**NOIDA INSTITUTE OF ENGINEERING AND TECHNOLOGY GREATER NOIDA**

**(NAAC ACCREDIATED)**

**Approved by AICTE and Affiliated to Dr. A.P.J. Abdul Kalam**

**Technical University Uttar Pradesh, Lucknow**



**COURSE FILE**

**COURSE: B.TECH. (AIML ) SEMESTER: III**

**DISCRETE STRUCTURE**

**(ACSE 0306)**

**Department of AIML**

**(NBA Accredited)**

**2022-23**

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| SEM-3RD (ODD) |

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|  | Vision & Mission of the Institute | SESSION-2022-23 |
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**Vision & Mission of Institute**

**Vision of Institute:**

To be an Institute of academic excellence in digital arena with global outreach delivering socially responsible professionals to become a university and an entrepreneurial hub.

**Mission of Institute**

To impart quality education and hone student’s skills and competencies making them future ready.

To foster an ecosystem for research, product development, innovation, incubation and entrepreneurship.

To instill values and ethics to produce socially responsible technocrats addressing global problems.

To develop an environment for sharing and exchange of resources globally for lifelong learning.

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|  | Vision &Mission Of Department | SESSION-2022-23 |
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**Vision and Mission of the Department**

**Vision**

To develop globally competent and ethical professionals, in the field of Artificial Intelligence and Machine Learning, ready to serve industry and society at large.

**Mission**

**M1:** • To impart cutting-edge technology skills and competencies in the field of Artificial Intelligence and

Machine Learning, thus producing industry-ready professionals and entrepreneurs.

**M2:** • To collaborate with the leading industries to exhilarate innovative research and development in Artificial.

Intelligence and Machine Learning and its allied technologies.

T **M3:** • To inculcate ethical values amongst students who are always eager to address global issues for life- inculcate et long learning. .values amongst students who are always eager to address global issues for life-long lea

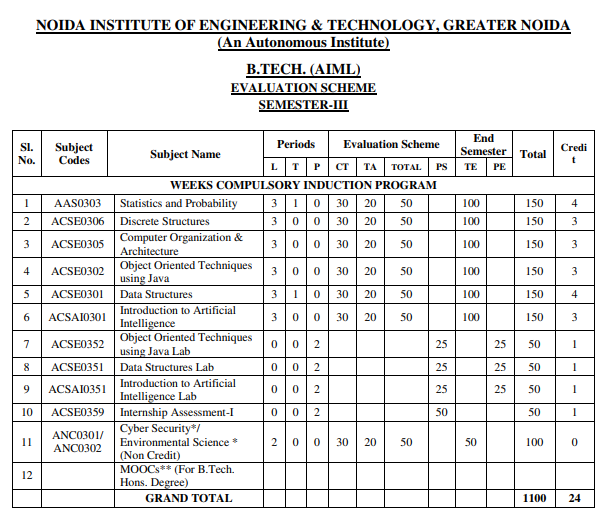
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|  | Subject Summary Sheet 1 | SESSION-2022-23 |
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| **Session** | **Semester** | **Branch** | **Issue Detail** | | | **CO Attainment** | **Return Detail** | | |
| **Date of issue** | **Subject Coordinator Name** | **Signature** | **Date of Return** | **Receiver Name** | **Signature** |
| **2022-23** | III | AIML |  |  |  | 2.8 |  |  |  |
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|  | Subject Summary Sheet 2 | SESSION-2022-23 |
| SEM-3RD (ODD) |

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| **Session** | **Semester** | **Branch** | **Section** | **No of Student** | **Result Brackets** | | | **Result Analysis** | **Overall Result** | **Top five Student Name** | **Faculty Signature** |
| **>30%** | **≤ 30% to < 60%** | **60% ≥** |
| **2020-21** |  |  |  |  |  |  |  |  |  |  |  |
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| **2021-22** |  |  |  |  |  |  |  |  |  |  |  |
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| **2022-23** | III | AIML | A | 90 |  |  |  |  |  |  |  |
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|  | Course & Exam Scheme | SESSION-2022-23 |
| SEM-3RD (ODD) |



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|  | Subject Syllabus (W.E.F 16/08/2022) | SESSION-2022-23 |
| SEM-3RD (ODD) |

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| **Course Acronym** | **SEM** | **SECTION** | **Name of Faculty** | **Date of Commencement** | **Total Lectures Planned** | **Date of Conclusion** |
| AIML | 3rd | A & B | MS. ANAMIKA TIWARI | 16th August 2022 | 53 | 25th November 2022 |

