SEMESTER 3

PERIOD: OCTOBER 2021-MARCH 2022

RAJAGIRI SCHOOL OF ENGINEERING & TECHNOLOGY
Department of Information Technology, Programme: Artificial Intelligence & Data Science

Vision

To evolve into a centre of excellence in information technology by creation and exchange of knowledge through leading edge research, innovation and services, which will in turn contribute towards solving complex societal problems and thus building a peaceful and prosperous mankind.

Mission

To impart high quality technical education, research training, professionalism and strong ethical values in the young minds for ensuring their productive careers in industry and academia so as to work with a commitment to the betterment of mankind.

Programme Educational Objectives (PEO)

Graduates of Artificial Intelligence & Data Science program shall

PEO 1: Have strong technical foundation for successful professional careers and to evolve as key-players/ entrepreneurs in the field of information technology.

PEO 2: Excel in analyzing, formulating and solving engineering problems to promote life-long learning, to develop applications, resulting in the betterment of the society.

PEO 3: Have leadership skills and awareness on professional ethics and codes.

Programme Outcomes (PO)

Artificial Intelligence & Data Science Program Students will be able to:

PO1. Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2. Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3. Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO4. Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the

information to provide valid conclusions.
PO5. Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO6.The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO7.Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO8.Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO 9.Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO10.Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO11.Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO12. Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcomes (PSO)

Artificial Intelligence & Data Science Program Students will be able to:

PSO1: Apply the fundamentals of science, engineering and mathematics to understand, analyze and develop solutions in the areas related to artificial intelligence and data science for optimal design of intelligent systems.

PSO2: Design and Implement appropriate techniques and analytic tools for the integration of intelligent systems, with a view to engaging in lifelong learning for the betterment of society.

PSO3: Practice professional ethics in applying scientific method to model and support multidisciplinary facets of engineering and its societal implications.

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1. Assignment Schedule

SI No	Subject Code & Name	Faculty in-charge	Week
1	DISCRETE MATHEMATICAL STRUCTURES	Ms.Deepthi Mary Tresa S	WEEK 1
2	DATA STRUCTURES	Ms. Sreeja M.U	WEEK 2
3	STATISTICAL FOUNDATIONS FOR DATA SCIENCE	Mrs. Vinmol K Jesudas	WEEK 3
4	OPERATING SYSTEM	Dr. LakshmiK.S	WEEK 4
5	DESIGN & ENGINEERING	Prof. Kuttyamma A.J	WEEK 5
6	SUSTAINABLE ENGINEERING	Dr.Biju Paul	WEEK 6
7	DISCRETE MATHEMATICAL STRUCTURES	Ms.Deepthi Mary Tresa S	WEEK 7
8	DATA STRUCTURES	Ms. Sreeja M.U	WEEK 8
9	STATISTICAL FOUNDATIONS FOR DATA SCIENCE	Mrs. Vinmol K Jesudas	WEEK 9
10	OPERATING SYSTEM	Dr. LakshmiK.S	WEEK 10
11	DESIGN & ENGINEERING	Prof. Kuttyamma A.J	WEEK 11
12	SUSTAINABLE ENGINEERING	Dr.Biju Paul	WEEK 12

DISCRETE MATHEMATICAL STRUCTURES

2.1 COURSE INFORMATION SHEET

PROGRAMME: COMPUTER SCIENCE AND ENGINEERING	DEGREE: BTECH
COURSE: DISCRETE MATHEMATICS	SEMESTER: III CREDITS: 4
COURSE CODE: 100903/MA300A REGULATION: 2020	COURSE TYPE: CORE
COURSE AREA/DOMAIN: Logic Development	CONTACT HOURS: 3+1(Tutorial) hours/Week.
CORRESPONDING LAB COURSE CODE (IF ANY):	LAB COURSE NAME:

SYLLABUS:

UNIT	DETAILS	HOURS
I	**Module 1(Fundamentals of Logic)** (Relevant topics from sections 2.1, 2.2, 2.3, 2.4.) Mathematical logic: Basic connectives and truth table. Statements –Logical Connectives – Tautology – Contradiction. Logical Equivalence: The Laws of Logic, The principle of duality- Substitution Rules – The implication-The Contrapositive- the Converse – the Inverse. Logical Implication - Rules of Inference, The use of Quantifiers: Open Statement- Quantifier- Logically Equivalent – Contrapositive –Converse –Inverse, Logical equivalences and implications for quantified statement- implications, negation.	**9**
II	**Module- 2:(Fundamentals of Counting Theory)** (Relevant topics from sections 1.1, 1.2, 1.3, 1.4, 5.5 , 8.1, 8.2, 8.3 The Rule of Sum – Extension of Sum Rule - The Rule of Product - Extension of Product Rule – Permutations Combinations, The Binomial Theorem (without proof), Combination with Repetition. The Pigeonhole Principle, The principle of Inclusion and Exclusion Theorem (Without Proof).	**9**
III	**Module 3 (Relations and Functions)** (Text 1: Relevant topics from sections 5.1, 5.2, 7.1,7.2,7.3,7.4, 7.6) Cartesian Product - Binary Relation, Function – domain – range, One to One function, Image restriction, Properties of Relations- Reachability Relations- Reflexive Relations-Symmetric Relations-Transitive relations – Antisymmetric Relations, Partial Order relations, Equivalence Relation- irreflexive relations.	**9**

	Partially ordered Set –Hasse Diagram-Maximal-Minimal Element-Least upper bound (lub)- Greatest Lower bound(glb) Equivalence Relations and Partitions - Equivalence Class, Lattice- Dual Lattice – Sub lattice –Properties of glb and lub Properties of Lattice - Special Lattice Complete Lattice – Bounded Lattice– Completed Lattice – Distributive Lattice (From section 7.2, graph theory excluded. From 7.3,Topological sorting Algorithm- excluded)	
IV	**Module- 4 (Generating Functions and Recurrence Relations)** (Relevant topics from sections 9.1,9.2, 9.4, 10.1, 10.2, 10.3) First order linear recurrence relations with constant Coefficients- homogeneous nonhomogeneous- Solution. The second-order linear recurrence relation with Constant Coefficients - homogeneous- Nonhomogeneous – Solution- Three cases, The Nonhomogeneous Recurrence Relation -First order- Second Order. Solution of recurrence relation using Generating Functions.	**9**
V	**Module-5 (Algebraic Structures)** (Relevant topics from sections 15.1, 15.2, 15.3, 15.4, 15.5) Algebraic System-Properties- Homomorphism and Isomorphism. Semigroup and monoid–cyclic monoid, sub semigroup and sub monoid- Homomorphism and Isomorphism of Semigroup and monoids. Group- Elementary properties- subgroup- symmetric group on three symbols- The direct product of two groups. Group Homomorphism- Isomorphism of groups, Cyclic group. Right coset left cosets- Lagrange's Theorem.	**9**
TOTAL HOURS		**45**

TEXT/REFERENCE BOOKS:

1. Discrete and Combinatorial Mathematics (An Applied Introduction), Ralph P Grimaldi, B V Ramana , 5th Edition, Pearson

REFERENCE BOOKS

1. Kenneth H. Rosen, Discrete Mathematics and Its Applications with Combinatorics and Graph Theory, Seventh Edition, MGH, 2011
2. Trembly J.P and Manohar R, "Discrete Mathematical Structures with Applications to Computer Science", Tata McGraw Hill Pub. Co. Ltd., New Delhi, 2003.
3. Bernard Kolman, Robert C. Busby, Sharan Cutler Ross, "Discrete Mathematical Structures", Pearson Education Pvt Ltd., New Delhi, 2003
4. Kenneth H. Rosen, "Discrete Mathematics and its Applications", 5/e, Tata Mc Graw

5. Richard Johnsonbaugh, "Discrete Mathematics", 5/e, Pearson Education Asia, New Delhi, 2002.
6. Joe L Mott, Abraham Kandel, Theodore P Baker, "Discrete Mathematics for Computer Scientists and Mathematicians", 2/e, Prentice-Hall India, 2009.

COURSE PRE-REQUISITES:

C.CODE	COURSE NAME	DESCRIPTION	SEM
	Maths they studied at school level		

COURSE OBJECTIVES:

1	To introduce mathematical notations and concepts in discrete mathematics that is essential for computing
2	To train on mathematical reasoning and proof strategies.
3	To cultivate analytical thinking and creative problem-solving skills

COURSE OUTCOMES:

SL.NO	DESCRIPTION	Blooms' Taxonomy Level
C203.1	Students will be able to Learn the fundamentals of propositional logic and predicate calculus and apply to test the validity of statements.	Apply (level 3)
C203.2	Students will be able to Learn the fundamentals of enumeration or counting techniques and methods of arrangements and derangements	Validate (level 4)
C203.3	Students will be able to Learn the ideas of relations, functions equivalence relation and Posets and it's applications	Construct (level 5)
C203.4	Students will Understand recurrence relation and apply the method of solving different type of recurrence relations using generating functions	Solve/Apply (level 3)
C203.5	Students will be able to Understand Fundamentals of Algebraic structures its properties such as monoids and groups	Solve/Apply (level 3)

CO-PO AND CO-PSO MAPPING

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
C203.1	3	2	3	2	1	_	_	_	_	2	_	1	_	_	_
C203.2	3	2	3	2	3	_	_	_	_	2	_	2	_	_	_
C203.3	3	2	2	_	2	_	_	_	_	2	_	2	-	_	_
C203.4	3	2	3	1		_	_	_	_	2	_	_	_	_	_
C203.5	3	2	2	1	1	_	_	_	_	2	_	1	-	_	_

JUSTIFICATIONS FOR THE MAPPING

Mapping	**LOW/MEDIUM/HIGH**	**Justification**
CO1-PO1	H	The validity of facts can be verified using predicate and propositional logic.
CO1-PO2	M	The real-life events can be represented and verified using Mathematical logic.
CO1-PO3	H	Reasoning is made possible for engineering problems.
CO1-PO4	M	Logic Uses research-based knowledge and research methods including design of experiments.
CO1-PO5	L	Knowledge about logic can Create, select, and apply appropriate techniques with an understanding of the limitations.
CO2-PO1	H	The arrangement and combinations of data to be taken for different problems can be identified.
CO2-PO2	M	Counting techniques can be used to reach conclusions in the problems involving huge data.

CO2-PO3	H	Counting techniques will help life-long learning in the broadest context of technological change.
CO2-PO4	M	Counting techniques can be Used research-based knowledge and research methods.
CO2-PO5	L	Used to select and apply appropriate techniques with an understanding of the limitations.
CO2-PO10	M	Knowing logic will help in Communicating effectively on
		Complex engineering activities with the engineering community and with society.
CO2-PO12	M	Logic will help life-long learning in the broadest context of technological change.
CO3 -PO1	H	The reasoning and inferences made by them can be substantiated by the various proof techniques.
CO3-PO2	M	The proof techniques can be used to verify the complex engineering solutions.
CO3-PO5	M	The arrangement and combinations of data to be taken for different problems can be identified.
CO3-PO10	M	Discrete structures can be used to reach conclusions in the problems involving huge data.
CO3-PO12	M	Discrete structures will help life-long learning in the broadest context of technological change.
CO4-PO1	H	The concepts of discrete structures can be used to solve various complex engineering problems.
CO4-PO2	M	The knowledge about the discrete computational structures will help them to reach conclusions about the complexity and methodologies for solving real life problems.
CO4-PO3	H	Discrete structures can aid in the representation of various real-life problems.
CO4-PO4	L	The knowledge about the discrete computational structures Use research-based knowledge and research methods including design of experiments.
CO4-PO10	M	Knowing Discrete structures will help to Communicate effectively on complex engineering activities with the engineering community and with society.
CO5-PO1	H	Algebraic structures can be used to visualize the complex engineering problems involving sets of data.
CO5-PO2	M	The similarity and characteristics of data can be analyzed using algebraic principles.

CO5-PO3	M	It can be used to compare the complexity of algorithms that were developed.
CO5-PO4	L	It helps to analyze the complexity and choose the best method for the problem.
CO5-PO5	L	All algebraic structures can be compared using a single measure to identify the amount of computations involved in them so that the optimal one can be identified.
CO5-PO10	M	The proof techniques can be used to verify the complex engineering solutions.
CO5-PO12	L	Algebraic structures will help life-long learning in the broadest context of technological change

GAPS IN THE SYLLABUS - TO MEET INDUSTRY/PROFESSION REQUIREMENTS:

Sl NO	DESCRIPTION	PROPOSED ACTIONS	RELEVANCE WITH POs	RELEVANCE WITH PSOs
1	Graph Theory and its applications	Seminar	1	1
2	Plotting graph for a function	Class lecturing along with the topic of function	1	

PROPOSED ACTIONS: TOPICS BEYOND SYLLABUS/ASSIGNMENT/INDUSTRY VISIT/GUEST LECTURER/NPTEL ETC

TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN:

Sl NO	DESCRIPTION	PROPOSED ACTIONS	RELEVANCE WITH POs	RELEVANCE WITH PSOs
1	Different types of numbers and their properties	Class Assignment	1,3	3

WEB SOURCE REFERENCES:

1	http://web.stanford.edu/class/cs103x/cs103x-notes.pdf

2	https://www.tutorialspoint.com/discrete_mathematics/discrete_mathematics_recurrence_relation.htm
3	http://nms.lu.lv/wp-content/uploads/2016/04/21-linear-recurrences.pdf
4	http://wwwhome.cs.utwente.nl/~infrieks/MHMI/2005.jk.pdf
5	http://nicolas.thiery.name/macs358/Notes/AlgebraicStructures.pdf

DELIVERY/INSTRUCTIONAL METHODOLOGIES:

✔ CHALK & TALK	✔ STUD. ASSIGNMENT	✔ WEB RESOURCES	
✔ LCD/SMART BOARDS	✔ STUD. SEMINARS	☐ ADD-ON COURSES	

ASSESSMENT METHODOLOGIES-DIRECT

✔ASSIGNMENTS	✔ STUD. SEMINAR S	✔ TESTS/MODEL EXAMS	✔ UNIV.EXAMINATION
✔ STUD. LAB PRACTICES	✔ STUD. VIVA	☐ MINI/MAJOR PROJECTS	☐CERTIFICATIONS
☐ ADD-ON COURSES	☐ OTHERS		

ASSESSMENT METHODOLOGIES-INDIRECT

✔ ASSESSMENT OF COURSE OUTCOMES (BY FEEDBACK, ONCE)	✔ STUDENT FEEDBACK ON FACULTY (TWICE)
☐ ASSESSMENT OF MINI/MAJOR PROJECTS BY EXT. EXPERTS	☐ OTHERS

Prepared by

Ms.Deepthi Mary Tresa S

(Faculty)

Approved by

Neeba E A

(HOD)

2.2 Course Plan

No	Contents	No. of Lecture Hrs
Module – 1 (Fundamentals of Logic) (9 Hrs.)		
1.1	**Mathematical logic, Basic Connectives and Truth Table**	1
1.2	Statements, Logical Connectives, Tautology, Contradiction	1
1.3	Logical Equivalence, The Laws of Logic	1
1.4	The Principle of duality, Substitution Rules	1
1.5	The implication, The Contrapositive, the Converse , the Inverse	1
1.6	Logical Implication, Rules of Inference, Logical Implication	1
1.7	The use of Quantifiers, Open Statement, Quantifier, Negation	1
1.8	Logically Equivalent, Contrapositive, The Converse, The Inverse	1
1.9	Logical Implications	1
Module - 2 (Fundamentals of Counting Theory) (9 Hrs)		
2.1	The Pigeon-hole Principle	1
2.2	The Rule of Sum	1
2.3	Extension of Sum Rule	1
2.4	The Rule of Product	1
2.5	Extension of Product Rule , Permutations	1
2.6	Combinations, Combination with repetition	2
2.7	The Binomial Theorem	1
2.8	The Principle of Inclusion and Exclusion Theorem (Without Proof) Generalization of the Principle	1
Module - 3 (Relations and Functions) (9 Hrs)		
3.1	Cartesian Product, Binary Relation, Function, Domain, Range , One to One Function Image - Restriction	1

