
1.	George F Luger, Artificial Intelligence: Structure and Strategies for Complex, Pearson Education, 5 th Edition, 2011



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2.	Nils J. Nilsson, Principles of Artificial Intelligence, Elsevier, 1980
3.	Saroj Kaushik, Artificial Intelligence, Cengage Learning, 2014

Web links and Video lectures (e-Resources)

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

ASSESSMENT STRUCTURE:

The assessment in each course is divided equally between Continuous Internal Evaluation (CIE) and the Semester End Examination (SEE), with each carrying 50% weightage. To qualify and become eligible to appear for SEE, in the CIE, a student must score at least 40% of 50 marks, i.e., 20 marks. To pass the SEE, a student must score at least 35% of 50 marks, i.e., 18 marks. Notwithstanding the above, a student is considered to have passed the course, provided the combined total of CIE and SEE is at least 40 out of 100 marks.

CONTINUOUS INTERNAL EVALUATION (CIE):

CIE	Type of Assessment	Max. Marks	Max. Marks Scaling Down to	Total Marks
Theory	Internal Assessment1	50	40 (Average of Best two Assessments)	50
	Internal Assessment2	50		
	Internal Assessment3	50		
AAT	Any Two Assessments as per Regulations	20	10	
SEE	Semester End Examination	100	50	50
Total Marks				100

SEMESTER END EXAMINATION (SEE):

1. The Question paper for each course contains two parts, Part – A and Part – B.
2. Part – A consists of **Short Answer Questions** (2 Marks/1 mark) for 20 marks covering the complete syllabus and it is compulsory. Multiple Choice Questions are allowed.
3. Part – B consists of 10 questions, two questions of 16 marks (with max. of 3 sub questions) from each module with internal choice. Students shall answer five full questions, selecting one full question from each module.

CO-PO Mapping:

PO \ CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	-	-	-	-	-	-	-	-	-
CO2	3	3	2	2	2	-	-	-	-	-	-
CO3	3	3	3	2	2	-	-	-	-	-	-
CO4	3	2	2	3	2	-	-	-	-	-	-
CO5	3	3	3	3	3	-	-	-	-	-	-

Level 3 - High, Level 2 – Moderate, Level 1 - Low



Semester-IV					
Database Management Systems Lab					
Category: PCCL					
(Common to CSE, ISE, CSD, AIML)					
Course Code	:	B25CSL406	CIE	:	50 Marks
Teaching Hours L : T : P : S	:	0 : 0 : 28 : 2	SEE	:	50 Marks
Total Hours/Semester	:	30	Total	:	100 Marks
Credits	:	1	SEE Duration	:	3 Hrs

Course Learning Objective is	
1.	To Provide a strong foundation in database concepts, technology, and practice.
2.	To Practice SQL programming through a variety of database problems.
3.	To Understand the relational database design principles.
4.	To Demonstrate the use of concurrency and transactions in database.
5.	To Design and build database applications for real world problems

Sl. No	List of Experiments
1.	Implementation of DDL commands of SQL with suitable examples • Create • Alter • Drop • Truncate • Rename
2.	Implementation of DML commands of SQL with suitable examples • Insert • Update • Delete • Select
3.	Implementation of different types of function with suitable examples • Aggregate Function • Using Parentheses • Column Aliases • Literal Character Strings • Duplicate Row
4.	Implementation of different types of operators in SQL • Arithmetic Operators • Concatenation Operator • Comparison Operator (=, >, >=, <, <=, <>) • Other Comparison Operator (BETWEEN, IN, LIKE, IS NULL) • Logical Operator (AND, OR, NOT)
5.	Implementation of different types of Joins • Inner Join • Outer Join i. Left outer join ii. Right outer join iii. Full outer Join • Natural Join
6.	Study and Implementation of • Group By & having clause • Order by clause • Sorting in Descending & Ascending order
7.	Study & Implementation of different types of constraints. • Primary Key & Foreign Key Constraints • NOT NULL Constraints • Default 1 Constraints • Check constraints



	• Domain Constraints • Entity Integrity Constraints • Referential Integrity Constraints
8.	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.
9.	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 1. 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.
10.	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) Write SQL queries to 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.

Course Outcomes: At the end of the course, the students will be able to	
CO1	Create, Update and query on the database.
CO2	Demonstrate the working of different concepts of DBMS.
CO3	Implement SQL commands for database schema creation and modification.
CO4	Apply Primary and Foreign Key constraints to enforce entity integrity and referential integrity.
CO5	Explain the purpose and functionality of different types of joins in relational databases.