**COURSE SYLLABUS as per University**

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| **Discrete Structure (Code: ACSE0306)** | | **3-1-0** |
| **Unit** | **Topic** | **ProposedLectures** |
| **I** | Set Theory, Relation, Function: Set Theory: Introduction to Sets and Elements, Types of sets, Venn Diagrams, Set Operations, Multisets, Ordered pairs. Proofs of some general Identities on sets. Relations: Definition, Operations on relations, Pictorial Representatives of Relations, Properties of relations, Composite Relations, Recursive definition of relation, Order of relations. Functions: Definition, Classification of functions, Operations on functions, Growth of Functions. Combinatorics: Introduction, basic counting Techniques, Pigeonhole Principle. Recurrence Relation & Generating function: Recursive definition of functions, Recursive Algorithms, Method of solving Recurrences. Proof techniques: Mathematical Induction, Proof by Contradiction, Proof by Cases, Direct Proof. | **08** |
| **II** | Algebraic Structures: Definition, Operation, Groups, Subgroups and order, Cyclic Groups, Cosets, Lagrange's theorem, Normal Subgroups, Permutation and Symmetric Groups, Group Homomorphisms, Rings, Internal Domains, and Fields. | **08** |
| **III** | Lattice and Boolean Algebra: Ordered set, Posets, Hasse Diagram of partially ordered set, Lattices: Introduction, Isomorphic Ordered set, Well ordered set, Properties of Lattices, Bounded and Complemented Lattices, Distributive Lattices. Boolean Algebra: Introduction, Axioms and Theorems of Boolean Algebra, Algebraic Manipulation of Boolean Expressions, Simplification of Boolean Functions. | **08** |
| **IV** | Propositional Logic: Introduction, Propositions and Compound Statements, Basic Logical Operations, Wellformed formula, Truth Tables, Tautology, Satisfiability, Contradiction, Algebra of Proposition, Theory of Inference. Predicate Logic: First order predicate, Well-formed formula of Predicate, Quantifiers, Inference Theory of Predicate Logic. | **08** |
| **V** | Trees: Definition, Binary tree, Complete and Extended Binary Trees, Binary Tree Traversal, Binary Search Tree. Graphs: Definition and terminology, Representation of Graphs, Various types of Graphs, Connectivity, Isomorphism and Homeomorphism of Graphs, Euler and Hamiltonian Paths, Graph Coloring | **08** |
| **References : Nptel link / Web links / Books**   1. B. Kolman, R.C. Busby, and S.C. Ross, Discrete Mathematical Structures, 5/e, Prentice Hall, Edition 6th, 2018. 2. Liptschutz, Seymour, “Discrete Mathematics”, McGraw Hill, Edition 3rd, 2017. 3. Trembley, J.P & R. Manohar, “Discrete Mathematical Structure with Application to Computer Science”, McGraw Hill, Edition 1st, 2017. 4. Liu and Mohapatra, “Elements of Discrete Mathematics”, McGraw Hill. 5. Deo & Narsingh, “Graph Theory With application to Engineering and Computer Science.”, PHI. 6. Krishnamurthy, V., “Combinatorics Theory & Application”, East-West Press Pvt. Ltd., New Delhi. 7. Koshy, Discrete Structures, Elsevier Pub. 2008 Kenneth H. Rosen, Discrete Mathematics and Its Applications, 6/e, Mc Graw-Hill, Edition 7th, 2017. | | |

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|  | Course Objectives | SESSION-2022-23 |
| SEM-3RD (ODD) |

## Course Objectives: In this course students will learn about

The subject enhances one’s ability to develop logical thinking and ability to problem solving. The objective of discrete structure is to enables students to formulate problems precisely, solve the problems, apply formal proofs techniques and explain their reasoning clearly.

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|  | Course Outcomes | SESSION-2022-23 |
| SEM-3RD (ODD) |

**Course Outcomes: At the end of this course students will demonstrate the ability to:**

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| **(CO)** | **Course Outcomes** | **Bloom’s Knowledge Level (KL)** |
| **CO1** | Apply the basic principles of sets, relations & functions and mathematical induction in computer science & engineering related problems. | K3 |
| **CO2** | Understand the algebraic structures and its properties to solve complex problems | K2 |
| **CO3** | Describe lattices and its types and apply Boolean algebra to simplify digital circuit. | K2, K3 |
| **CO4** | Infer the validity of statements and construct proofs using predicate logic formulas. | K3, K5 |
| **CO5** | Design and use the non-linear data structure like tree and graphs to solve real world problems | K3, K6 |

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|  | Program Education Objectives | SESSION-2022-23 |
| SEM-3RD (ODD) |

**Program Educational Objectives**

The graduates will be:

**PEO1:** Solve real time complex problems and adapt to technological changes with the ability of lifelong learning.

**PEO2:** Work as data scientists, entrepreneurs and bureaucrats for goodwill of the society and pursue higher education.

**PEO3:** Exhibit professional ethics and moral values with good leadership qualities and effective interpersonal skills

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|  | Program Outcomes | SESSION-2022-23 |
| SEM-3RD (ODD) |

## Program Outcomes

**1. Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization for the solution of complex engineering problems.

**2. Problem analysis:** Identify, formulate, research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

**3. 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 public health and safety, and cultural, societal, and environmental considerations.

**4. Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of information to provide valid conclusions.

**5. 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.

**6. 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.

**7. 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.

**8. Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

**9. Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

**10. Communication:** Communicate effectively on complex engineering activities with the engineering community and with the 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.