3.2	Properties , Reachability Relations , Reflexive Relations, Symmetric Relations, Transitive relations, Antisymmetric Relations.	1
3.3	Partial Order relations	1
3.4	Equivalence Relation, Irreflexive Relations.	1
3.5	Partially ordered Set, Hasse Diagram.	1
3.6	Maximal-Minimal Element, Least Upper bound, Greatest Lower Bound	1
3.7	Equivalence Relations and Partitions ,Equivalence Class	1
3.8	Lattice- Dual Lattice,sublattice , Properties of glb and lub	1
3.9	Properties of Lattice , Special Lattice , Complete Lattice, Bounded Lattice, Completed Lattice, Distributive Lattice	1
Module - 4 (Generating Functions and Recurrence Relations) (9 Hrs)		
4.1	Generating Function , Definition and Examples	1
4.2	Exponential Generating Function.	1
4.3	First Order Linear Recurrence Relations with Constant Coefficients	1
4.4	Homogeneous Solution	1
4.5	Non homogeneous Solution	1
4.6	Second order linear recurrence relations with constant coefficients	2
4.7	Homogeneous Solution	1
4.8	Non homogeneous Solution	1
Module - 5 (Algebraic Structures)(9 Hrs)		
5.1	Algebraic System-Properties, Homomorphism and Isomorphism	1
5.2	Semi group , Monoid, Cyclic monoid	1
5.3	Sub semigroup and sub monoid	1
5.4	Homomorphism and Isomorphism of Semigroup, Monoids and Groups	1
5.5	Elementary Properties, Subgroup, Symmetric group on three symbols	1
5.6	The direct Product of two Groups	1

5.7	Group Homomorphism, Isomorphism, Cyclic group	1
5.8	Right coset, Left coset	1
5.9	Lagrange's Theorem	1

2.3 Assignment Questions

1. A committee of 12 is to be selected from 10 men and 10 women. In how many ways can the selection be carried out if (a) there are no restrictions? (b) there must be six men and six women? (c) there must be an even number of women? (d) there must be more women than men? (e) there must be at least eight men?

2. Consider the collection of all strings of length 10 made up from the alphabet 0, 1,2, and 3.

How many of these strings have weight 3? How many have weight 4? How many have even weight?

3. In how many ways can 10 (identical) dimes be distributed among five children if (a) there are no restrictions? (b) each child gets at least one dime? (c) the oldest child gets at least two dimes?

4. Two -digit integers (leading zeros allowed) are considered equivalent if one is a rearrangement of the other. (For example, 12033, 20331, and 01332 are considered equivalent five-digit integers.) (a) How many five-digit integers are not equivalent? (b) If the digits 1, 3, and 7 can appear at most once, how many nonequivalent five-digit integers are there?

5. In how many ways can one arrange the letters in CORRESPONDENTS so that (a) there is no pair of consecutive identical letters? (b) there are exactly two pairs of consecutive identical letters? (c) there are at least three pairs of consecutive identical letters?

6. An auditorium has a seating capacity of 800. How many seats must be occupied to guarantee that at least two people seated in the auditorium have the same first and last initials?

7. To raise money for a new municipal pool, the chamber of commerce in a certain city sponsors a race. Each participant pays a $5 entrance fee and has a chance to win one of the different-sized trophies that are to be awarded to the first eight runners who finish.

   a) If 30 people enter the race, in how many ways will it be possible to award the

trophies?

b) If Roberta and Candice are two participants in the race, in how many ways can thetrophies be awarded with these two runners among the top three?

8. An alphabet of 40 symbols is used for transmitting messages in a communication system. How many distinct messages (lists of symbols) of 25 symbols can the transmitter generate if symbols can be repeated in the message? How many if 10 of the 40 symbols can appear only as the first and/or last symbols of the message, the other 30 symbols can appear anywhere, and repetitions of all symbols are allowed?

9. a) How many arrangements are there of all the letters in SOCIOLOGICAL? b) In how many of the arrangements in part (a) are A and G adjacent? c) In how many of the arrangements in part (a) are all the vowels adjacent?

10. a) In how many ways can seven people be arranged about a circular table? b) If two of the people insist on sitting next to each other, how many arrangements are possible?

2.4 Tutorial Questions

1. In how many ways can a gambler draw five cards from a standard deck and get (a) a flush(five cards of the same suit)? (b) four aces? (c) four of a kind? (d) three aces and two jacks? (e) three aces and a pair? (f) a full house (three of a kind and a pair)? (g) three of a kind? (h) two pairs?

2. A certain ice cream store has 31 flavors of ice cream available. In how many ways can we order a dozen ice cream cones if (a) we do not want the same flavor more than once? (b) a flavor may be ordered as many as 12 times? (c) a flavor may be ordered no more than 11times?

3. How many ways are there to place 12 marbles of the same size in five distinct jars if (a)the marbles are all black? (b) each marble is a different color?

4. If 13 cards are dealt from a standard deck of 52, what is the probability that these 13 cards include (a) at least one card from each suit? (b) exactly one void (for example, no clubs)?(c) exactly two voids?

5. Show that if any 14 integers are selected from the set S = {1, 2, 3, … , 25}, there are at least two whose sum is 26.

6. The 50 members of Nardines aerobics class line up to get their equipment. Assuming that no two of these people have the same height, show that eight of them (as the line is equipped from first to last) have successive heights that either decrease or increase.

7. At a 12-week conference in mathematics, Sharon met seven of her friends from college. During the conference she met each friend at lunch 35 times, every pair of them 16 times, every trio eight times, every foursome four times, each set of five twice, and each set of six once, but never all seven at once. If she had lunch every day during the 84 days of the conference, did she ever have lunch alone?

8. Prove that if we select 101 integers from the set S = {1, 2, 3, .. . , 200}, there exist m, n in the selection where gcd(m, n) = 1.

9. Let S be a set of five positive integers the maximum of which is at most 9. Prove that the sums of the elements in all the nonempty subsets of S cannot all be distinct.

10. Pamela has 15 different books. In how many ways can she place her books on two shelves so that there is at least one book on each shelf?

11. An alphabet of 40 symbols is used for transmitting messages in a communication system.

How many distinct messages (lists of symbols) of 25 symbols can the transmitter generate if symbols can be repeated in the message? How many if 10 of the 40 symbols can appear only as the first and/or last symbols of the message, the other 30 symbols can appear anywhere, and repetitions of all symbols are allowed?

12. How many positive integers n can we form using the digits 3, 4, 4, 5, 5, 6, 7 if we want to exceed 5,000,000?

13. How many ways are there to pick a five-person basketball team from 12 possible players? How many selections include the weakest and the strongest players?

14. A gym coach must select 11 seniors to play on a football team. If he can make his selection in 12,376 ways, how many seniors are eligible to play?

15. In how many ways can Beth place 24 different books on four shelves so that there is at least one book on each shelf? (For any of these arrangements consider the books on each shelf to be placed one next to the other, with the first book at the left of the shelf.)

DATA STRUCTURES

3.1 COURSE INFORMATION SHEET

PROGRAMME: Artificial Intelligence and Data Science	DEGREE: B.TECH
COURSE: Data Structures	SEMESTER: Third CREDITS: 4
COURSE CODE: 100002/AD300C REGULATION:2020	COURSE TYPE: CORE
COURSE AREA/DOMAIN: Programming	CONTACT HOURS: 4 hours/ Week
CORRESPONDING LAB COURSE CODE (IF ANY):100002/AD322S	LAB COURSE NAME: Data Structures Lab

SYLLABUS:

UNIT	DETAILS	HOURS
I	**Module 1: BASIC CONCEPTS OF DATA STRUCTURES** System Life Cycle, Algorithms, Performance Analysis, Space Complexity, Time Complexity, Asymptotic Notation, Complexity Calculation of Simple Algorithms	8
II	**Module 2: ARRAYS AND SEARCHING** Polynomial representation using Arrays, Sparse matrix, Stacks, Queues-Circular Queues, Priority Queues, Double Ended Queues, Evaluation of Expressions, Linear Search and Binary Search	11
III	**Module 3: LINKED LIST AND MEMORY MANAGEMENT** Self-Referential Structures, Dynamic Memory Allocation, Singly Linked List-Operations on Linked List. Doubly Linked List, Circular Linked List, Stacks and Queues using Linked List, Polynomial representation using Linked List Memory allocation and de-allocation-First-fit, Best-fit and Worst-fit allocation schemes	15
IV	**Module 4: TREES AND GRAPHS** Trees, Binary Trees-Tree Operations, Binary Tree Representation, Tree Traversals, Binary Search Trees- Binary Search Tree Operations Graphs, Representation of Graphs, Depth First Search and Breadth First Search on Graphs, Applications of Graphs	14
V	**Module 5: SORTING AND HASHING** Sorting Techniques – Selection Sort, Insertion Sort, Quick Sort, Merge Sort and Heap Sort Hashing- Hashing Techniques, Collision Resolution, Overflow handling, Hashing functions- Mid square, Division, Folding, Digit Analysis	12
TOTAL HOURS		60

TEXT/REFERENCE BOOKS:

T/R	BOOK TITLE/AUTHORS/PUBLICATION
T	Ellis Horowitz, Sartaj Sahni and Susan Anderson-Freed, Universities Press, Fundamentals of Data Structures in C
R	1. Samanta D., Classic Data Structures, Prentice Hall India. 2. Richard F. Gilberg, Behrouz A. Forouzan, Data Structures: A Pseudocode Approach with C, 2/e, Cengage Learning. 3. Aho A. V., J. E. Hopcroft and J. D. Ullman, Data Structures and Algorithms, Pearson Publication. 4. Tremblay J. P. and P. G. Sorenson, Introduction to Data Structures with Applications, Tata McGraw Hill. 5. Peter Brass, Advanced Data Structures, Cambridge University Press. 6. Lipschuts S., Theory and Problems of Data Structures, Schaum's Series. 7. Wirth N., Algorithms + Data Structures = Programs, Prentice Hall. 8. Hugges J. K. and J. I. Michtm, A Structured Approach to Programming, PHI. 9. Martin Barrett, Clifford Wagner, C And Unix: Tools For Software Design, John Wiley.

COURSE PRE-REQUISITES: Programming in C

COURSE OBJECTIVES:

- To understand the various data structures, their organization and operations.
- To assess the applicability of different data structures and associated algorithms for solving real world problems.
- To compare and select appropriate data structures to solve the problem efficiently.
- To introduce abstract concepts for data organization and manipulation using data structures such as stacks, queues, linked lists, binary trees, heaps and graphs for designing their own data structures to solve practical application problems in various fields of Computer Science.

COURSE OUTCOMES: After the completion of the course the student will be able to

CO1	Design an algorithm for a computational task and calculate the time/space complexities of that algorithm (Cognitive Knowledge Level: Apply)
CO2	Identify the suitable data structure (array or linked list) to represent a data item required to be processed to solve a given computational problem and write an algorithm to find the solution of the computational problem (Cognitive Knowledge Level: Apply)

CO3	Write an algorithm to find the solution of a computational problem by selecting an appropriate data structure (binary tree/graph) to represent a data item to be processed (Cognitive Knowledge Level: Apply)
CO4	Store a given dataset using an appropriate Hash Function to enable efficient access of data in the given set (Cognitive Knowledge Level: Apply)
CO5	Select appropriate sorting algorithms to be used in specific circumstances (Cognitive Knowledge Level: Analyze)
CO6	Design and implement Data Structures for solving real world problems efficiently (Cognitive Knowledge Level: Apply)

CO-PO AND CO-PSO MAPPING

	PO1	PO2	PO3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	3	2	1	1	-	1	-	-	-	-	-	3
CO2	3	2	3	1	-	1	-	-	-	-	-	3
CO3	3	2	3	1	-	1	-	-	-	-	-	3
CO4	3	2	3	1	-	1	-	-	-	-	-	3
CO5	1	2	1	1	-	1	-	-	-	-	-	3
CO6	1	2	3	1	-	1	-	-	-	-	-	3

JUSTIFICATIONS FOR CO-PO/PSO MAPPING

MAPPING	LOW/MEDIUM/HIGH	JUSTIFICATION
CO1-PO1	H	The knowledge in programming methodologies helps in designing solutions for complex engineering problems.
CO1-PO2	H	The knowledge of asymptotic notation helps in the analysis of complex problems and comparison of the solutions to the problem.
CO1-PO3	H	The knowledge of asymptotic notation can be used to select a better solution to an engineering problem.
CO1-PO4	H	The knowledge of asymptotic notation helps to investigate and analyze complex problems.
CO1-PO5	L	Time and space complexity analysis can be done with the help of modern tools
CO1-PO6	L	The knowledge of complexity calculation of an algorithm helps to solve health, safety and legal servicing problems efficiently
CO1-PO12	H	The knowledge of asymptotic notations helps to learn many other topics of engineering and help for a lifelong learning.
CO2-PO1	H	The knowledge of arrays, linked lists, stacks and queues can be applied to solve complex engineering problems.
CO2-PO2	M	The knowledge of linear data structures can be applied to analyze various engineering problems.
CO2-	H	The knowledge of arrays, linked lists, stacks and queues can be

PO3		applied to design of solutions to complex engineering problems.
CO2-PO4	L	The knowledge of linear data structures helps to investigate and analyze complex problems.
CO2-PO5	M	The knowledge of linear data structures helps to implement them using modern tools
CO2-PO6	M	The knowledge of linear data structures helps to solve health, safety and legal servicing problems efficiently
CO2-PO12	H	The knowledge of Linear data structures helps to learn many other topics of engineering and help for a lifelong learning.
CO3-PO1	H	The knowledge of nonlinear data structures like trees and graphs can be applied to solve complex engineering problems
CO3-PO2	M	The knowledge of nonlinear data structures can be applied to analyze various engineering problems.
CO3-PO3	H	This knowledge of nonlinear data structures can be used to design efficient solutions to complex problems.
CO3-PO4	M	The knowledge of nonlinear data structures helps to investigate and analyze complex problems.
CO3-PO5	M	Implementation of nonlinear data structures can be done using modern tools
CO3-PO6	L	The knowledge of nonlinear data structures helps to solve health, safety and legal servicing problems efficiently
CO3-PO12	H	The knowledge of non-Linear data structures helps to learn many other topics of engineering and help for a lifelong learning.
CO4-PO1	H	The knowledge of Hash functions can be applied to solve complex engineering problems
CO4-PO2	M	The knowledge of Hash function can be applied to analyze various engineering problems.
CO4-PO3	H	This knowledge of Hash Functions can be used to design efficient solutions to complex problems
CO4-PO4	L	Knowledge of Hash Functions can be used to conduct investigation on large set of data to analyze the performance on different set of data
CO4-PO5	M	Implementation of hashing can be done using modern tools
CO4-PO6	M	The knowledge of hashing help to solve health, safety and legal servicing problems efficiently
CO4-PO12	H	The knowledge of hashing helps to learn many other topics of engineering and help for a lifelong learning.
CO5-PO1	H	The knowledge of Sorting algorithms can be applied to solve complex engineering problems
CO5-PO2	M	The knowledge of Hash function can be applied to analyze various engineering problems.
CO5-PO3	H	This knowledge of Sorting algorithms can be used to design efficient solutions to complex problems

CO5-PO4	L	Knowledge of Hash Functions can be used to conduct investigation on large set of data to analyze the performance on different set of data
CO5-PO5	M	Implementation of Sorting algorithms can be done using modern tools
CO5-PO6	M	The knowledge of Sorting algorithms helps to solve health, safety and legal servicing problems efficiently
CO5-PO12	H	The knowledge of hashing helps to learn many other topics of engineering and help for a lifelong learning.
CO6-PO1	H	The knowledge of design and implementation of data structures helps to find solutions for various engineering problems.
CO6-PO2	M	The knowledge of design and implementation of data structures helps to analyze various engineering problems.
CO6-PO3	H	The knowledge of design and implementation of data structures helps to design and develop solutions for various complex engineering problems.
CO6-PO4	L	Knowledge of design and implementation of data structures techniques can be used to conduct investigation on large set of data to analyze the performance on different set of data
CO6-PO5	H	Design and Implementation of data structures can be done using modern tools.
CO6-PO6	H	The knowledge of design and implementation of data structures help to solve health, safety and legal servicing problems efficiently
CO6-PO12	H	The knowledge of hashing techniques helps to learn many other topics of engineering and help for a lifelong learning.