ASSESSMENT STRUCTURE FOR LABORATORY:

- The assessment for each course is equally divided between Continuous Internal Evaluation (CIE) and the Semester End Examination (SEE), with each component carrying 50% weightage.
- For both CIE and SEE, the student is required to conduct one experiment each from both Part A and Part B.
- To qualify and become eligible to appear for SEE, in the CIE component, a student must secure a minimum of 40% of 50 marks, i.e., 20 marks.
- In SEE component, Part A must be evaluating as 40% and Part B will be evaluating as 60%.
- To pass the SEE component, a student must secure a minimum of 35% of 50 marks, i.e., 18 marks. A student is deemed to have successfully completed the course if the combined total of CIE and SEE is at least 40 out of 100 marks.

CIE	Type of Assessment	Max. Marks	Max. Marks Scaling Down to	Total Marks
Laboratory	Lab Conduction & Record	Evaluate each expt. for 10 marks.	15	50
	Laboratory Test 1	50	15	
	Laboratory Test 2	50	20	
SEE	Semester End Examination	100	50	50
Total Marks				100

CO-PO Mapping

PO \ CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	3	3	3	2	-	-	-	-	-	1
CO2	3	3	3	3	2	-	-	-	-	-	1
CO3	3	3	3	3	2	-	-	-	-	-	1
CO4	3	3	3	3	2	-	-	-	-	-	1
CO5	3	3	3	3	2	-	-	-	-	-	1

Level 3 - High, Level 2 - Moderate, Level 1 - Low



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Department of Artificial Intelligence and Machine Learning

Semester-IV					
Principles of Artificial Intelligence Lab					
Category: AEC					
Course Code	:	B25AIL407	CIE	:	50 Marks
Teaching Hours L: T: P:S	:	0:0:28:2	SEE	:	50 Marks
Total Hours/Semester	:	30	Total	:	100 Marks
Credits	:	1	SEE Duration	:	3 Hrs

Course Learning Objective is	
1.	To understand AI foundations and basic concepts.
2.	To apply AI techniques for problem-solving.
3.	To use heuristic search and propositional logic for reasoning.
4.	To perform inference using First Order Logic methods.
5.	To understand probabilistic reasoning and expert systems.

Sl. No	List of Experiments
1.	Implement and Demonstrate the Depth First Search Algorithm on the Water Jug Problem
2.	Implement and Demonstrate the Best First Search Algorithm on Missionaries-Cannibals Problems using Python.
3.	a. Implement A* Search algorithm b. Implement AO* Search algorithm
4.	Solve the 8-Queens Problem with suitable assumptions
5.	Implementation of TSP using a heuristic approach
6.	Implementation of the problem- solving strategies: either using Forward Chaining or Backwards Chaining
7.	Implement the resolution principle on FOPL-related problems
8.	Implement the Tic-Tac-Toe game using Python
9.	Build a bot that provides all the information related to text in the search box
10.	Implement any Game and demonstrate the game-playing strategies

Course Outcomes: At the end of the course, the students will be able to	
CO1	Apply knowledge of agent architectures, search, and reasoning techniques to various applications.
CO2	Compare various Searching and inference techniques..
CO3	Develop knowledge base sentences using propositional logic and first-order logic.
CO4	Describe the concepts of quantifying uncertainty.
CO5	Apply the concepts of expert systems to build applications.

ASSESSMENT STRUCTURE FOR LABORATORY:

- The assessment for each course is equally divided between Continuous Internal Evaluation (CIE) and the Semester End Examination (SEE), with each component carrying 50% weightage.
- For both CIE and SEE, the student is required to conduct one experiment each from both Part A and Part B.
- To qualify and become eligible to appear for SEE, in the CIE component, a student must secure a minimum of 40% of 50 marks, i.e., 20 marks.
- In SEE component, Part A must be evaluating as 40% and Part B will be evaluating as 60%.
- To pass the SEE component, a student must secure a minimum of 35% of 50 marks, i.e., 18 marks. A student is deemed to have successfully completed the course if the combined total of CIE and SEE is at least 40 out of 100 marks



MOOGAMBIGAI CHARITABLE AND EDUCATIONAL TRUST

Rajarajeswari College of Engineering

(An Autonomous Institution under Visvesvaraya Technological University, Belagavi)

Department of Artificial Intelligence and Machine Learning

CIE	Type of Assessment	Max. Marks	Max. Marks Scaling Down to	Total Marks
Laboratory	Lab Conduction & Record	Evaluate each expt. for 10 marks.	15	50
	Internal Test 1	50	15	
	Internal Test 2	50	20	
SEE	Semester End Examination	100	50	50
Total Marks				100