**11. 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.

**12. 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.

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|  | Program Specific Outcomes | SESSION-2022-23 |
| SEM-3RD (ODD) |

On successful completion of graduation degree, the Artificial Intelligence & Machine Learning graduates will be able to:

1. **Engineering knowledge:** Apply the knowledge of mathematics, science and electronics & communication engineering to work effectively in the industry based on same or related area.
2. **Design/development of solutions:** Use their skills to work in modern electronics & communication engineering tools, software and equipment’s to design solutions for complex problems in the related field that meet the specified needs of the society.
3. **Individual and teamwork:** Function effectively as an individual and as a member or leader of a team by qualifying through examinations like GATE, IES, PSUs, TOEFL, GMAT and GRE etc.

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|  | Mapping (Cos & POs , ) | SESSION-2022-23 |
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Mapping of Course Outcomes and Program Outcomes, Course Outcomes and Program Specific Outcomes :

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| **Discrete Structure (ACSE0306)** | | | | | | | | | **Year of Study: 2022-23** | | | |
|  | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
| **ACSE0306.1** | 2 | 2 | 3 | 3 | 2 | 2 | - | - | 2 | 1 | - | 3 |
| **ACSE0306.2** | 1 | 3 | 2 | 3 | 2 | 2 | - | 1 | 1 | 1 | 2 | 2 |
| **ACSE0306.3** | 2 | 2 | 3 | 2 | 2 | 2 | - | 2 | 2 | 1 | 2 | 3 |
| **ACSE0306.4** | 2 | 2 | 2 | 3 | 2 | 2 | - | 2 | 2 | 1 | 1 | 3 |
| **ACSE306.5** | 3 | 2 | 2 | 2 | 2 | 2 | - | 2 | 1 | 1 | 1 | 2 |

Mapping of Course Outcomes and **Educational Objectives** Program :

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|  | **PSO1** | **PSO2** | **PSO3** | **PSO4** |
| **ACSE0306.1** | 3 | 3 | 2 | 2 |
| **ACSE0306.2** | 3 | 3 | 2 | 3 |
| **ACSE0306.3** | 3 | 3 | 2 | 2 |
| **ACSE0306.4** | 3 | 3 | 3 | 3 |
| **ACSE0306.5** | 3 | 3 | 3 | 3 |
| **Average** | 3 | 3 | 2.4 | 2.6 |

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|  | Lecture Plan **of** Unit -I | SESSION-2022-23 |
| SEM-3RD (ODD) |

**Total Period: 14**

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| **Lecture No.** | **Unit** | **Topics to be Covered** | **Text Book** | **CO** |
| **1** | **I** | **Introduction to Discrete Structures**, CO, PO and mapping | T1 | **CO1** |
| **2** | **Set Theory, Set Representation** | T1 | **CO1** |
| **3** | Types of Set, Venn Diagrams, Operations on set | T1 | **CO1** |
| **4** | Algebra of sets, Duality, principle of Extension | T1 | **CO1** |
| **5** | Multisets | T1 | **CO1** |
| **6** | Cartesian Product of two sets | T1 | **CO1** |
| **7** | Introduction to Relations, Binary Relations | T1 | **CO1** |
| **8** | Domain and Range Relations | T1 | **CO1** |
| **9** | Operations of Relations, Representation of Relation, Complement and Inverse of Relations | T1 | **CO1** |
| **10** | Types of Relations, Reflexive, Symmetric, Transitive | T1 | **CO1** |
| **11** |  | Identity of Relation, Closure Properties of Relations | T1 | **CO1** |
| **12** |  | Functions, Types of Functions | T1 | **CO1** |
| **13** |  | Basic Counting Techniques, Pigeonholes Principles | T1 | **CO1** |
| **14** |  | Hashing: The symbol table, Hashing Functions, Collision-Resolution Techniques. | T1 | **CO1** |
|  |  | Recurrence Relations | T1 | **CO1** |
|  |  | Homogeneous Recurrence Relations | T1 | **CO1** |
|  |  | Non Homogeneous Recurrence Relations | T1 | **CO1** |
|  |  | Proof Techniques, Mathematical Induction | T1 | **CO1** |
| **QUIZ, Assignment, Tutorial on Unit 1** | | |  |  |

**Signature of Faculty**

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|  | **Lecture Plan of** Unit –II | SESSION-2022-23 |
| SEM-3RD(ODD) |

**Total Period: 08**

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| **Lecture No.** | **Unit** | **Topics to be Covered** | **Text Book** | **CO** |
| **1** | **II** | **Algebraic Structures** | T1 | **CO2** |
| **2** | **Semi Group, Momoid** | T1 | **CO2** |
| **3** | **Group, Abelian Group** | T1 | **CO2** |
| **4** | **Subgroups and Orders** | T1 | **CO2** |
| **5** | **Cyclic Groups, Cosets** | T1 | **CO2** |
| **6** | **Lagranges, Theorem** | T1 | **CO2** |
| **7** | Discussion on Sessional – I | T1 | **CO2** |
| **8** | Normal Subgroups, Group Homomorphisms | T1 | **CO2** |
| **QUIZ, Assignment, Tutorials on Unit II** | | |  | Rings |
|  | | |  | Internal Domain field |
|  | | |  | Field |

**Name & Sign.Of Faculty**

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|  | **Lecture Plan of** Unit -III | SESSION-2022-23 |
| SEM-3RD (ODD) |