GAPS IN THE SYLLABUS - TO MEET INDUSTRY/PROFESSION REQUIREMENTS:

SNO	DESCRIPTION	PROPOSED ACTIONS	PO
1	Towers of Hanoi Problem (Example of recursion).	Provide learning material	2,3

PROPOSED ACTIONS: TOPICS BEYOND SYLLABUS/ASSIGNMENT/INDUSTRY VISIT/GUEST LECTURER/NPTEL ETC

TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN:

SNO	DESCRIPTION	PO
1	M-way search trees	2,3

WEB SOURCE REFERENCES:

1	http://nptel.ac.in/courses/106103069
2	www.nptel.iitm.ac.in/video.php?subjectId=106105085
3	www.cse.unt.edu/~rada/CSCE3110/Lectures/Trees.ppt
4	www.nptel.iitm.ac.in/video.php?subjectId=106105085

5	cslibrary.stanford.edu/103/LinkedListBasics.pdf

DELIVERY/INSTRUCTIONAL METHODOLOGIES:

✓ CHALK & TALK	✓ STUD. ASSIGNMENT	✓ WEB RESOURCES
✓ LCD/SMART BOARDS	✓ STUD. SEMINARS	✓ ADD-ON COURSES

ASSESSMENT METHODOLOGIES-DIRECT

✓ASSIGNMENTS	✓ STUD. SEMINARS	✓ TESTS/MODEL EXAMS	✓ UNIV. EXAMINATION
✓ STUD. LAB PRACTICES	✓ STUD. VIVA	☐ MINI/MAJOR PROJECTS	☐ CERTIFICATIONS
☐ ADD-ON COURSES	☐ OTHERS		

ASSESSMENT METHODOLOGIES-INDIRECT

✓ ASSESSMENT OF COURSE OUTCOMES (BY FEEDBACK, ONCE)	✓ STUDENT FEEDBACK ON FACULTY (TWICE)
☐ ASSESSMENT OF MINI/MAJOR PROJECTS BY EXT. EXPERTS	☐ OTHERS

Prepared by **Approved by**

Sreeja M. U. **(HOD)**

3.2 Course Plan

No	Topic	No. of Lectures
1	**Module 1 : BASIC CONCEPTS OF DATA STRUCTURES**	**8 hours**
1.1	System Life Cycle	1 Hour
1.2	Algorithms, Performance Analysis	2 Hour
1.3	Space Complexity, Time Complexity	2 Hour
1.4	Asymptotic Notation (Big O Notation)	1 Hour
1.5	Complexity Calculation of Simple Algorithms	2 Hour
2	**Module 2: ARRAYS AND SEARCHING**	**11 hours**
2.1	Polynomial representation using Arrays	1 Hour
2.2	Sparse matrix (Lecture 1)	1 Hour
2.3	Sparse matrix (Lecture 2)	1 Hour
2.4	Stacks	1 Hour
2.5	Queues, Circular Queues	2 Hour
2.6	Priority Queues	1 Hour
2.7	Double Ended Queues	1 Hour
2.8	Conversion and Evaluation of Expressions	2 Hour
2.9	Linear Search and Binary Search	1 Hour
3	**Module 3: LINKED LIST AND MEMORY MANAGEMENT**	**15 hours**
3.1	Self-Referential Structures	1 Hour
3.2	Dynamic Memory Allocation	1 Hour
3.3	Singly Linked List-Operations on Linked List	2 Hour
3.4	Doubly Linked List	2 Hour
3.5	Circular Linked List	1 Hour
3.6	Stacks using Linked List	1 Hour
3.7	Queues using Linked List	1 Hour
3.8	Polynomial representation using Linked List (Lecture 1)	1 Hour
3.9	Polynomial representation using Linked List (Lecture2)	1 Hour
3.10	Memory de-allocation	1 Hour
3.11	Memory allocation-First-fit	1 Hour
3.12	Best-fit and Worst-fit allocation schemes	2 Hour
4	**Module 4: TREES AND GRAPHS**	**14 hours**
4.1	Trees, Binary Trees	2 Hour
4.2	Tree Operations, Binary Tree Representation,	1 Hour
4.3	Tree Traversals	2 Hour
4.4	Binary Search Trees	1 Hour
4.5	Binary Search Tree Operations	2 Hour
4.6	Graphs, Representation of Graphs	2 Hour
4.7	Depth First Search and Breadth First Search on Graphs	2 Hour
4.8	Applications of Graphs	2 Hour
5	**Module 5: SORTING AND HASHING**	**12 hours**

5.1	Sorting Techniques – Selection Sort	1 Hour
5.2	Insertion Sort	1 Hour
5.3	Quick Sort	1 Hour
5.4	Merge Sort	1 Hour
5.5	Heap Sort	1 Hour
5.6	Hashing- Hashing Techniques	2 Hour
5.7	Collision Resolution	1 Hour
5.8	Overflow handling	1 Hour
5.9	Hashing functions – Mid square and Division methods	2 Hour
5.10	Folding and Digit Analysis methods	1 Hour

3.3 Assignment Questions

Assignment 1

1. Find out the time complexity of

    a. biggest of an array of n numbers

    b. matrix multiplication

Assignment 2

1. Write an algorithm to check whether the brackets are closed properly?

    eg: (2+3)-4) not properly closed.

2. Write an algorithm to reverse a string using stack.

3. Given 5 memory partitions of 100Kb, 500Kb, 200Kb, 300Kb, 600Kb. How would the first fit, best fit and worst fit algorithm place processes of 212Kb, 417Kb, 112Kb & 426Kb. Which algorithm make the most efficient use of memory?

Assignment 3

1. Let there be initial memory block as 150,200,300,410,500 etc. show the allocation of 400k, 90k, 70k, 150k using best fit , worst fit and first fit allocation method. Apply Quick sort and selection sort on the following numbers

    12, 34,2, 65, 54,33, 29,67, 89,43, 49

2. The size of the hash table is 11. Open addressing is used to resolve Collision. The hash function is H(K)=K mod 11. What will be the hash table after the insertion in the following order?

    12, 34,2, 65, 54,33, 29,67, 89,43, 49

STATISTICAL FOUNDATIONS FOR DATA SCIENCE

4.1 COURSE INFORMATION SHEET

PROGRAMME: **ARTIFICIAL INTELLIGENCE AND DATA SCIENCE**	DEGREE: **BTECH**
COURSE: **STATISTICAL FOUNDATIONS FOR DATA SCIENCE**	SEMESTER: III CREDITS: **4**
COURSE CODE**: 100008/MA300C** REGULATION: **2021**	COURSE TYPE: **CORE**
COURSE AREA/DOMAIN: **Creative Development**	CONTACT HOURS: **3+1(Tutorial) hours/Week**.
CORRESPONDING LAB COURSE CODE (IF ANY):	LAB COURSE NAME:

SYLLABUS:

UNIT	DETAILS	HOURS
I	**PROBABILITY AND PROBABILITY DISTRIBUTIONS** Probability spaces- Sample space and events, Random variables , Axioms of probability and related problems, Conditional probability, Baye' s theorem, Independence, Distribution functions-Probability mass function, Probability density functions.	**9**
II	**DISCRETE AND CONTINUOUS DISTRIBUTIONS** Functions of random variables- expectations, mean and variance, Moments and moment generating functions, Binomial distribution, mean and variance, Poisson distribution - meanand variance, Normal distribution function.	**9**
III	**JOINT AND MARGINAL DISTRIBUTIONS** Chebyshev's inequality , Distribution of two variables- Discrete and Continuous, Marginal and Conditional distributions, Expectation, Conditional expectations and independence.	**9**
IV	**CORRELATION AND SAMPLING DISTRIBUTION** Covariance - discrete and continuous , Correlation - discrete and continuous, Sampling distribution of the mean(SD known), Central limit theorem, Sampling distribution of themean (SD unknown).	**9**
V	**ESTIMATION AND REGRESSION** Point estimation, Interval estimation of large samples, Testing of Hypothesis-Test of significance of single mean, Estimation of proportions, Regression-least square estimators of the regression parameters, Estimation using the regression line.	**9**
TOTAL HOURS		**45**

TEXT/REFERENCE BOOKS:

1. Text Books

1. B. L. S. Prakasa Rao, A First Course in Probability and Statistics, World Scientific/Cambridge University Press India, 2009.
2. R. V. Hogg, J. W. McKean and A. Craig, Introduction to Mathematical Statistics, 6th Ed.,Pearson Education India, 2006.

2. Reference Books

1) Sundarapandian, V. *Probability, statistics and queuing theory*. PHI Learning Pvt. Ltd.(2009).
2) Levin, Richard I. *Statistics for management*. Pearson Education India, 2011.
3) Thirupathi Rao Pillalamarry A Textbook of Probability and Statistics, Laxmi publications, 2011.
4) Devore, J. L. *Probability and Statistics for Engineering and the Sciences*. Cengagelearning. (2011).
5) Veerarajan, T. *Probability, statistics and random processes*. Tata McGraw-Hill. (2008).

COURSE PRE-REQUISITES:

C.CODE	COURSE NAME	DESCRIPTION	SEM
	A basic study of probability in school class.		

COURSE OBJECTIVES:

1	To introduce mathematical notations and concepts in probability that is essential for computing.
2	To train on different distributions to model strategies.
3	To cultivate analytical thinking and creative problem-solving skills.

COURSE OUTCOMES:

After the completion of the course the student will be able to

CO1: Solve conditional probability and independent events. Also, apply the concept probability mass and density function.

CO2: Find moments and moments generating functions using mathematical expectation.

CO3: Find marginal and conditional probabilities.

CO4: Evaluate standard multivariate distributions and calculate correlation.

CO5 Conduct testing of hypothesis and analyze different types of estimation.

CO-PO AND CO-PSO MAPPING

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

JUSTIFICATIONS FOR THE MAPPING

Mapping	LOW/MEDIUM/HIGH	Justification
CO1-PO1	H	Sample spaces can be used to visualize the complex engineering problems .
C01-PO2	M	Continuous distributions can be used to reach conclusions in the problems involving huge data
CO1-PO3	L	Discrete distributions will help life-long learning in the broadest context of technological change.
CO1-PO9	M	Baye's theorem and total probability are helpful in designing problems.
CO1-PO10	L	Used to select and apply appropriate techniques with an understanding of the limitations.
CO2-PO1	H	Probabilistic models are helpful in analyzing real life problems.
CO2-PO2	M	Techniques involving expectation will help life-long learning in the broadest context of technological change.
CO2-PO3	L	The distributions can be analyzed using various properties
CO2-PO9	M	It can be used to compare the complexity of distributions that were developed
CO2-PO10	L	It helps to analyze the complexity and choose the best method for the problem

CO3-PO1	H	All joint probabilistic models can be compared using a single measure to identify the amount of computations involved in them so that the optimal can be identified
CO3-PO2	M	Conditional expectation will help life-long learning in the broadest context of technological change.
CO3-PO3	L	Chebyshev's inequality will give insight into various systems.
CO3-PO9	M	Marginal distribution will help life-long learning in the broadest context of technological change.
CO3 -PO10	L	Joint distribution can be used to reach conclusions in the problems involving huge data.
CO4-PO1	H	Sampling techniques will help life-long learning in the broadest context of technological change.
CO4-PO2	M	The arrangement and combinations of data to be taken for different problems can be identified
CO4-PO3	M	Central limit theorem can be Used in research-based knowledge and research methods.
CO4-PO9	M	Knowing correlation between random variables will help in Communicating effectively on complex engineering activities with the engineering community and with society
CO4-PO10	L	The concepts of covariance can be used to solve various complex engineering problems
CO5-PO1	H	The knowledge about the testing will help them to reach conclusions about the complexity and methodologies for solving real life problems
CO5-PO2	M	Knowledge about regression can aid in the representation of various real life problems
CO5-PO3	L	The knowledge about testing and research methods including design of experiments
CO5-PO9	M	Testing of hypothesis will help to Communicate effectively on complex engineering activities with the engineering community and with society
CO5-PO10	H	The reasoning and inferences made by them can be substantiated by the various proof techniques

GAPS IN THE SYLLABUS - TO MEET INDUSTRY/PROFESSION REQUIREMENTS:

Si NO	DESCRIPTION	PROPOSED ACTIONS	RELEVANCE WITH POs	RELEVANCE WITH PSOs
1	Applications of structures	Study Material	1	1
2	Plotting graph for a function	Class lecturing along with the topic of function	1	1

PROPOSED ACTIONS: TOPICS BEYOND SYLLABUS/ASSIGNMENT/INDUSTRY VISIT/GUEST LECTURER/NPTEL ETC

TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN:

Si NO	DESCRIPTION	PROPOSED ACTIONS	RELEVANCE WITH POs	RELEVANCE WITH PSOs
1	Different types of numbers and their properties and algorithms in graph theory	Class Assignment	1,3	1

WEB SOURCE REFERENCES:

1	http://web.stanford.edu/class/cs103x/cs103x-notes.pdf
2	https://www.tutorialspoint.com/discrete_mathematics/discrete_mathematics_recurrence_relation.htm
3	http://nms.lu.lv/wp-content/uploads/2016/04/21-linear-recurrences.pdf
4	http://www.home.cs.utwente.nl/~infrieks/MHMI/2005.jk.pdf
5	http://nicolas.thiery.name/macs358/Notes/AlgebraicStructures.pdf

DELIVERY/INSTRUCTIONAL METHODOLOGIES:

✓ CHALK & TALK	✓ STUD. ASSIGNMENT	✓ WEB RESOURCES	
✓ LCD/SMART BOARDS	✓ STUD. SEMINARS	☐ ADD-ON COURSES	

ASSESSMENT METHODOLOGIES-DIRECT

✓ ASSIGNMENTS	✓ STUD. SEMINARS	✓ TESTS/MODEL EXAMS	✓ UNIV. EXAMINATION
✓ STUD. LAB	✓ STUD. VIVA	☐ MINI/MAJOR	☐

PRACTICES		PROJECTS	CERTIFICATIONS
☐ ADD-ON COURSES	☐ OTHERS		

ASSESSMENT METHODOLOGIES-INDIRECT

✓ ASSESSMENT OF COURSE OUTCOMES (BY FEEDBACK, ONCE)	✓ STUDENT FEEDBACK ON FACULTY (TWICE)
☐ ASSESSMENT OF MINI/MAJOR PROJECTS BY EXT. EXPERTS	☐ OTHERS

Prepared by **Approved by**

Vinmol K. Jesudas **HOD**

4.2 Course Contents And Lecture Schedule

No	Topic	No. of Lectues
1	**PROBABILITY AND PROBABILITY DISTRIBUTIONS (9 hours)**	
1.1	Probability spaces- Sample space and events, Random variables	1 Hour
1.2	Axioms of probability and related problems	1 Hour
1.3	Conditional probability	1 Hour
1.4	Baye' s theorem	2 Hours
1.5	Independence	1 Hour
1.6	Distribution functions-Probability mass function	2 Hours
1.7	Probability density functions	1 Hour
2	**DISCRETE AND CONTINUOUS DISTRIBUTIONS (9 hours)**	
2.1	- expectations, mean and variance	2 Hours
2.2	Moments and moment generating functions	2 Hours
2.3	Binomial distribution, mean and variance	2 Hours
2.4	Poisson distribution - mean and variance	1 Hour
2.5	Normal distribution function	2 Hours
3	**JOINT AND MARGINAL DISTRIBUTIONS (9 hours)**	
3.1	Chebychev' s inequality	2 Hours
3.2	Distribution of two variables- Discrete and Continuous	2 Hours
3.3	Marginal and Conditional distributions	2 Hours
3.4	Expectation	1 Hour
3.5	Conditional expectations and independence	2 Hours
4	**CORRELATION AND SAMPLING DISTRIBUTION (9 hours)**	
4.1	Covariance - discrete and continuous	2 Hours
4.2	Correlation - discrete and continuous	2 Hour
4.3	Sampling distribution of the mean (SD known)	1 Hours
4.4	Central limit theorem	2 Hour

4.5	Sampling distribution of the mean (SD unknown)	2 Hours
5	**ESTIMATION AND REGRESSION (9 hours)**	
5.1	Point estimation	1 Hour
5.2	Interval estimation of large samples	2 Hours
5.3	Testing of Hypothesis- Test of significance of single mean	2 Hour
5.4	Estimation of proportions	2 Hour
5.5	Regression- least square estimators of the regression parameters	1 Hour
5.6	Estimation using the regression line	1 Hour

4.3 ASSIGNMENT QUESTIONS

Module-I

1. There are three unbiased coins and one biased coin with head on both sides. A coin is chosen at random and tossed 4 times. If head occurs all the 4 times, what is the probability that the biased coin has been chosen?
2. The members of a consulting firm rent cars from rental agencies A, B and C as 60%, 30% and 10% respectively. If 9%, 20% and 6% of cars from A, B and C respectively, agencies need tune up and if a rental car delivered to the firm does not need tune up, what is the probability that it came from B agency?
3. A can hit a target 3 times in 5 shots, B 2 times in 5 shots and C 3 times in 4 shots. Find the probability of the target being hit , when all of them try?
4. A fair die is thrown and an outcome of 4 or 5 is considered to be a success. If the die is thrown 9 times and X denotes the number of successes, find (a) the mean and variance of X (b)$P(X = 2)$ (c)$P(X \leq 2) and\ (d) P(X \geq 2)$
5. Let X be a continuous random variable with p.d.f. f(x) $=$ $\begin{cases} kx, o < x < 1 \\ 0, otherwise \end{cases}$ where k is a constant.
   1. Determine the value of k
   2. Find p($\frac{1}{4} < X \leq 2$).
6. A continuous random variable X that can assume any value between x=2 and x=5 has a density function given byf(x) $=$ k(1 + x). Find p(X $<$ 4).
7. If X is continuous r.v with pdff(x) $= \frac{1}{5} e^{\frac{-x}{5}}$, x > 0 $and\ f(x) = 0$ otherwise , then find P(X >10).
8. Check whether f(x) $= \frac{1}{2} e^{-|X|}$, $-\infty < x < \infty$ is a pdf.
9. Suppose that X is a continuous random variable whose probability density function is given byf(x) = C (4x-2x^2), 0<x<2 and f(x) = 0 ,otherwise. Then find C and P(X>1).
10. Let *X* be a continuous random variable whose probability density function is: $f(x) = \frac{x^3}{4}$for an interval 0 < *x* < *c*. What is the value of the constant *c* that makes *f*(*x*) a valid probability density function?

MODULE 2 ASSIGNMENT QUESTIONS

1. A car hire firm has 2 cars which it hires out day by day. The number of demands for a car on each day follows a Poisson distribution with mean 1.5.Calculate the proportion of days on which
    a. neither car is used
    b. some demand is not fulfilled.
2. If X is a Poisson random variable with $p(X = 2) = p(X = 3)$,find $p(X = 4)$
3. If the probability that an individual suffers a bad reaction from injection of a serum is 1%,find the probability that out of 800 individuals,
    a. No individual will suffer a bad reaction
    b. exactly 2 individuals will suffer a bad reaction
    c. more than 2 individuals will suffer a bad reaction
4. a) A coin is biased so that a head is thrice as likely to appear as a tail. If the coin is tossed 5 times, find the probability of getting (a) atleast 3 heads (b) atmost 3 heads and (c) exactly 3 tails
5. If X is a random variable following binomial distribution with mean 2.4 and variance 1.44,find $p(x \geq 5)$
6. If the chance that anyone of the 10 telephone lines is busy at any instant is 0.2,what is the chance that 5 of the lines are busy? What is the probability that all the lines are busy?
7. If the probability of hitting a target is 10% and 10 shots are fired independently ,what is the probability that the target will be hit atleast once.
8. The mean and variance of a binomial random variable is 1 and $\frac{2}{3}$.Then find $p(x \leq 2)$
9. Find 'p' for the binomial random variable X if n=6 and if $9p(X = 4) = p(X = 2)$.
10. A radar unit is used to measure speeds of cars on a motorway. The speeds are normally distributed with a mean of 90 km/hr and a standard deviation of 10 km/hr. What is the probability that a car picked at random is travelling at more than 100 km/hr?

MODULE 3 ASSIGNMENT QUESTIONS

1. A continuous r.v (X, Y) has joint density given byf(x,y)= c ;0 < y ≤ x <1 and 0 ,otherwise.
    a. Find c

b. The mpdf's of X and Y

c. Are X and Y independent?

2. The j.p.d.f of X and Y is $f(x,y) = \begin{cases} \frac{2}{(x+y+1)^3} & x,y > 0 \\ 0 & \text{elsewhere} \end{cases}$ then find the marginal density function of X.
3. The jpmf of X and Y is given by P(0,1) =1/3 , P(1, -1) = 1/3 , and P(1,1) = 1/3. Find mpmf's of X ad Y.
4. Given the Joint probability density function of (X, Y).

$$f(x,y)= cxy \ ; 0 \le x \le 1, \ 0 \le y \le 1$$

a. Find c

b. Are X and Y independent ?

c. Find P(X+Y<1).

5. The jpmf of X and Y is given by $p(x,y) = \frac{x^2+y}{32}$, $x = 0,1,2,3$, $y = 0,1$. Find mpmf's of X and Y.
6. If the joint pdf of (X,Y) is given by $f(x,y) = k$, $0 \le x < y \le 2$, find k , marginal pdf of X and Y and conditional pdf of X given Y and Y given X.
7. The following table represents the joint probability distribution of the discrete random variable (X, Y). Find all the marginal distributions and find the conditional pdf of Y given X=1 and X given Y=2.

Y \ X	1	2	3
1	1/12	1/6	0
2	0	1/9	1/5
3	/18	1/4	2/15

8. The jpdf of the random variable (X,Y) is given by $f(x,y) = axy$, $1 \le x \le 3$, $2 \le y \le 4$ .Find the value of 'a'. Find the marginal pdf of X and Y. Are X and Y independent?
9. The jpmf of X and Y is given by $p(x,y) = \frac{2x+y}{27}$, $x = 0,1,2$, $y = 0,1,2$. Find mpmf's of X and Y.

10. The joint probability density function of X and Y is given by f(x,y)= {94−x−y, if 0<x<2, 0<y<20
    (i) Find the marginal density functions of X and Y.
    (ii)Find the conditional density function of X givenY=y..
    (iii) Find the conditional density function of Y given X=x.X=x.
    (iv) Are X and Y independent ?

MODULE 4ASSIGNMENT QUESTIONS

1. A random sample of size 200 is taken from a population whose mean is 50 and variance is 600. Using Central Limit Theorem, Find the probability that the mean of the sample will not differ from μ=50μ=50 by more than 5?
2. The lifetime of a certain brand of an electric gadget may be considered as a random variable with mean 1000 hours and standard deviation 400 hours. Using Central Limit Theorem, find the probability that the average life time of 50 gadgets exceeds 1100 hours?.
3. The lifetime of a certain type of electric bulb may be considered as an exponential random variable with mean 50 hours. Using Central Limit Theorem, find the approximate probability that 100 of these electric bulbs will provide a total of more than 6000 hours of burning time?
4. b) A coin is tossed 200 times. Find the approximate probability that the number of heads obtained is between 80 and 120 ?
5. A population consists of five numbers 2,3,6,8,11. Consider all possible samples of size two which can be drawn with replacement from this population. Find the standard error of the means.
6. A population consists of six numbers4, 8, 12, 16, 20, 24. Consider all samples of size two which can be drawn without replacement from this population, find

   (i) population mean

   (ii) population standard deviation

   (iii) mean of the sampling distribution of means

   (iv) standard deviation of the sampling distribution of means
7. If the population is 3, 6, 9, 15, 27

   (i) List all possible samples of size 3 that can be taken without replacement from the finite population.

   (ii) Calculate the mean of each of the sampling distribution of means.

(iii) Find the standard deviation of sampling distribution of means.

8. Two random variables X and Y have the joint probability density function f(x,y) = $\{\frac{xy}{96}$, 0<x<4, 1<y<5
   Find E(X), E(Y), E(XY), E(2x+3Y), V(X),V(Y), Cov(X,Y).
9. a) A random sample of size 64 is taken from normal population with μ=51.4and σ=6.8. What is the probability that the mean of the sample will
   (i) Exceed 52.9

   (ii) Between 50.5 and 52.3

   (iii) <<50.6
10. The mean height of students in a college is 155cms and standard deviation is 15. What is the probability that the mean height of 36 students is less than 157 cms?

MODULE 5 ASSIGNMENT QUESTIONS

1. A random sample of size 100 is taken from a population with σσ=5.1. Given that the sample mean is 21.6. Construct 95% confidence interval for the population mean.

2. A panel of judges A and B graded seven debators and independently awarded the following marks:

Debator	1	2	3	4	5	6	7
Marks by A	40	34	28	30	44	38	31
Marks by B	32	39	26	30	38	34	28

   An eighth debator was awarded 36 marks by judge A while judge B was not present.

   If judge B was also present, how many marks would you expect hi,m to award to eighth debator assuming same degree of relationship exists in judgement?

3. A random sample of 200 measurements from a large population gave a mean value of 50 and a S.D. of 9. Determine 95% confidence interval for the mean of population.
4. From the following data , Obtain the two regression equations and also the correlation coefficient.

Sales	91	97	108	121	67	124	51	73	111	57
Purchases	71	75	69	97	70	91	39	61	80	47

5. In a wine company , due to some effects of chemical reactor, 16 of 91 bottles were considered spoiled. Does this data provide strong evidence for concluding that more than 15% of all such bottles are contaminated in this way ?(level of significance is 0.1)

6. The mean weight obtained from a random sample of size 100 is 64gms. The S.D. of the weight distribution of the population is 3gms. Test the statement that the mean weight of the population is 67gms at 5% level of significance .Also set up 99% confidence limits of the mean weight of the population.

7. A manufacturer of sprinkler systems used for fire protection in office buildings claims that the average system-activation temperature is 130°. A sample of n=9 systems, when tested, yields a sample average activation temperature of131.08°F. If the distribution of activation times is normal with standard deviation 1.5°F, does the data contradict the manufacturer's claim at siginificance level α=.01?

8. The melting point of each of 16 samples of a certain brand of hydrogenated vegetable oil was determined, resulting in $\bar{X}$=94.32. Assume that the distribution of the melting point is normal with σ = 1.20.
   (i) Test H_0:μ=95 versus Ha:μ ≠95 using a two-tailed level .01 test.
9. A sample of 64 students has a mean weight of 70 kgs. Can this be regarded as a sample from a population with mean weight 65 kgs and standard deviation 25 kgs ?

10. In a random sample of 60 workers the average time taken by them to get to work is 33.8 minutes with a standard deviation of 6.1 minutes, Can we reject the null hypothesis μ=32.6μ=32.6 minutes in favour of alternative hypothesis μ>32.6μ>32.6 at α=0.025α=0.025 level of significance ?
11. a) An oceanographer wants to check whether the average depth of the ocean in a certain region is 57.4 fathoms, as had previously been recorded. What can be concluded at the level of significance 0.05 if soundings take at 40 random locations in the given region yielded a mean of 59.1 fathoms with a standard deviation of 5.2 fathoms ?

    b) It is claimed that a random sample of 100 tyres with a mean life of 15269 km is drawn from a population of tyres which has a mean life of 15200 km and a standard deviation of 1248 km. Test the validity of this claim.

OPERATING SYSTEM

5.1 COURSE INFORMATION SHEET

PROGRAMME: Artificial Intelligence and Data Science	DEGREE: B.TECH
COURSE: Operating System	SEMESTER: Third CREDITS: 4
COURSE CODE: I00008/IT300D REGULATION:2021	COURSE TYPE: CORE
COURSE AREA/DOMAIN: System Software	CONTACT HOURS: 4 hours/ Week
CORRESPONDING LAB COURSE CODE (IF ANY):No	LAB COURSE NAME:NA

SYLLABUS:

UNIT	DETAILS	HOURS
I	**Module 1: INTRODUCTION: WHAT IS AN OPERATING SYSTEM** Computer System Organization: Processors, memory, Disks, I/O devices- Computer System Architecture: Single processor System, Multi-processor system, Clustered System- Operating Systemservices- Types of Operating Systems: Batch, Multi programmed, Time-sharing and Real timesystems, System calls, System Programs, Operating System Structure – Monolithic system, LayeredSystem – Kernel, Shell.	**12**
II	**Module 2: PROCESS MANAGEMENT** Process, Process States, Process control block, Scheduler, Dispatcher- Process Scheduling: Non-Preemptive Scheduling, Preemptive scheduling- Scheduling Algorithms: First come first serve,Shortest Job First, Priority scheduling, Shortest remaining time next, Round Robin Scheduling, multilevelqueue scheduling- Guaranteed scheduling.	**10**
III	**Module 3: PROCESS SYNCHRONIZATION AND DEADLOACKS** Process Synchronization:- Race Conditions - Critical Sections – Mutual Exclusion - Busy Waiting –Peterson's Solution - Mutex- Semaphores – Monitors. Deadlocks:- Deadlock characteristics -conditions for deadlock-Resource allocation graph- Methods for handling deadlocks: prevention, avoidance, detection, recovery from dead lock –bankers algorithm.	**14**
IV	**Module 4: MEMORY MANAGEMENT AND VIRTUAL MEMORY** Memory management :- Memory address space- swapping – Memory	**12**

	partitions: fixed partitions, variable partitions – Memory allocation-fragmentation – segmentation- paging - segmented paging-Page table, Inverted page table- Translation Look-aside Buffer. Virtual memory:- concepts - demand paging - page replacement:– FIFO, Optimal, LRU- Space allocation policies-Thrashing.	
V	**Module 5: STORAGE MANAGEMENT AND FILE SYSTEM** Storage Management:- Mass storage structure- Physical characteristics – Disk scheduling algorithms– FCFS, SSTF, SCAN, C-SCAN, LOOK, C-LOOK. File System:- File concept – Access methods – Directory structure – implementation – Linear list, Hash table –Case study: Linux system	**12**
TOTAL HOURS		**60**

TEXT/REFERENCE BOOKS:

T/R	BOOK TITLE/AUTHORS/PUBLICATION
T	J. L. Peterson and A. Silberschatz, Operating System Concepts, Addison Wesley
R	1. Andrew S. Tanenbaum, "Modern Operating Systems", Prentice Hall 2. D M Dhamdhere, "Operating Systems A Concept-based Approach", Tata McGraw Hill, New Delhi, 2nd Edition, 2010. 3. William Stallings, Operating Systems,6th Edition, Pearson, 2009, ISBN 978-81-317-2528-3 4. Rohit Khurana, Operating System, Vikas Publishing House Pvt. Ltd.