**Total Period: 9**

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| **Lecture No.** | **Unit** | **Topics to be Covered** | **Text Book** | **CO** |
| **1** | **III** | Ordered Set, Poset | T1 | **CO3** |
| **2** | Hasse Diagram | T1 | **CO3** |
| **3** | Join, Meet, LUB, GLB | T1 | **CO3** |
| **4** |  | Lattice, | T1 | **CO3** |
| **5** |  | Properties of Lattice | T1 | **CO3** |
| **6** |  | Bounded, complement and Distributive Lattice |  |  |
| **7** |  | 1. Sessional – II |  |  |
| **8.** |  | Boolean Algebra |  |  |
| **9.** |  | Simplification of Boolean Function |  |  |
| **QUIZ, Assignment, Tutorials on Unit III** | | |  |  |

**Name & Sign. Of Faculty**

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|  | **Lecture Plan of** Unit -IV | SESSION-2022-23 |
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**Total Period: 5**

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| **Lecture No.** | **Unit** | **Topics to be Covered** | **Text Book** | **CO** |
| **1** |  | **Propositional Logic- Proposition and Compound Statement** | T2 | **CO4** |
| **2** | **Basic logical operation, Well formed formula** | T2 | **CO4** |
| **3** | **Truth Tables, Tautology, Satisfiability, Contradiction** | T2 | **CO4** |
| **4** | **Algebra of Proposition, Theory of Inference** | T2 | **CO4** |
| **5** | **Predicate Logic** | T2 | **CO4** |
| **QUIZ, Assignment, Tutorials on Unit IV** | | |  |  |

**Name & Sign.Of Faculty**

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|  | **Lecture Plan of** Unit –V | SESSION-2022-23 |
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**Total Period: 11**

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| **Lecture No.** | **Unit** | **Topics to be Covered** | **Text Book** | **CO** |
| **1** | **V** | **Trees, Binary Tree** |  |  |
| **2** | **Extended Binary Tree, Tree Traversal** |  |  |
| **3** | **Binary Search Tree** |  |  |
| **4** | **Graph- Definition and Terminology, Representation of graph** |  |  |
| **5** | **Types of Graph** |  |  |
| **6** | **Planar Graph, connectivity** |  |  |
| **7** | **Connected, Complete, Bipartite Graph** |  |  |
| **8** | **Homomorphism and Isomorphism of Graph** |  |  |
| **9** | **Euler and Hamiltonian Graph , Path** |  |  |
| 10 | **Theorems and Numerical** |  |  |
| **11** | **Graph Coloring** |  |  |
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| **QUIZ, Assignment, Tutorials on Unit V** | | |  |  |

**Name & Sign.Of Faculty**

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|  | **Academic Calendar** | SESSION-2022-23 |
| SEM-7TH (ODD) |

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|  | ASSIGNMENT 1 | SESSION-2022-23 |
| SEM-3RD (ODD) |

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| **Assignment-01**  **UNIT-I**  Subject: Discrete Structure Code: ACSE0306  **AIML-III, Sec.-A and Sec.-B** |

1. Find the first four terms each of the following recurrence relation

ak = 2aK-1+k For all integers k >= 2, a1 = 1

2. Solve recurrence relation an - an-1+2an-2 =0 then find the particular solution ao = 0 and a1 = 1

3. Find N if 2P ( N, 2) + 50 =P (2N, 2).

4. Solve the recurrence relation an+2 - 5an+1+6an =2 with initial condition ao = 1 and a1 = -1.

5. Find the recurrence relation with initial condition for the following: 2, 10, 50, 250, …….

6. Solve the recurrence relation yn+2 - Yn+1 - 2yn =n2

7. Define Pigeonhole counting theory**.**

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|  | ASSIGNMENT 2 | SESSION-2022-23 |
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| **Assignment-02**  **UNIT-II**  Subject: Discrete Structure Code: ACSE0306  **AIML-III, Sec.-A and Sec.-B** |

1. Let (G, \*) be a group, where \* is usual multiplication operation on G. Then show that for any x, y ∈G following equations holds: (x-1)-1 = x (xy)-1 = y-1x-1
2. Define rings and write its properties.
3. Write the properties of Group. Show that the set(1,2,3,4,5)is not group under addition and multiplication modulo 6.
4. Define rings and fields
5. Show that (R – {1}, \*) where the operation is defined as a\*b = a +b –ab is an abelian group.
6. Let G = (Z2, +) be a group and let H be a subgroup of G where H = {(x, y) | x = y}. Find the left cosets of H in G. Here Z is the set of integers
7. Let u8 = {1, 3, 5, 7} be a group with binary operation multiplication modulo 8. Find all proper subgroups of u8.
8. Prove that (R, +, \*) is a ring with zero divisors, where R is 2×2 matrix and + and \* are usual addition and multiplication operations

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|  | ASSIGNMENTS 3 | SESSION-2022-23 |
| SEM-3RD (ODD) |

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| **Assignment-03**  **UNIT-III**  Subject: Discrete Structure Code: ACSE0306  **AIML-III, Sec.-A and Sec.-B** | |
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| . | 1. Define Poset.  2. Explain Join and Meet.  3. Draw K- map and simplify the Boolean expression  A’B’C’D’+ A’B C’ D + A’ B’ C D + A’B’C D’ + A’B C D  4. Consider the poset A = {a, b, c, d, e, f, g} be ordered . Also let B = {c, d, e}.  Determine the upper and lower bound of B.  5. 6.Determine all the sub-lattices of D30 that contain at least four elements,  D30= {1,2,3,5,6,10,15,30} |
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|  | ASSIGNMENT 4 | SESSION-2022-23 |
| SEM-3RD (ODD) |

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| **Assignment-04**    **UNIT-IV**  Subject: Discrete Structure Code: ACSE0306  **AIML-III, Sec.-A and Sec.-B**  1. What do you mean by logical equivalence? Explain with an example.  **2.** Construct the truth table of the following  ~ (𝑃∨ (𝑄∧𝑅)) ⟺ ((𝑃∨𝑄) ∧ (𝑃∨𝑅 ))  **3.** Show that which of the following statements tautology are.  (i) (( ∨∽𝑄) ∧(∽𝑃∨∽𝑄))∨𝑄  (ii) (~𝑃∧𝑄 ⟹(𝑄⟹𝑃))  **4.** Using truth table prove that: P ↔ Q ≡ (P → Q) ∧ (Q → P).    **5.** Using logical equivalent formulas, show that  ~ (P ∨ (~ P ∧ Q)) ≡ ~ P ∧ ~ Q.  **6.** Express (~𝑝→𝑟) ∧ (𝑞⟷𝑞) in its principle conjunctive normal form  **7.** Define Minterms and Maxterms and find the principal disjunctive normal form of the following:- (𝑝∧𝑞) ∨ (~𝑝∧𝑟) ∨(𝑞∧𝑟) |

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|  | ASSIGNMENT 5 | SESSION-2022-23 |
| SEM-3RD (ODD) |

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| **Assignment-0**  **UNIT-IV**  Subject: Discrete Structure Code: ACSE0301  **AIML-III, Sec.-A and Sec.-B** | |
|  | 1. Explain different type of graph with example.  2. Explain different terminology of graph with example  3. Define incidence and adjacency matrix of graph with example..  5. Explain planar graph with example.  6. Explain Euler circuit and Euler path.  7. What is isomorphic graph?  8. Explain chromatic number.  9. For the expression (7-(4\*5))+(9/3) which of the following is the post order tree traversal?  10. Define planar graph. Prove that for any connected planar graph, v – e+ r = 2 Where v, e, r is the number of vertices, edges, and regions of the graph respectively.  11.How Adjacency Matrix different from Adjacency List? Draw Adjacency Matrix and Adjacency List for the given graph. |
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|  | Question Bank (Unit 1) | SESSION-2022-23 |
| SEM-3rd (ODD) |

1. Explain composition of relation. List the basic need for composition of relation and also give it&#39;s example.
2. What are the differences between complement and inverse of a relation. Give example using venn diagram.
3. State atleast two possible ways to represent relation, Also explain about domain and range of relation.
4. What is Ordered set and Ordered pairs. If set A have 5 numbers of elements and set B have 4 number of elements then what will be the cardinality.
5. Prove the Distributive law of algebraic structure for Union and Intersection.
6. Explain the idea of Subset and Super set with example. State how a Null set can be a subset of Singleton set.
7. Prove the Association law of algebraic structure for Union and Intersection.
8. Determine whether each of these functions is a bijection from R to R.<br/>a) f(x) = 2x + 1<br/>b) f(x) = x2 + 1
9. Let A = {a, b, c}, B = {x, y}, and C = {0, 1}. Find a) A × B × C, b) C × B × A.
10. What is recurrence relation. Also define order and degree of recurrence relation.
11. Define different proof techniques available in recurrence relation.
12. Let f and g be the functions from the set of integers to the set of integers defined by f(x) = 2x + 3 and g(x) = 3x + 2. What is the composition of f and g? What is the composition of g and f ?
13. Let f be the function from {a, b, c} to {1, 2, 3} such that f(a) = 2, f(b) = 3, and f(c) = 1. Is f invertible, and if it is, what is its inverse? (CO1)
14. Let A, B, and C be sets. Show that:<br/>a) (A ∪ B) ⊆ (A ∪ B ∪ C)<br/>b) (A ∩ B ∩ C) ⊆ (A ∩ B).
15. Represent following using venn diagram: (i) (A - B)  ∪ (B - C) ∪ (A - C) and (ii) A ∩ (B − C).
16. Define Symmetric difference and simplify following: (i) A ⨁ B = (A ∪ B) - (A ∩ B) and (ii) A ⨁ B = (A - B)  ∪ (B - A).
17. A = {(a,b) | b = a – 1 and a, b belong to {1, 2, 3}}. The reflexive transitive closure of A is?
18. How Range and Co-domain of a funtion are related to each other.
19. state the condition(s) for inverse of a function and give an example.
20. What is Multiset. Give example on different operations possible on Multisets.