COURSE PRE-REQUISITES: NIL

COURSE OBJECTIVES:

- To provide basic knowledge of computer operating system structures and functioning.
- To understand the fundamental concepts, processes and communication.
- To understand and analyze implementation of process synchronization.
- To know design issues associated with operating systems.
- To familiarize with memory management including virtual memory.

COURSE OUTCOMES:

After the completion of the course the student will be able to

CO1	Identify the basic concepts, functionalities and structure of operating system
CO2	Understand and evaluate different process scheduling algorithms used in operating system
CO3	Analyze the design issues of various process synchronization techniques and the precautions taken to prevent as well as avoid deadlock occurrence
CO4	Learn, analyze and evaluate efficient memory management techniques used in different operating systems
CO5	Classify various file management approaches and identify the different disk scheduling algorithms and evaluate their efficiency

CO-PO AND CO-PSO MAPPING

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

JUSTIFICATIONS FOR CO-PO/PSO MAPPING

MAPPING	LOW/MEDIUM/HIGH	JUSTIFICATION
CO1-PO1	L	The knowledge of basic concepts of Operating system will help the students to apply the same to formulate solutions for engineering problems.
CO1-PO2	L	The knowledge of different ways of handling operating system principles will help the students to apply the same to identify and analyze engineering problems.
CO1-PSO1	M	The knowledge of operating system concepts helps students to

		develop system programs and system calls and implement using C language and shell scripts.
CO2-PO1	L	The knowledge of basic concepts of process will help the students to apply the same to formulate solutions for engineering problems.
CO2-PO2	M	Understanding of different process scheduling algorithms will help to review and analyze scheduling problems in operating system.
CO2-PO3	M	Thorough understanding of different types of process scheduling algorithms will help in the design and development of abstract models for scheduling problems.
CO2-PO4	H	Study of process and process scheduling schemes and criteria with examples will help in conducting detailed investigation of complex process scheduling problems in operating system.
CO2-PO5	L	Knowledge in process scheduling algorithms helps in applying appropriate techniques in operating system design.
CO2-PSO2	M	Understanding of different types of process and process scheduling mechanisms will aid in design of real time algorithms for complex problems.
CO3-PO1	M	Correlating the study of process synchronization to real world applications will aid in formulating engineering problems with similar background and arriving at with solutions.
CO3-PO2	M	The real world application study of process synchronization and deadlock will help to design and develop solutions of similar kind engineering problems
CO3-PO3	H	Study of deadlock can be utilized in designing, analyzing and interpreting of different problems and provide valid solutions
CO3-PO4	M	Students will be able to use research-based knowledge and research methods to provide valid conclusions for the precautions taken to avoid deadlock occurrence
CO3-PO5	M	Students will be able to create, select, and apply appropriate techniques, to eliminate the design issues of OS and the precautions taken to avoid deadlock occurrence with an understanding of the limitations
CO3-PSO2	M	The Students will be able to contribute their knowledge of deadlock prevention and avoidance techniques in developing efficient OS
CO4-PO2	H	Detailed analytical and evaluative study of memory management in OS will help in identification, formulation and finding feasible solutions for real world computational problems
CO4-PO3	M	An evaluative knowledge of paging and segmentation will help in

		applying the same while designing and developing solutions to computational problems
CO4-PO4	L	Evaluative learning of different type of page replacement algorithms will help in analysis and synthesis of real time computational problems related to memory management in different OS.
CO4-PSO2	L	Can contribute knowledge in memory management in OS for designing abstract models for different OS environment.
CO5-PO1	M	Understanding the different categories of basic file management problems in OS will aid in applying the knowledge to find solutions of complex problems
CO5-PO2	M	Different file system management problems can be identified, formulated, reviewed and conclusions can be reached, when we are aware of the basic requirements
CO5-PO3	M	Complexity study of Linux OS will help in design and development of solutions for real time computational problems
CO5-PO4	L	Study of Linux OS will help to provide valid conclusions of real time computational problems
CO5-PSO1	M	Students will be able to contribute in designing new models related to file management in different OS and provide an implementation of the same
CO5-PSO2	L	Students will be able to contribute engineering skills to develop OS for real time applications

GAPS IN THE SYLLABUS - TO MEET INDUSTRY/PROFESSION REQUIREMENTS:

SNO	DESCRIPTION	PROPOSED ACTIONS
1	Familiarization of various system calls which is used for the design of kernels	Conducting lab session

PROPOSED ACTIONS: TOPICS BEYOND SYLLABUS/ASSIGNMENT/INDUSTRY VISIT/GUEST LECTURER/NPTEL ETC

TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN:

1	Shell programming- Lab sessions

WEB SOURCE REFERENCES:

1	http://www.brokenthorn.com/Resources/OSDev13.html

2	http://www.osnews.com/story/24405/Hobby_OS-deving_3_Designing_a_Kernel/
3	http://lwn.net/
4	https://www.kernel.org/
5	http://ww5.linuxdrivers.net/

DELIVERY/INSTRUCTIONAL METHODOLOGIES:

✓ CHALK & TALK	✓ STUD. ASSIGNMENT	✓ WEB RESOURCES
✓ LCD/SMART BOARDS	✓ STUD. SEMINARS	✓ ADD-ON COURSES

ASSESSMENT METHODOLOGIES-DIRECT

✓ ASSIGNMENTS	✓ STUD. SEMINARS	✓ TESTS/MODEL EXAMS	✓ UNIV. EXAMINATION
STUD. LAB PRACTICES	☐ STUD. VIVA	☐ MINI/MAJOR PROJECTS	☐ CERTIFICATIONS
☐ ADD-ON COURSES	☐ OTHERS		

ASSESSMENT METHODOLOGIES-INDIRECT

✓ ASSESSMENT OF COURSE OUTCOMES (BY FEEDBACK, ONCE)	✓ STUDENT FEEDBACK ON FACULTY (TWICE)
☐ ASSESSMENT OF MINI/MAJOR PROJECTS BY EXT. EXPERTS	☐ OTHERS

Prepared by **Approved by**

Dr. Lakshmi K.S **(HOD)**

5.2 Course Plan

No	Topic	No. of Lectures
1	**INTRODUCTION: WHAT IS AN OPERATING SYSTEM?**	**12 Hours**
1.1	Computer System Organization:- Processors, memory, Disks, I/Odevices.	3 Hours
1.2	Computer System Architecture:- Single processor System, Multiprocessorsystem, Clustered System-Operating System services.	3 Hours
1.3	Types of Operating Systems: Batch, Multi programmed, Time-sharingand Real time systems.	3 Hours
1.4	System calls, System Programs, Operating System Structure –Monolithic system, Layered System – Kernel, Shell.	3 Hours
2	**PROCESS MANAGEMENT**	**10 Hours**
2.1	Process, Process States, Process control block, Scheduler, Dispatcher.	2 Hours
2.2	Process Scheduling: Non-Preemptive Scheduling, Preemptive Scheduling.	2 Hours
2.3	Scheduling Algorithms: First come first serve, Shortest Job First, Priority scheduling, Shortest remaining time next, Round Robin Scheduling.	4 Hours
2.4	Multilevel queue scheduling- Guaranteed scheduling	2 Hours
3	**PROCESS SYNCHRONIZATION AND DEADLOACKS**	**14 Hours**
3.1	Process Synchronization: Race Conditions - Critical Sections – Mutual Exclusion.	2 Hours
3.2	Busy Waiting – Peterson's Solution – Mutex-Semaphores – Monitors.	6 Hours
3.3	Deadlocks: Deadlock characteristics -conditions for deadlock-Resource allocation graph.	2 Hours
3.4	Methods for handling deadlocks: prevention, avoidance, detection, recovery from dead lock -bankers algorithm.	4 Hours
4	**MEMORY MANAGEMENT AND VIRTUAL MEMORY**	**12 Hours**
4.1	Memory management :- Memory address space-swapping – Memory partitions: fixed partitions, variable partitions.	3 Hours
4.2	Memory allocation-fragmentation – segmentation-paging – segmented paging- Page table, Inverted page table- Translation Look-aside Buffer.	4 Hours
4.3	Virtual memory: concepts - demand paging - page	5 Hours

	replacement: FIFO, Optimal, LRU- Space allocation policies-Thrashing.	
5	**STORAGE MANAGEMENT AND FILE SYSTEM**	**12 Hours**
5.1	Storage Management: Mass storage structure- Physical characteristics.	2 Hours
5.2	Disk scheduling algorithms – FCFS, SSTF, SCAN, C-SCAN, LOOK, CLOOK	4 Hours
5.3	File System: File concept – Access methods.	3 Hours
5.4	Directory structure – Implementation – Linear list, Hash table –Casestudy: Linux system.	3 Hours

5.3 Assignment Questions

Assignment-1 (submission date: 28/10/2021)

1. Explain Von Neumann architecture. (10 marks)
2. Write short note on memory. (10 marks)
3. Write short note on Input devices. (10 marks)
4. Write short note on Output devices. (10 marks)
5. Explain in detail about Single processor System, Multi-processor system and Clustered System. (10 marks)
6. Differentiate between computer organization and computer architecture. (5 marks)
7. Write short note on buses. (address, data and control) (5 marks)
8. Explain different parts of a computer system. (10 marks)
9. Write short note on secondary storage devices. (10 marks)
10. Write short note on microprocessor. (10 marks)

Assignment- 2 (submission date: 20/02/2022)

1. What is a File? List and explain the various file attributes.
2. Describe the various file operations.
3. Briefly explain about file system structure.
4. Explain in detail about file-system implementation.
5. Explain in detail about directory implementation.
6. Briefly explain about disk allocation methods.
7. Compare sequential access and direct access methods of storage devices.
8. What is the significance of access rights associated with each file in a system?
9. How can we make a new magnetic disk ready for use (to store files)?
10. What is swap space? How is it managed in Linux system?

11. Explain the various file access methods.
12. Discuss about the following directory structure: i) Tree structure ii) Acyclic graph
13. Explain protection goals and principles of Operating System.
14. How is protection implemented using access matrix?
15. Briefly explain the file system organization in Linux.

Assignment-3

1. Explain briefly about the design principles, kernel modules and process management of a Linux System.
2. Write short note on the following in Linux System
   - Scheduling
   - Memory Management
   - File Systems
   - Input and Output
3. Write short note on the following in Linux System
   - Interprocess Communication
   - Network Structure
   - Security

DESIGN & ENGINEERING

6.1 COURSE INFORMATION SHEET

PROGRAMME: **Information Technology / Artificial Intelligence and Data Science**	DEGREE: **BTECH**
COURSE: **DESIGN AND ENGINEERING**	SEMESTER: **III** CREDITS: 2
COURSE CODE: **100908/CO900E** **REGULATION: 2020**	COURSE TYPE: **CORE**
COURSE AREA/DOMAIN: **HUMANITIES/Engineering**	CONTACT HOURS: 2 (Lecture) + 0 (Tutorial) + 0 (Practical) Hours / Week.
CORRESPONDING LAB COURSE CODE (IF ANY):**NIL**	LAB COURSE NAME: **NA**

SYLLABUS:

Module	DETAILS	HOURS
I	Design Process:- Introduction to Design and Engineering Design, Defining a Design Process-:Detailing Customer Requirements, Setting Design Objectives, Identifying Constraints, Establishing Functions, Generating Design Alternatives and Choosing a Design.	05
II	Design Thinking Approach:-Introduction to Design Thinking, Iterative Design Thinking Process Stages: Empathize, Define, Ideate, Prototype and Test. Design Thinking as Divergent-Convergent Questioning. Design Thinking in a Team Environment.	05
III	Design Communication (Languages of Engineering Design):- Communicating Designs Graphically, Communicating Designs Orally and in Writing. Mathematical Modeling In Design, Prototyping and Proofing the Design.	05

IV	Design Engineering Concepts:-Project-based Learning and Problem-based Learning in Design. Modular Design and Life Cycle Design Approaches. Application of Biomimicry, Aesthetics and Ergonomics in Design. Value Engineering, Concurrent Engineering, and Reverse Engineering in Design.	05
V	Expediency, Economics and Environment in Design Engineering:-Design for Production, Use, and Sustainability. Engineering Economics in Design. Design Rights. Ethics in Design	05
TOTAL HOURS		**25**

TEXT/REFERENCE BOOKS:

S. No.	T/R	AUTHORS/BOOK TITLE/PUBLICATION
1.	T	Yousef Haik, Sangarappillai Sivaloganathan, Tamer M. Shahin, Engineering Design Process, Cengage Learning, 2003, Third Edition. ISBN-10: 978130525328
2.	T	Voland. G., Engineering by Design, Pearson India 2014, Second Edition, ISBN: 9332535051
3.	R	Balmer, William Keat, George Wise, Exploring Engineering, Fourth Edition: An Introduction to Engineering and Design, Academic Press 2015, 4th Edition, ISBN: 9780128012420.
4.	R	Clive L. Dym, Engineering Design: A Project based Introduction, John Wiley & Sons, New York 2009, Fourth Edition, ISBN: 978-1-118-32458-5
5.	R	Nigel Cross, Design Thinking: Understanding How Designers Think and Work, Berg Publishers 2011, First Edition, ISBN: 978-1847886361.
6.	R	Pahl. G., Beitz W., Feldhusen J., rote K. H., Engineering Design: A Systematic Approach, Springer 2007, Third Edition, ISBN: 978-1-84628-319-2.

7.	R	Jayasree PK, Balan K, Joy Varghese, Gouri P, Design and Engineering, Second Edition, CBS Publishers & Distributors Pvt Ltd., 2018.

COURSE PREREQUISITES: NIL.

The course will be generic to all engineering disciplines and will not require specialized preparation or prerequisites in any of the individual engineering disciplines.

COURSE OBJECTIVES:

1	To introduce the undergraduate engineering students the fundamental principles of design engineering.
2	To make them understand the steps involved in the design process.
3	To familiarize them with the basic tools used and approaches in design.

COURSE OUTCOMES :

Ref. No.	DESCRIPTION	Bloom's Taxonomy Level
EST200.1	Explain the different concepts and principles involved in design engineering.	Remember, Understand (Level 1 & 2)
EST200.2	Apply design thinking while learning and practicing engineering. Develop innovative, reliable, sustainable and economically viable	Apply (Level 3)
EST200.3	Develop innovative, reliable, sustainable and economically viable designs incorporating knowledge in engineering.	Apply (Level 3)

CO-PO AND CO-PSO MAPPING

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO8	PO 9	PO 10	PO11	PO 12	PSO 1	PSO 2	PSO 3
EST 200.1	**2**	**1**	**-**	**-**	**-**	**-**	**1**	**-**	**-**	**1**	**-**	**-**	**2**	**-**	**2**
EST 200.2	**-**	**2**	**-**	**-**	**-**	**1**	**-**	**1**	**-**	**-**	**-**	**2**	**2**	**-**	**2**
EST 200.3	**-**	**-**	**2**	**–**	**-**	**1**	**1**	**-**	**2**	**2**	**-**	**1**	**-**	**-**	**2**

JUSTIFICATIONS FOR CO-PO MAPPING

MAPPING	LOW/MEDIUM/ HIGH	JUSTIFICATION
EST200.1-PO1	M	Students will be able to apply the concepts and principles of design engineering.
EST 200.1-PO2	L	Students will be able to analyze and design complex engineering problems.
EST 200.1-PO7	L	Students will be able to understand the impact of engineering designs in societal and environmental contexts.
EST200.1-PO10	L	Students will be able to communicate the designs effectively to the engineering community and society at large.
EST200.1-PSO1	M	Students will be able to identify, analyze and design complex engineering problems in the area of computer science.