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|  | Question Bank (Unit 2) | SESSION-2022-23 |
| SEM-7TH (ODD) |

1. Find all the generators of (G={1,2,3,4,5},X4 ).
2. Prove that (G={0,1,2,3,4},+5) is a cyclic group and 1 and 3 are its generators.
3. Prove that, If in a group (G,\*), ‘x’, ‘y’ and ‘z’ are three elements such that x \* y = z \* y, then x = z.
4. Let group G= (Z,+) and H=2Z, find the distinct right cosets of H in G.
5. Let Z be the group of integers with the binary operation defined by a\* b= a+ b+ 2 , for all a, b belongs to Z . Find the identity element of the group (Z ,\*) .
6. Discuss an example of Ring which is not field.
7. Show that (Z,\*) is a group with a\*b = a+b+1.
8. Let (R,+,·) be a nontrivial ring with unity and let a ∈ R be such that there exists a unique b ∈ R such that ab = 1. (a) Show that a is not a zero divisor. (b) Show that a is a unit.
9. Let G be a group. Prove that every subgroup H of G of index 2 is a normal subgroup.
10. (a) Prove that the additive group Q=(Q,+) of rational numbers is not finitely generated. (b) Prove that the multiplicative group Q<span style="font-size: 10.8333px;">\*</span>=(Q∖{0},&times;) of nonzero rational numbers is not finitely generated.
11. Suppose that p is a prime number greater than 3. Consider the multiplicative group G=(Z/pZ,\*) of order p&minus;1. (a) Prove that the set of squares S={x<sup>2</sup>∣x&isin;G} is a subgroup of the multiplicative group G. (b) Determine the index [G:S].
12. Let G be a group and let H1,H2 be subgroups of G such that H1 is not a subset of H2 and H2 is not a subset of H1. (a) Prove that the union H1 U H2 is never a subgroup in G. (b) Prove that a group cannot be written as the union of two proper subgroups.
13. The set G = {0,1,2,3,4,5} is a group with respect to addition modulo 6.
14. Show that G = {1, –1, i, –i } is an abelian group under multiplication.
15. Show that the set of all positive rational numbers forms an abelian group under the composition \* defined by a \* b = (ab)/2.
16. Show that the set of all strings ‘S’ is a monoid under the operation ‘concatenation of strings’. Is S a group w.r.t the above operation? Justify your answer.
17. Let G,G′ be groups. Suppose that we have a surjective group homomorphism f:G→G′. Show that if G is an abelian group, then so is G′.
18. Let G be a group. Let a and b be elements of G. If the order of a,b are m,n respectively, then is it true that the order of the product ab divides mn? If so give a proof. If not, give a counterexample.
19. Let G be a finite group. Let S be the set of elements g such that g<sup>5</sup>=e, where e is the identity element in the group G. Prove that the number of elements in S is odd.
20. Let G be a group. Suppose that the number of elements in G of order 5 is 28. Determine the number of distinct subgroups of G of order 5.

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|  | Question Bank (Unit 3) | SESSION-2022-23 |
| SEM-3rd (ODD) |

1. Define the POSET .Show that "less then or equal to " relation on set of real number is partial ordering .Draw the hasse diagram of following set under the partial ordering relation ""
2. Describe the Boolean duality principle. Write the dual of each boolean expression.<br/>(i). x+x&#39;y = x+y <br/>(ii). (x.1)+(x&#39; +0)= 0
3. Let L1 be the lattice D6 (divisor of 6) = {1, 2, 3,6} and L2 be the lattice (P(S),subset)where S={a,b}. These two lattices are isomophic
4. Consider the subset {2,3} {4,6} and {3,6}, and ({1,2,3,4,5,6}, / ) is the poset. <br/> i) Draw the Hasse Diagram.<br/> ii) Find the Lower bound and Upper bound of each subset if I exists.<br/> iii) Find GLB and LUB of each subset if it exists.
5. Define Isomorphism. Let A = {1, 2, 3, 6} and let ‘≤’ be the divisibility relation on A. Let B = {ϕ, {a}, {b}, {a,b}} and let ‘≤’ be the relation ⊆. Then (A, ≤ ) and (B, ≤) are isomorphic.
6. Show that Lattice represented by diagram is modular , distributive but not complemented.
7. Prove that a non empty finite partially order set has at most one greatest element and at most one least element.
8. Show that the pentagonal lattice is not modular.
9. Draw the Hasse diagram for the set of all subset of {1,2,3,4} having at least 2 number partially ordered by ⸦=.
10. In any bounded distributive lattice , the elements having complements , form a sublattice. Prove it.
11. Show that D30 is a finite Boolean algebra under partial order of divisibility.
12. Show that with an example that the union of two sublattice may or may not be a sub lattice.
13. Define the following:(1).join homomorphism (2). Meet homomorphism (3). Order-homomorphism.
14. Prove that Product of two lattice is also a lattice with proper justification .
15. Concern the following poset ({1},{2},{4},{1,2}{1,4}{2,4},{3,4}{1,3,4},{2,3,4},⸦=), (1) find the maximal element(2). Find the minimal elements. (3). Find all the upper bound of ({2},{4}) and the least upper bound if it exist.
16. Consider the lattice D12 ={1,2,3,4,6} . Find the following (1). Lower bound and upper bound of D12 (2). Complement of 4,6 (3). Is D12 a complemented lattice?
17. Define the following:(1). Poset (2) Hasse diagram (3). /isomorphic Lattice(4) Complemented lattice
18. If x \* y = x + y + xy then (G, \*) is?
19. Let (A, ⊗)=({1, 2, 3, 4, 5, 6}, ⊗) is a group. It has two sub groups X and Y. X={1, 3, 6}, Y={2, 3, 5}. What is the order of union of subgroups?
20. If group G has 65 elements and it has two subgroups namely K and L with order 14 and 30. What can be order of K intersection L?

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|  | Question Bank (Unit 4) | SESSION-2022-23 |
| SEM-3rd (ODD) |

1. The premises (p ∧ q) ∨ r and r → s imply which of the conclusion?
2. What are the converse of the conditional statement “When Raj stay up late, it is necessary that Raj sleep until noon.”
3. State about: (a) order of an element of a group with example. (b) Generating element in a cyclic group with example.
4. Show that each of these conditional statements is a tautology by using truth table.
5. Suppose that the domain of the propositional function P (x) consists of the integers 0, 1, 2, 3, and 4. Write out each of these propositions using disjunctions, conjunctions, and negations.
6. Show that (p → q) ∨ (p → r) and p → (q ∨ r) are logically equivalent.
7. Use proof by contradiction to prove that the sum of an irrational number and a rational number is irrational. (CO4)
8. Use resolution to show the hypotheses “Allen is a bad boy or Hillary is a good girl” and “Allen is a good boy or David is happy” imply the conclusion “Hillary is a good girl or David is happy.”
9. Determine whether ∀x(P (x) → Q(x)) and ∀xP (x) → ∀xQ(x) are logically equivalent. Justify your answer.
10. Use a truth table to verify the first De Morgan law ¬(p ∧ q) ≡ ¬p ∨ ¬q.
11. Construct a truth table for ((p → q) → r) → s.
12. Explain, without using a truth table, why (p ∨ q ∨ r) ∧ (¬p ∨ ¬q ∨ ¬r) is true when at least one of p, q, and r is true and at least one is false, but is false when all three variables have the same truth value.
13. Construct a truth table for (p ↔ q) ↔ (r ↔ s).
14. Explain, without using a truth table, why (p ∨ ¬q) ∧ (q ∨ ¬r) ∧ (r ∨ ¬p) is true when p, q, and r have the same truth value and it is false otherwise.
15. How many rows appear in a truth table for each of these compound propositions?(
16. a) (q → ¬p) ∨ (¬p → ¬q) (b) (p ∨ ¬t) ∧ (p ∨ ¬s) (c) (p → r) ∨ (¬s → ¬t) ∨ (¬u → v)<br/>d) (p ∧ r ∧ s) ∨ (q ∧ t) ∨ (r ∧ ¬t)
17. What rules of inference are used in this argument? “No man is an island. Manhattan is an island. Therefore, Manhattan is not a man.
18. Translate these system specifications into English where the predicate S(x, y) is “x is in state y” and where the domain for x and y consists of all systems and all possible states, respectively.<br/>a) ∃xS(x, )
19. write rules of inference for Disjunctive syllogism
20. Define the negation of a proposition.

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|  | Question Bank (Unit 5) | SESSION-2022-23 |
| SEM-3rd (ODD) |

1. Let G be a connected graph. Prove: (a) If G contains cycle C which contains an edge e; then G-e is still connected. (b) If e= {u, v} is an edge such that G-e is disconnected, then u and v belong to different components of G - e.
2. (a) Suppose a graph G contains two distinct paths from vertex u to a vertex v. Show that G has a cycle. (b) Find the number of connected graph with 4 vertices. Also draw the graph.
3. Consider the graph G where V(G)= {A, B, C, D,E} and E(G)= {( A,D), (B,C) (C,E) (D,B) (D,D)(D,E)}. (i) Express G by its adjacency table.(ii) Does G have any loop or parallel edges;(iii) Find all simple path from D to E.;(iv) Find all cycles in G.(v) Find the number of sub graphs of G with vertices C, D, E
4. Can you find a unique tree when any two traversals are given? Using the INORDER: H K D B I L E A F C M J G. PREORDER: A B D H K E I L C F G J M
5. Prove that a graph is connected if and only if it has a spanning tree. (ii) Let G be a graph in which degree of every vertex is at least two. Prove that G contain a cycle.
6. Let G be a simple graph. Prove that if G is not connected then its complement G is connected.
7. Prove that a connected graph with n vertices must have n-1 edges. Can a single undirected graph of 8 vertices have 40 edges excluding self loop.
8. What are the different ways to represent graphs? Define Euler Circuit and Euler graph. Give necessary and sufficient conditions for Euler circuits and path.
9. Explain the following: i. Show that a Hamiltonian path is a tree(ii). Find all non-isomorphic simple graphs of order 4. iii. Discuss the travelling salesman problem.
10. Explain the following :i. Show that a Hamiltonian path is a tree (ii). Find all non-isomorphic simple graphs of order 4.iii. Discuss the travelling salesman problem.
11. Define the chromatic number of a graph. What is four color conjecture? Discuss with example.
12. Prove that a connected Graph G is a Euler graph if and only if it can be decomposed into circuits.
13. Define closed walk, open walk, path and circuit. Take a graph of your choice and give an example to each one.
14. For maximal planar graph G, prove or disprove the following: (i) if the number of vertices is less than or equal to 11 then G has minimum degree less than or equal to 4. (ii) if the number of vertices is greater than or equal to 4 then G has minimum degree greater than or equal to 3. (iii) every 5-connected maximal planar graph has at least 12 vertices.
15. Define the edge connectivity and vertex connectivity of a graph. Prove that the vertex connectivity of any graph G never exceeds the edge connectivity of G
16. Define planar graph. Prove that for any connected planar graph, v & n; e+ r = 2 Where v, e, r is the number of vertices, edges, and regions of the graph respectively.
17. Show that there does not exist a graph with 5 vertices with degrees 1, 3, 4, 2, 3 respectively. Also explain Define Graph coloring. What is its application?
18. With given sequence of numbers, construct BST 34, 23, 67, 45, 12, 54, 87, 43, 98, 75, 84, 93, 31
19. Define Hamiltonian cycle? Also explain Complete Graph with example.
20. Let G be a graph with ten vertices. If four vertices has degree four and six vertices has degree five, then find the number of edges of G.