EST 200.1-PSO3	M	Students will be able to design and develop innovative products to meet societal needs and thereby emerge as eminent researchers and entrepreneurs.
EST200.2-PO2	M	Students will be able to analyze and design complex engineering problems by applying a design thinking approach.
EST200.2-PO6	L	Students will be able to apply a design thinking approach considering the societal, health, safety, legal, and cultural issues.
EST200.2-PO8	L	Students will be able to apply a design thinking approach while adhering to ethics and professional responsibility.
EST200.2-PO12	M	Students will be able to recognize the need for & engage in independent and life-long learning in the context of technological change.
EST200.2-PSO1	M	Students will be able to identify, analyze and design complex engineering problems in the area of computer science by applying a design thinking approach.
EST200.2-PSO3	M	Students will be able to design and develop innovative products in the computer science area to meet societal needs and thereby emerge as eminent researchers and entrepreneurs.
EST200.3-PO3	M	Students will be able to design and develop solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
EST 200.3-PO6	L	Students will be able to develop designs considering the societal, health, safety, legal, and cultural issues.

EST 200.3-PO7	L	Students will be able to develop designs, understanding the impact of engineering designs in societal and environmental contexts.
EST 200.3-PO9	M	Students will function effectively as an individual, and as a member or leader in teams, and in multidisciplinary settings while developing innovative designs.
EST200.3-PO10	M	Students will be able to communicate the designs they develop effectively to the engineering community and society at large.
EST200.3-PO12	L	Students will be able to recognize the need for & engage in independent and life-long learning in the context of technological change while involving design and development.
EST200.3-PSO3	M	Students will be able to design and develop innovative products in the computer science area to meet societal needs and thereby emerge as eminent researchers and entrepreneurs.

GAPS IN THE SYLLABUS - TO MEET INDUSTRY/PROFESSION REQUIREMENTS:

None identified at this time.

S. NO	DESCRIPTION	PROPOSED ACTIONS	PO MAPPING
	Nil		

PROPOSED ACTIONS: NA

TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN:

S. NO	TOPIC	PO MAPPING
1	NIL	

WEB SOURCE REFERENCES:

1	https://www.interaction-design.org/

DELIVERY/INSTRUCTIONAL METHODOLOGIES:

☐ CHALK & TALK	☐ STUD. ASSIGNMENT √	☐ WEB RESOURCES √
☐ LCD/SMART BOARDS	☐ STUD. SEMINARS	☐ DISCUSSIONS/ DEBATES
☐ ONLINE CLASSES √	☐ ONLINE QUIZ & POLLS √	

ASSESSMENT METHODOLOGIES-DIRECT:

☐ ASSIGNMENTS √	☐ STUD. SEMINARS	☐ TESTS/MODEL EXAMS √	☐ UNIV. EXAMINATION √
☐ STUD. LAB PRACTICES	☐ STUD. VIVA	☐ MINI/MAJOR PROJECTS	☐ CERTIFICATIONS
☐ADD-ON COURSES	☐ OTHERS		

ASSESSMENT METHODOLOGIES-INDIRECT:

☐ ASSESSMENT OF COURSE OUTCOMES (BY FEEDBACK, ONCE) √	☐ STUDENT FEEDBACK ON FACULTY (ONCE) √
☐ ASSESSMENT OF MINI/MAJOR PROJECTS BY EXT. EXPERTS	☐ OTHERS

Prepared by
Prof. Kuttyamma A.J
(Faculty)

Approved by
Dr.Neeba E.A
(HOD)

6.2 COURSE PLAN

Sl.No	Module	Planned Date	Planned
1	1	25-Oct-21	Introduction to Design and Engineering Design
2	1	27-Oct-21	Design Process - Detailing Customer Requirements
3	1	1-Nov-21	Design Process - Detailing Customer Requirements (Contd..), Setting Design Objectives
4	1	3-Nov-21	Design Process - Identifying Constraints, Establishing Functions, Establishing Specifications
5	1	8-Nov-21	Design Process - Establishing Specifications
6	1	16-Nov-21	Design Process - Generating Design Alternatives & Choosing a Design
7	1	22-Nov-21	Design Process - Generating Design Alternatives & Choosing a Design(cont..)
8	2	25-Nov-21	Introduction to Design Thinking
9	2	26-Nov-21	Design Thinking in a Team Environment, Design Thinking Frameworks, Design Thinking Process Stages - Empathize
10	2	30-Nov-21	Design Thinking Process Stages - Empathize (Contd..), Analyze, Define
11	2	2-Dec-21	Design Thinking Process Stages - Ideate
12	2	6-Dec-21	Design Thinking Process Stages - Ideate (Contd..), Prototype & Test
13	3	14-Dec-21	Communicating Designs Graphically
14	3	16-Dec-21	Communicating Designs Orally and in Writing
15	3	18-Jan-22	Prototyping and Proofing the Design
16	3	3-Feb-22	Mathematical Modelling in Design
17	3	10-Feb-22	Case Studies: Communicating Designs Graphically

18	4	15-Feb-22	Project based Learning and Problem based Learning in Design
19	4	16-Feb-22	Modular Design and Life Cycle Design Approaches
20	4	17-Feb-22	Life Cycle Design Approaches - Design for X
21	4	18-Feb-22	Application of Bio-mimicry, Aesthetics and Ergonomics in Design
22	4	22-Feb-22	Value Engineering, Concurrent Engineering, and Reverse Engineering in Design
23	5	24-Feb-22	Design for Production, Use and Sustainability Engineering Economics in Design
24	5	1-Mar-22	Design Rights Ethics in Design

6.3 ASSIGNMENT QUESTIONS

Assignment -I

Students are divided into 11 groups of 6 each in their roll no. order and let each group go through different stages of the design process for designing the simple products/solutions for one of the problems listed below.

Develop the following artifacts from different stages of design process:

- Need/Problem Statement
- Prioritized list of requirements
- Objective Tree
- List of Design Constraints
- Functional Structure
- Morphological Chart
- Decision Matrix & Selection of Best Solution(s)
- Conceptual Sketches for 2 Best Alternate Designs Chosen.

List of Creative Design Problems to solve:

1. List out the problems of the present design of safety pins. Suggest alternative

designs to overcome the problems.

2. Design modifications for a nail cutter to avoid nails falling on the floor while cutting
3. Non-availability of people for cutting tree branches and plucking coconuts
4. School children have to carry extra heavy bags daily to school. Design an alternative for school bags to carry the heavy book loads.
5. Design modifications for wipers in a car so that visibility through car screen is enhanced during rainy season.
6. Design a product which can be used as a roller skate as well as a bicycle.
7. Modify the design of a cloth hanger to increase its usability and marketability.
8. Suggest new designs for a pair of shoes with a material other than the ones available in the market at present, so that its durability and value can be increased.
9. Design a kitchen tool that combines the functions of a scissor, knife and vegetable cutter/scraper.
10. Design modifications for a wheelchair so that it can be used for climbing and descending stairs.
11. Suggest alternative designs for thermo flask especially to carry insulin vial or pen while travelling.
12. Suggest alternative designs (other than rain coats) to protect two wheeler riders from rain.
13. Middle-aged people have difficulty standing for a long time (especially in church, buses and other public places). Design a handy chair that can be carried easily.
14. Design a multi-purpose walking stick for aged people.
15. List out the limitations of berths in Indian railway coaches. Suggest alternative designs to overcome these limitations.
16. Suggest ideas/solutions to detect the presence of letters/materials in your mailbox at the gate.
17. Rajagiri campus may get flooded every year during the rainy season. Suggest ideas/solutions to avoid flooding and/or to reduce the impact/consequences.
18. Identify different ways to reduce manpower for cleaning / gardening etc. in your college.
19. Identify ideas/solutions to prevent dust falling from blackboard duster while

using it.

20. Identify alternative ideas/solutions for cleaning ceiling fans.
21. Suggest ideas/solutions for 'detecting a golf ball'.
22. Students always forget to bring their id cards to college. Identify alternative ideas/solutions to overcome this problem.
23. Taking attendance is a time consuming process now. Suggest alternative ideas/solutions for making it easy and fast.
24. Identify additional features for a carrom board to increase its value.

Question I

Modify the design of the conventional umbrella so that the below mentioned problems can be solved.

a. The floor becomes wet once you close the umbrella and put it on the floor after a rain.

b. Opening of umbrella in a crowd can hurt people.

Question II

a. Design a device to cut trees with minimal manpower by using the following objectives and constraints.

Objectives: The device should be useful to cut big trees also and can work both manually and with electricity

Constraints: The person who cuts the tree should be able to carry it while climbing to the top

Question III

a. A box consists of oranges of different size. Design a system for sorting the oranges into 3 sets based on their size without any block. Justify your design.

Assignment -II

1. Discuss the different design for "X" in the case of a Bag, to make it competitive in the market.
2. Compare the two products based on design for "X". (a) Laptop (b) Desktop
3. Suggest design modification based on design for "X" for
   (a) a ladder – safety & Logistics
   (b) a pressure cooker – Safety, Quality, Maintenance
   (c) a fan – Assembly, Manufacturing, Maintenance

SUSTAINABLEENGINEERING

7.1 COURSE INFORMATION SHEET

PROGRAMME:INFORMATION TECHNOLOGY	DEGREE*:* BTECH
COURSE:SUSTAINABLE ENGINEERING	SEMESTER: 3CREDITS: NIL
COURSE CODE:100908CO300F REGULATION: 2019	COURSE TYPE:CORE
COURSE AREA/DOMAIN:ENGINEERING (All Branches)	CONTACT HOURS:2(LECTURE) HOUR/WEEK
CORRESPONDING LAB COURSE CODE (IF ANY):NIL	LAB COURSE NAME:NIL

SYLLABUS:

MODULE	CONTENTS	HOURS
I	Sustainability: Introduction, concept, evolution of the concept; Social, environmental and economic sustainability concepts; Sustainable Development, Nexus between Technology and Sustainable Development; Millennium Development Goals(MDGs) and Sustainable Development Goals (SDGs),Clean Development Mechanism(CDM).	5
II	Environmental Pollution: Air Pollution and its effects, Water pollution and its sources ,Zero waste concept and 3R concepts in solid waste management; Greenhouse Effect, Global warming, ,Ozone layer depletion, Carbon Credits, carbon trading carbon footprint, legal provisions for environmental protection.	6
III	Environmental Management Standards: ISO 14001:2015 framework and benefits, Scope and goal of Life Cycle Analysis (LCA), Circular Economy, Biomimicking, Environment Impact Assessment(EIA), Industrial Ecology And Industrial Symbiosis.	6

IV	Resources And Its Utilization: Basic concepts of Conventional Non-conventional energy, General Idea About Solar Energy, Fuel Cells, Wind Energy, Small Hydro Plants, Biofuels, Energy Derived From Oceans And Geothermal Energy.	4
V	Sustainability Practices: Basic concept of sustainable habitat, Methods for increasing energy, Green Engineering, Sustainable Urbanization, Sustainable cities, Sustainable transport.	4

TEXT/REFERENCE BOOKS:

T/R	BOOK TITLE/AUTHOR/PUBLICATION
T1	Allen, D. T. and Shonnard, D. R., Sustainability Engineering: Concepts, Design and Case Studies, Prentice Hall.
T2	Bradley. A.S; Adebayo,A.O., Maria, P. Engineering applications in sustainable design and development, Cengage learning.
T3	Environment Impact Assessment Guidelines, Notification of Government of India, 2006.
T4	Mackenthun, K.M., Basic Concepts in Environmental Management, Lewis Publication, London, 1998.
T5	ECBC Code 2007, Bureau of Energy Efficiency, New Delhi Bureau of Energy Efficiency Publications-Rating System, TERI Publications - GRIHA Rating System.
T6	Ni bin Chang, Systems Analysis for Sustainable Engineering: Theory and Applications, McGraw-Hill Professional.
T7	Twidell, J. W. and Weir, A. D., Renewable Energy Resources, English Language Book Society (ELBS).
T8	Purohit, S. S., Green Technology - An approach for sustainable environment, Agrobios publication

COURSE PREREQUISITES: NIL

C.CODE	COURSE NAME	DESCRIPTION	SEM
	SCIENCE	BASIC KNOWLEDGE	SCHOOL LEVEL

COURSE OBJECTIVES:

1	To have an increased awareness among students on issues in areas of sustainability.
2	To understand the role of engineering and technology within sustainable development.
3	To know the methods, tools, and incentives for sustainable product-service system development.
4	To establish a clear understanding of the role and impact of various aspects of engineering and engineering decisions on environmental, societal, and economic problems.

COURSE OUTCOMES:

Sl. NO	DESCRIPTION	Blooms' Taxonomy Level
CBE103.1	Students will be able to define and describe the concept and importance of sustainability.	Knowledge (Level 1)
CBE103.2	Students will be able to identify, describe, classify, explain and interpret the different types of environmental pollution problems and their sustainable solutions and to *apply* them in practice when called for.	Understand (Level 2)
CBE103.3	Students will be able to apply Life cycle analysis and environmental impact assessment.	Apply (Level 3)

CBE103.4	Students will be able to survey the current Habitat problems, point out issues and hence suggest improvements for attaining sustainability.	Analyse (Level 4)
CBE103.5	Students will be able to compare various types of conventional and non-conventional energy sources and assess the significance of renewable energy sources.	Evaluate (Level 5)
CBE103.6	Students will be able to understand green engineering concepts & develop sustainable solutions for Engineering problems.	Create (Level 6)

CO-PO AND CO-PSO MAPPING

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CBE103.1	1	-	-	-	-	2	3	-	-	-	-	-	-	-	-
CBE103.2	2	2	-	-	-	2	3	1	-	-	-	-	1	1	-
CBE103.3	-	2	3	-	-	2	3	2	-	-	-	-	-	1	-
CBE103.4	1	1	3	-	-	2	3	1	-	-	-	-	-	-	2
CBE103.5	1	-	-	-	-	2	3	2	-	-	-	-	2	-	-
CBE103.6	1	1	3	-	-	1	3	1	-	-	-	-	-	2	-
CBE10	1.2	1.5	3	-	-	1.83	3	1.4	-	-	-	-	1.5	1.33	2

1- Low correlation (Low), 2- Medium correlation(Medium) , 3-High correlation(High)

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USTIFICATIONS FOR CO-PSO MAPPING

MAPPING	LOW/MEDIUM/HIGH	JUSTIFICATION
CBE 103.2 – PSO.1	L	Better effluent treatment methods could be adopted
CBE 103.2 – PSO.2	L	New mechanical systems could be designed so that the waste generation is minimum
CBE 103.3 – PSO.2	L	Best designs made after conducting LCA and EIA
CBE 103.4 – PSO.3	M	Green building designs & upgrading existing buildings to green
CBE 103.5 – PSO.1	M	Improvement in energy extraction and high efficient appliances
CBE 103.6 – PSO.2	M	Better designs and developments in industries to ensure social, environmental and economic sustain abilities

GAPS IN THE SYLLABUS - TO MEET INDUSTRY/PROFESSION REQUIREMENTS:

SI NO	DESCRIPTION	PROPOSED ACTIONS	RELEVANCE WITH POs	RELEVANCE WITH PSOs
1	NIL	NIL	-	-

WEB SOURCE REFERENCES:

1	www.nptel.ac.in
2	file:///E:/SustainableEnggNew/PublishBook/SolidWaste/Keynote%20Address%20for%203rd%20Regional%203R%20Forum.pdf
3	http://www.exergy.se/goran/hig/ses/pdfs/algobaisi1.pdf
4	http://unfccc.int/kyoto_protocol/mechanisms/clean_development_mechanism/items/2718.php

5	http://www.moef.nic.in/downloads/public-information/2010-08-28-Note%20on%20India%20and%20MEAs.pdf
6	http://ec.europa.eu/environment/international_issues/agreements_en.htm

DELIVERY/INSTRUCTIONAL METHODOLOGIES:

☑CHALK & TALK	☑STUD. ASSIGNMENT	☑WEB RESOURCES
☑LCD/SMART BOARDS	☑STUD. SEMINARS	☑DISCUSSIONS/ DEBATES

ASSESSMENT METHODOLOGIES-DIRECT

☑ASSIGNMENTS	☐ STUD. SEMINARS	☑TESTS/MODEL EXAMS	☑UNIV. EXAMINATION
☐STUD. LAB PRACTICES	☐ STUD. VIVA	☑MINI/MAJOR PROJECTS	☐ CERTIFICATIONS
☐ ADD-ON COURSES	☐ OTHERS		

ASSESSMENT METHODOLOGIES-INDIRECT

☑ASSESSMENT OF COURSE OUTCOMES (BY FEEDBACK, ONCE)	☑STUDENT FEEDBACK ON FACULTY (ONCE)
☐ ASSESSMENT OF MINI/MAJOR PROJECTS BY EXT. EXPERTS	☐ OTHERS

Prepared by

Dr. Biju Paul

(Faculty)

Approved by

Dr.Neeba E.A

(HOD)

7.2 COURSE PLAN

No	Topic	No. of Lectures
1	**Sustainability**	
1.1	Introduction, concept, evolution of the concept	1
1.2	Social, environmental, and economic sustainability concepts	1
1.3	Sustainable development, Nexus between Technology and Sustainable	1
1.4	Millennium Development Goals (MDGs) and Sustainable Development Goals(SDGs)	1
1.5	Clean Development Mechanism (CDM)	1
2	**Environmental Pollution**	
2.1	Air Pollution and its effects	1
2.2	Water pollution and its sources	1
2.3	Zero waste concept and 3 R concepts in solid waste management	1
2.4	Greenhouse effect, Global warming, Climate change, Ozone layer depletion	1
2.5	Carbon credits, carbon trading and carbon footprint.	1
2.6	Legal provisions for environmental protection.	1
3	**Environmental management standards**	
3.1	Environmental management standards	1
3.2	ISO 14001:2015 framework and benefits	1
3.3	Scope and Goal of Life Cycle Analysis (LCA)	1
3.4	Circular economy, Bio-mimicking	1
3.5	Environment Impact Assessment (EIA)	1
3.6	Industrial Ecology, Industrial Symbiosis	1

4	**Resources and its utilization**	
4.1	Basic concepts of Conventional and non-conventional energy	1
4.2	General idea about solar energy, Fuel cells	1
4.3	Wind energy, Small hydro plants, biofuels	1
4.4	Energy derived from oceans and Geothermal energy	1
5	**Sustainability Practices**	
5.1	Basic concept of sustainable habitat	1
5.2	Methods for increasing energy efficiency of buildings	1
5.3	Green Engineering	1
5.4	Sustainable Urbanization, Sustainable cities, Sustainable transport	1

7.3 ASSIGNMENT QUESTIONS

Assignment -1

1. What is Bio mimicking? Give an example and write a short note on it.

Assignment -2

1. Explain one sustainable development that you have seen in your hometown.

DATA STRUCTURES LAB

8.1 COURSE INFORMATION SHEET

PROGRAMME: INFORMATION TECHNOLOGY	DEGREE: BTECH (JULY- DECEMBER 2021)
COURSE: DATA STRUCTURES LAB	SEMESTER: III CREDITS: 4
COURSE CODE: 100004/IT322S **REGULATION:** 2020	COURSE TYPE: LAB
COURSE AREA/DOMAIN: COMPUTER HARDWARE	CONTACT HOURS: 3+1 (Tutorial) hours/Week.
CORRESPONDING LAB COURSE CODE (IF ANY):	LAB COURSE NAME:

SYLLABUS:

LIST OF EXPERIMENTS

1. Develop a C program to implement insertion sort, Selection sort and bubble sort*.
2. Design a program to Implement i) Quick sort ii) Merge sort*.
3. Create Programs for i) Linear Search ii) Binary Search*.
4. Create a menu driven program to implement singly linked list operations with options for insertion, deletion, search and traversal*.
5. Device a menu driven program to implement doubly linked list operations with options for insertion at front, insertion at end, deletion at front, deletion at end and traversal.
6. Apply linked list concept to perform polynomial addition.*
7. Simulate first fit, best fit and worst fit memory allocation strategies using linked list.*
8. Develop a program to perform stack operations using i) array ii) linked list.* Perform queue operations using i) array ii) linked list.*
9. Apply stack to perform i) Infix to postfix conversion ii) Postfix evaluation. *
10. Develop a program to perform preorder, in-order, post order traversals on binary trees.*
11. Construct binary search trees to perform insertion, deletion, search.

TEXT/REFERENCE BOOKS:

T/R	BOOK TITLE/AUTHORS/PUBLICATION
T	Samanta D., Classic Data Structures, Prentice Hall India, 2/e, 2009.
T	Ellis horowitz, Sartaj Sahni, Fundamentals of Data structures, Galgotia Booksource
R	Horwitz E., S. Sahni and S. Anderson, Fundamentals of Data Structures in C, University Press (India), 2008.
R	Aho A. V., J. E. Hopcroft and J. D. Ullman, Data Structures and Algorithms, Pearson Publication,1983
R	Tremblay J. P. and P. G. Sorenson, Introduction to Data Structures with Applications, Tata McGraw Hill, 1995.

COURSE PREREQUISITES:NIL

COURSE OBJECTIVES:

1	Understanding the importance of data structures, abstract data type, and their basic usability in different applications.
2	Implementing linear and non-linear data structures using linked lists and arrays.
3	Applying various data structure such as stacks, queues, trees, graphs, etc. to solve various computing problems

COURSE OUTCOMES:

CO_No	Course Outcome(CO)	Bloom's Category
CO 1	Compare various kinds of searching and sorting techniques	level 5: Evaluate
CO 2	Construct Linear and nonlinear data structures using arrays and linked list	level 6:Create
CO 3	Develop Programs employing dynamic memory management	level 6:Create

CO 4	Choose appropriate data structure to solve various computing problems.	level 5: Evaluate
CO 5	Originate hash tables and collision resolution Techniques	level 6:Create
CO 6	Identify suitable data structure and algorithm to solve a real world problem.	level 3:Apply

CO-PO AND CO-PSO MAPPING

	PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO1 2
CO1	3	3	3	2	2	1	-	-	-	-	2	1
CO2	3	3	3	3	3	1	-	-	-	-	2	1
CO3	3	3	3	3	3	1	-	-	-	-	2	1
CO4	3	3	3	3	3	1	-	-	-	-	2	1
CO5	3	3	3	3	3	1	-	-	-	-	2	1
CO6	3	3	3	3	3	1	-	-	-	-	2	1

JUSTIFICATIONS FOR CO-PO MAPPING

MAPPING	LOW/MEDIUM /HIGH	JUSTIFICATION
CO1-PO1	H	Knowledge of Boolean algebra helps the students in circuit designing.
CO1-PO4	H	Analysis of logic circuits provides students a better understanding of digital circuits.
CO1-PO12	L	Help the students in the design of simple digital circuits using gates.
C02-PO1	H	Acquire skills to easily simplify Boolean functions.
CO2-PO2	H	Analysis of the combinational circuits to provide simple conclusions.
CO2-PO3	H	Designing of complex combinational circuits is achieved.

CO2-PO4	M	Ability to choose a simplified circuit for implementing a combinational circuit using an appropriate simplification method.
CO2-PO12	M	Knowledge of Boolean algebra helps in the design of efficient circuits.
CO3-PO1	H	Having knowledge in Boolean function, students could develop sequential circuits.
CO3-PO2	H	Knowledge of Flip flops could be used to reduce the complexity of the sequential circuits.
CO3-PO4	H	Having the knowledge in various sequential circuit design principles students could analyze the problem and come to a conclusion on which design principle to be used.
CO4-PO1	H	Choosing the appropriate method to implement the sequential circuit will help in designing efficient circuits.
CO4-PO4	H	Knowledge of hardware description language to understand the concept of simple circuits.
CO5-PO1	H	Having knowledge of hardware description language helps students to design logic circuits.
CO5-PO2	H	Having knowledge of hardware description language students to analyze complex circuits.
CO5-PO12	M	Students will be able to implement and test the circuits.

GAPS IN THE SYLLABUS - TO MEET INDUSTRY/PROFESSION REQUIREMENTS:

SNO	DESCRIPTION	PO
1	Sparse Matrix And Its Operations	2,3
2	Circular Doubly Linked List	2,3

PROPOSED ACTIONS: TOPICS BEYOND SYLLABUS/ASSIGNMENT/INDUSTRY VISIT/GUEST LECTURER/NPTEL ETC

TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN:

SNO	DESCRIPTION	PO

1	AVL TREES	2,3

WEB SOURCE REFERENCES:

1	http://www.cse.iitk.ac.in/users/dsrkg/cs210/applets/sortingII/mergeSort/mergeSort.html
2	www.nptel.iitm.ac.in/video.php?subjectId=106105085
3	www.cse.unt.edu/~rada/CSCE3110/Lectures/Trees.ppt
4	cslibrary.stanford.edu/110/BinaryTrees.pdf
5	cslibrary.stanford.edu/103/LinkedListBasics.pdf
6	www.nptel.iitm.ac.in/video.php?subjectId=106105085
7	www.iitg.ernet.in/cse/?page_id=220

DELIVERY/INSTRUCTIONAL METHODOLOGIES:

☐ CHALK & TALK	☐ STUD. ASSIGNMENT	☐ WEB RESOURCES	☐ LCD/SMART BOARDS
☐ STUD. SEMINARS	☐ ADD-ON COURSES		

ASSESSMENT METHODOLOGIES-DIRECT:

☐ ASSIGNMENTS	☐ STUD. SEMINARS	☐ TESTS/MODEL EXAMS	☐ UNIV. EXAMINATION
☐ STUD. LAB PRACTICES	☐ STUD. VIVA	☐ MINI/MAJOR PROJECTS	☐ CERTIFICATIONS
☐ ADD-ON COURSES	☐ OTHERS		

ASSESSMENT METHODOLOGIES-INDIRECT:

☐ ASSESSMENT OF COURSE OUTCOMES (BY FEEDBACK, ONCE)	☐ STUDENT FEEDBACK ON FACULTY (TWICE)
☐ ASSESSMENT OF MINI/MAJOR PROJECTS BY EXT. EXPERTS	☐ OTHERS

Prepared by
Ms. Sreeja M.U (Faculty)

Approved by
Dr. Neeba E.A(HOD)

8.2 COURSE PLAN

Sl.No	Module	Planned Date	Planned
1	1	28-Oct-2021	Develop a C program to implement insertion sort, Selection sort and bubble sort.
2	1	11-Nov-2021	Design a program to Implement i) Quick sort ii) Merge sort*.
3	1	25-Nov-2021	Create Programs for i) Linear Search ii) Binary Search.
4	1	2-Dec-2021	Create a menu driven program to implement singly linked list operations with options for insertion, deletion, search and traversal*.
5	1	9-Dec-2021	Device a menu driven program to implement doubly linked list operations with options for insertion at front, insertion at end, deletion at front, deletion at end and traversal.
6	1	16-Dec-2021	Apply linked list concept to perform polynomial addition*
7	1	06-Jan 2022	Develop a program to perform stack operations using i) array ii) linked list*. Perform queue operations using i) array ii) linked list
8	1	13-Jan 2022	Apply stack to perform i) Infix to postfix conversion ii) Postfix evaluation
9	1	24-Jan 2022	Develop a program to perform preorder, in-order, post order traversals on binary trees*
10	1	03-Feb-2022	Apply Queue and stack in Breadth First Search and Depth First Search respectively *
11	1	10-Feb-2022	Resolve the collisions if any using collision resolution techniques like linear Probing, Random Probing, Double hashing and Quadratic Probing*

8.3 LAB CYCLE

1. Develop a C program to implement insertion sort, Selection sort and bubble sort*.
2. Design a program to Implement i) Quick sort ii) Merge sort*.
3. Create Programs for i) Linear Search ii) Binary Search*.

4. Create a menu driven program to implement singly linked list operations with options for insertion, deletion, search and traversal*.
5. Device a menu driven program to implement doubly linked list operations with options for insertion at front, insertion at end, deletion at front, deletion at end and traversal.
6. Apply linked list concept to perform polynomial addition*
7. Simulate first fit, best fit and worst fit memory allocation strategies using linked list*.
8. Develop a program to perform stack operations using i) array ii) linked list*.
9. Perform queue operations using i) array ii) linked list*
10. Apply stack to perform i) Infix to postfix conversion ii) Postfix evaluation *
11. Develop a program to perform preorder, in-order, post order traversals on binary trees*
12. Construct binary search trees to perform insertion, deletion, search
13. Apply Queue and stack in Breadth First Search and Depth First Search respectively.
14. Device Dijkstra's Algorithm for finding Shortest path
15. Resolve the collisions if any using collision resolution techniques like linear Probing, Random Probing, Double hashing and Quadratic Probing*

8.4 ADVANCED QUESTIONS

1. To implement Quick Sort
2. To implement Merge Sort
3. Write a Python program for union and intersection of two sorted arrays
4. Write a Python program for bubble sort
5. Write a Python program to Reverse a Sentence Using Recursion
6. Write a Python Program to Find G.C.D Using Recursion
7. Write a Python Program to Check Whether a Number can be Express as **Sum of** Two Prime Numbers
8. Write a Python program for insertion Sort?
9. Write a Python program to raise any number x to a positive power n?
10. Write a Python program to insert an element in an array
11. Write a Python program to do linear search in an array
12. Write a Python program to print three numbers in descending order

8.5 OPEN QUESTIONS

1. Array and linked list implementation of List ADT
2. Array and linked list implementation of Stack ADT
3. Array and linked list implementation of Queue ADT
4. Applications of Stack,Queue and List
5. Implementation of Binary tree and its operations
6. Implementation of Binary Search tree and its operations
7. Implementation of AVL and its operations
8. Implementation of Heap
9. Implementation of searching and sorting operations
10. Hashing operations-any two methods

PYTHON FOR AI AND DATA SCIENCE

9.1 COURSE INFORMATION SHEET

PROGRAMME: ARTIFICIAL INTELLIGENCE AND DATA SCIENCE	DEGREE: BTECH
COURSE: PYTHON FOR AI AND DATA SCIENCE	SEMESTER: 3 CREDITS: 2
COURSE CODE: 100008/IT322T REGULATION: 2020	COURSE TYPE: LAB
COURSE AREA/DOMAIN: PROGRAMMING	CONTACT HOURS: 3 hours/Week.
CORRESPONDING LAB COURSE CODE (IF ANY):	LAB COURSE NAME: Nil

SYLLABUS

UNIT	DETAILS	HOURS
I	Part A : Programming in Python 1. Basic programming experiments to familiarization of data types and input- output statements 2. Decision making, branching and looping statements 3. Function & Function calls 1. Function definitions and access 2. Parameters and arguments 3. Recursion 4. Strings a) String traversal, join, slicing b) String searching, Comparison c) Other important String methods 5. Lists, Tuples and Dictionaries a) Creation of List & List Operations b) Tuple and Tuple operations c) Creation of Dictionary and Operations d) Comparison of List and Tuple 6. Matrix representation a) Creating matrix b) Matrix operations - addition, subtraction and multiplication 7. Files and Operations a) Files - defining, opening/closing, read/write operations b) Exceptions in Python c) Pickling 8. Object Oriented Programming using Python a) Creation of Classes & Instances, method calling b) Constructor & Destructor concepts c) Implementation of Inheritance	

TEXT/REFERENCE BOOKS:

T/R	BOOK TITLE/AUTHORS/PUBLICATION
T	1. Allen Downey, Jeffrey Elkner, Chris Meyers, " How to think like a Computer Scientist-Learning with Python", Green Tea Press, First edition, 2002. 2. Mark Lutz,"Learning Python: Powerful Object-Oriented Programming" , O'Reilly Media Inc.,5th,2013
R	1. S.A.Kulkarni, "Problem Solving and PYTHON Programming", 2nd edition, Yes Dee Publishing Pvt Ltd, 2018 2. Kenneth A. Lambert, B. L. Juneja, "Fundamentals of Python", Cengage Learning India Pvt. Ltd., 2015. 3. Mark Summerfield," Programming in Python 3: A Complete Introduction to the Python Language", Pearson Education, 2nd,2018 5. Yashavant Kanetkar ,Aditya Kanetkar ,"Let Us Python ",BPB Publications, 1st Edition, 2019 6. Allen Downey, "Learning with Python", Dreamtec Press, 1st Edition, 2015 7. https://docs.python.org/3/reference/ 8. Version Control with Git: Powerful tools and techniques for collaborative software development 2nd Edition, Kindle Edition by Jon Loeliger, Matthew McCullough

COURSE PRE-REQUISITES

C.CODE	COURSE NAME	DESCRIPTION	SEM
	-	Python Programming Knowledge	-

COURSE OUTCOMES:

CO No.	Course Outcome	Bloom's Category
CO 1	Develop readable* Python programs by making use of basic constructs- Decision controls, Looping controls, Lists, Tuple and Strings	Create
CO 2	Design modular Python programs using normal and recursive functions	Create

CO3	Design programs using Dictionaries and Files	Create
CO 4	Experiment with the basic Windows/ Linux administration & network configuration utilities	Apply
CO 5	Experiment with version control tools using git	Apply
readable* - readability of a program means the following: 1.Logic used is easy to follow 2.Standards to be followed for indentation and formatting 3.Meaningful names are given to variables 4.Concise comments are provided wherever needed		

CO-PO MAPPING

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	2	2	3	1	3	-	-	-	-	-	-	-	2	-	-
CO2	2	3	3	3	3	-	-	-	-	-	-	-	2	-	-
CO3	2	3	3	3	3	-	-	-	-	-	-	-	2	-	-
CO4	2	2	1	2	1	-	-	-	-	-	-	-	1	-	-
CO5	-	-	2	-	3	-	-	-	3	2	-	-	1	-	-

Mapping	Level	Justification
CO1-PO1	2	Writing programs in python using basic constructs will help to apply the knowledge of engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
CO1-PO2	2	Writing programs in python using basic constructs will help to identify, formulate, and analyze complex engineering problems reaching substantiated conclusions using first principles of engineering sciences.

CO1-PO3	3	Writing programs in python using basic constructs will help to design solutions for complex engineering problems and design system processes that meet the specified needs with appropriate consideration for societal problems.
CO1-PO4	1	Writing programs in python using basic constructs will help to conduct investigations of complex problems.
CO1-PO5	3	Writing programs in python using basic constructs will help to apply IT tools to model complex engineering activities.
CO2-PO1	2	Writing modular programs in python to implement various computational tasks will help to apply the knowledge of engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
CO2-PO2	3	Writing modular programs in python to implement various computational tasks will help to identify, formulate, and analyze complex engineering problems reaching substantiated conclusions using first principles of engineering sciences.
CO2-PO3	3	Writing modular programs in python to implement various computational tasks will help to design solutions for complex engineering problems and design system processes that meet the specified needs with appropriate consideration for societal problems.
CO2-PO4	3	Writing modular programs in python to implement various computational tasks will help to conduct investigations of complex problems.
CO2-PO5	3	Writing modular programs in python to implement various computational tasks will help to apply IT tools to model complex engineering activities.
CO3-PO1	2	Writing programs in pythons using dictionaries and files will help to apply the knowledge of engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
CO3-PO2	3	Writing programs in pythons using dictionaries and files will help to identify, formulate, and analyze complex engineering problems reaching substantiated conclusions using first principles of engineering sciences.

C03-PO3	3	Writing programs in pythons using dictionaries and files will help to design solutions for complex engineering problems and design system processes that meet the specified needs with appropriate consideration for societal problems.
CO3-PO4	3	Writing programs in pythons using dictionaries and files will help to conduct investigations of complex problems.
CO3-PO5	3	Writing programs in pythons using dictionaries and files will help to Create, select, and apply appropriate techniques using IT tools.
CO4-PO1	2	Experimenting with the basic Windows/ Linux administration & network configuration utilities will help to apply the knowledge of engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
CO4-PO2	2	Experimenting with the basic Windows/ Linux administration & network configuration utilities will help to identify, formulate, and analyze complex engineering problems reaching substantiated conclusions using first principles of engineering sciences.
C04-PO3	1	Experimenting with the basic Windows/ Linux administration & network configuration utilities will help to design solutions for complex engineering problems and design system processes that meet the specified needs with appropriate consideration for the societal problems.
CO4-PO4	2	Experimenting with the basic Windows/ Linux administration & network configuration utilities will help to conduct investigations of complex problems.
CO4-PO5	1	Experimenting with the basic Windows/ Linux administration & network configuration utilities will help to create, select, and apply appropriate techniques using IT tools.
C05-PO3	2	Experimenting with version control tools will help to design solutions for complex engineering problems and design system processes that meet the specified needs with appropriate consideration for the societal problems.
CO5-PO5	3	Experimenting with version control tools will help to create, select, and apply appropriate techniques using IT tools.

CO5-P09	3	Experimenting with version control tools will help to function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
CO5-P10	2	Experimenting with version control tools will help to Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

Mapping	Level	Justification
CO1-PSO1	2	Writing programs in python using basic constructs will help to acquire skills to design, analyze and develop algorithms and implement those using Python.
CO2-PSO1	2	Writing modular programs in python programs to implement various computational tasks will help to acquire skills to design, analyze and develop algorithms and implement those using Python.
CO3-PSO1	2	Writing programs in pythons using dictionaries and files will help to acquire skills to design, analyze and develop algorithms and implement those using Python.
CO4-PSO1	1	Experimenting with operating system commands will help to acquire skills to design, analyze and develop algorithms and implement those using Python.
CO5-PSO1	1	Experimenting with version control tools to implement daily life problems and their solutions acquire skills to design, analyze and develop algorithms and implement those using Python.

TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN

Sl NO	DESCRIPTION	PROPOSED ACTIONS	RELEVANCE WITH POs	RELEVANCE WITH PSOs
1	Understanding Program Efficiency	NPTEL	3,5	1

WEB SOURCE REFERENCES

1	https://www.programiz.com/python-programming
2	https://pythonprogramming.net/introduction-to-python-programming/
3	https://www.tutorialspoint.com/python/

DELIVERY/INSTRUCTIONAL METHODOLOGIES

✓CHALK & TALK	✓STUD. ASSIGNMENT	✓ WEB RESOURCES
✓ LCD/SMART BOARDS	✓ STUD. SEMINARS	□ADD-ON COURSES

ASSESSMENT METHODOLOGIES-DIRECT

✓ ASSIGNMENTS	✓ STUD. SEMINARS	✓ TESTS/MODEL EXAMS	✓ UNIV. EXAMINATION
✓ STUD. LAB PRACTICES	✓ STUD. VIVA	□MINI/MAJOR PROJECTS	□CERTIFICATIONS
□ADD-ON COURSES	□OTHERS		

ASSESSMENT METHODOLOGIES-INDIRECT

✓ ASSESSMENT OF COURSE OUTCOMES (BY FEEDBACK, ONCE)	✓ STUDENT FEEDBACK ON FACULTY (TWICE)
□ASSESSMENT OF MINI/MAJOR PROJECTS BY EXT. EXPERTS	□OTHERS

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9.2 COURSE PLAN

DAY	EXPERIMENTS
2-11-2021	EXPERIMENT 1
9-11-2021	
17-11-2021	EXPERIMENT 2
23-11-2021	
29-11-2021	EXPERIMENT 3
6-12-2021	EXPERIMENT 4
9-12-2021	EXPERIMENT 5
13-12-2021	EXPERIMENT 6
14-2-2022	EXPERIMENT 7
21-2-2022	EXPERIMENT 8
28-2-2022	PRACTICE LAB
9-3-2022	LAB EXAM

9.3 LAB CYCLE

EXPERIMENT 1

Basic programming experiments to familiarization of data types and inputoutput statements
Develop a python program to

1. Write a program to accept two numbers from the user and calculate multiplication.
2. Display three string “Name”, “Is”, “James” as “Name**Is**James”.
3. Convert Decimal number to octal using print() output formatting.
4. Display float number with 2 decimal places using print() in python.
5. Accept a list of 5 float numbers as an input from the user.

6. Write a program to take three names as input from a user in the single input() function call.

EXPERIMENT 2

• Decision making, branching and looping statements

Develop a python program to

1. . Print all prime numbers with in an interval.
2. Search an element in a list.
3. Input a list of n numbers. Calculate and display the average of numbers. Also display the square of each value in the list.
4. Add two matrices.
5. Find the number of occurrences of a given substring in a string.
6. Count the number of vowels, consonants, words and question marks in a give string.
7. To write a python program to perform Matrix Multiplication.

EXPERIMENT 3

• Lists, Tuples and Dictionaries

Develop a python program to

1. Reverse a given list in Python.
2. Given a Python list of numbers. Turn every item of a list into its square.
3. Unpack the following tuple into 4 variables.
4. Swap the following two tuples.
5. Sort a tuple of tuples by 2nd item.
6. Create the below Dictionary and Access the value of key 'history'

```
sampleDict = {
"class":{
"student":{
"name":"Mike",
"marks":{
"physics":70,
"history":80
}
```

```
}
}
}
```

7. Get the key of a minimum value from the following dictionary.
8. Change Brad's salary to 8500 from a given Python dictionary.

```
sampleDict = {
'emp1': {'name': 'Jhon', 'salary': 7500},
'emp2': {'name': 'Emma', 'salary': 8000},
'emp3': {'name': 'Brad', 'salary': 6500}
}
```

9. Develop a python program to create dictionary of phone numbers and names of n persons. Display the contents of the dictionary in alphabetical order of their names.

EXPERIMENT 4

- **Function & Function calls**

Develop a python program to

1. Implements calculator with functions like add, subtract, multiply, divide, exponent etc.
2. Find factorial of a given number using recursion.
3. Find nth Fibonacci number using recursion.
4. Create a function with variable length of arguments.
5. Return multiple values from a function.
6. Create an inner function to calculate the addition in the following way
   - Create an outer function that will accept two parameters, a and b
   - Create an inner function inside an outer function that will calculate the addition of a and b
   - At last, an outer function will add 5 into addition and return it
7. Develop a python program to implement the following scenario. A book shop details contains the Title of book and Number of copies of each title. As books are added to the shop, the number of copies in each should increase and as books are sold the number of copies in each should decrease.

EXPERIMENT 5

- **Strings**

Develop a python program to

1. Write a program to create a new string made of an input string's first, middle, and last character.
2. Write a program to create a new string made of an input string's first, middle, and last character.
3. Arrange string characters such that lowercase letters should come first.
4. Count all letters, digits, and special symbols from a given string.
5. Find all occurrences of a substring in a given string by ignoring the case.
6. Calculate the sum and average of the digits present in a string.

EXPERIMENT 6
• Matrix representation

Develop a python program to

1. Accept 2 matrices and do the given operations
   a. Addition
   b. Subtraction
   c. Multiplication

EXPERIMENT 7
• Files and Operations

Develop a python program to

1. Develop a python code to read a text file, copy the contents to another file after removing the blank lines.
2. Find the most frequent words in a text read from a file.
3. Develop a python program to implement the following scenario. Given a give "data.txt" with three columns of data separated by spaces. Read it into 3 separate simple sequences.
4. Create a class student with attributes name, rollno and a method showData() for showing the details. Create two instances of the class and call the method for each instance. Develop a python program to implement the scenario.
5. Create a data file and develop a python program to implement using pickle module
   a. pickle (dump) the list object into the file and close it. Display the object (obj).

b. Adding objects in order
c. searching for objects
d. updating details for an object
e. deleting objects
f. displaying objects based on specific criteria

EXPERIMENT 8

- **Object Oriented Programming using Python**

Develop a python program to

1. A book shop maintains the inventory of books that are being sold at the shop. The list includes details such as author, title, price, publisher and stock position. Whenever a customer wants a book, the sales person inputs the title and author and the system searches the list and displays whether it is available or not. If it is not, an appropriate message is displayed. If it is, then the system displays the book details and requests for the number of copies required. If the requested copies are available, the total cost of the requested copies is displayed; otherwise "Required copies not in stock" is displayed.

   Design a system using a class called books with suitable member functions, constructors and destructors.

2. Create a **Bus** child class that inherits from the Vehicle class. The default fare charge of any vehicle is **seating capacity * 100**. If Vehicle is **Bus** instance, we need to add an extra 10% on full fare as a maintenance charge. So total fare for bus instance will become the **final amount = total fare + 10% of the total fare.** Note: The bus seating capacity is **50**. so the final fare amount should be **5500.** You need to override the fare() method of a Vehicle class in Bus class.

9.4 OPEN QUESTIONS

1. Write a Python program to check if a given positive integer is a power of two.
2. Write a Python program to find three numbers from an array such that the sum of there numbers equal to zero
3. Write a Python program to find the single element that appears once in a list where every element appears four times except for one.
4. Write a Python program to check a sequence of number is an arithmetic progression or not
5. Write a Python program to get the Hamming numbers upto a given numbers also check whether a given number is a Hamming number.
6. Write a Python program to find the majority element in a list.
7. Write a Python program to find the largest palindrome made from the product of two 4-digit numbers.
8. Write a Python program to find the 1000th prime numbers.
9. Given an unordered list of flights taken by someone, each represented as (origin, destination) pairs, and a starting airport. Write a Python program to compute the person's itinerary. If no such Itinerary exists, return null. If there are multiple possible itineraries, return the lexicographically smallest one. All flights must be used in the itinerary.
10. Write a Python program to remove the parentheses area in a string.

9.5 ADVANCED QUESTIONS

1. Write a Python program to find the operating system name, platform and platform release date.
2. Write a Python program to find the number of divisors of a given integer is even or odd.
3. Write a Python program to find the digits which are absent in a given mobile number.
4. Write a Python program to compute they summation of the absolute difference of all distinct pairs in a given array
5. Write a Python program to reverse the digits of a given number and add it to the original, If the sum is not a palindrome repeat this procedure.
6. Write a Python program to set the indentation of the first line.
7. Write a Python program to find the first non-repeating character in a given string.
8. Write a Python program to print all permutations with a given repetition number of characters of a given string.
9. Write a Python program to compute the similarity between two lists.
10. Write a Python program to replace the last element in a list with another list