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|  | Previous Years Question Paper 1 | SESSION-2022-23 |
| SEM-3rd (ODD) |

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B. TECH.

(SEM III) THEORY EXAMINATION 2019-20 DISCRETE STRUCTURES

***Time: 3 Hours*** ***Total Marks: 100***

**Note: 1.** Attempt all Sections. If require any missing data; then choose suitably.

**SECTION A**

1. **Attempt *all* questions in brief. 2 x 10 = 20**

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| Qno. | Question | Marks | CO |
| a. | Define various types of functions. | 2 | CO1 |
| b. | How many symmetric and reflexive relations are possible from a set A containing ‘n’ elements? | 2 | CO1 |
| c. | Let Z be the group of integers with binary operation \* defined by  *a* \**b*  *a*  *b*  2 , for all *a*, *b*  *Z* . Find the identity element of the group  *Z* ,\* | 2 | CO2 |
| d. | Show that every cyclic group is abelian. | 2 | CO2 |
| e. | Prove that a lattice with 5 elements is not a boolean algebra. | 2 | CO3 |
| f. | Write the contra positive of the implication: “if it is Sunday then it is a holiday”. | 2 | CO4 |
| g. | Show that the propositions 𝑝→𝑞𝑎𝑛𝑑 ¬𝑝𝗏𝑞 are logically equivalent. | 2 | CO4 |
| h. | Show that there does not exist a graph with 5 vertices with degrees 1, 3,  4, 2, 3 respectively. | 2 | CO5 |
| i. | Obtain the generating function for the sequence 4, 4, 4, 4, 4, 4, 4 | 2 | CO5 |
| j. | Define Pigeon hole principle. | 2 | CO5 |

**SECTION B**

1. **Attempt any *three* of the following: 3 x 10 = 30**

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| Q. no. | Question | Marks | CO |
| a. | Prove that 1  1  1  ......... 1  *n* for *n*  2 using principle 1 2 3 *n*  of mathematical induction | 10 | CO1 |
| b. | What do you mean by cosets of a subgroup? Consider the group Z of integers under addition and the subgroup  H = {…., -12, -6, 0, 6 12, ……} considering of multiple of 6   1. Find the cosets of H in Z 2. What is the index of H in Z. | 10 | CO2 |
| c. | Show that the following are equivalent in a Boolean algebra  *a*  *b*  *a* \**b* '  0  *b* ' *a*' *a*' *b* 1 | 10 | CO3 |
| d. | Show that ((*P*  *Q*)  ( *Q* *R*))  ( *P* *Q*)  ( *P* *R*) is a  tautology by using equivalences. | 10 | CO4 |
| e. | Define planar graph. Prove that for any connected planar graph,  v – e+ r = 2 Where v, e, r is the number of vertices, edges, and regions of the graph respectively. | 10 | CO5 |

SECTION C

1. **Attempt any *one* part of the following: 1 x 10 = 10**

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| Q no. | Question | Marks | CO |
| a. | Find the numbers between 1 to 500 that are not divisible by any of the integers 2 or 3 or 5 or 7. | 10 | CO1 |
| b. | Is the “divides” relation on the set of positive integers transitive? What is the reflexive and symmetric closure of the relation?  *R* = {*(a, b)* | *a > b*} on the set of positive integers? | 10 | CO1 |

1. **Attempt any *one* part of the following: 1 x 10 = 10**

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| Qno. | Question | Marks | CO |
| a. | What is Ring? Define elementary properties of Ring with example. | 10 | CO2 |
| b. | Prove or disprove that intersection of two normal subgroups of a group G is again a normal subgroup of G. | 10 | CO2 |

1. **Attempt any *one* part of the following: 1 x 10 = 10**

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| Qno. | Question | Marks | CO |
| a. | Let (*L*, , , ) be a distributive lattice and *a*, *b*  *L* . if *a*  *b*  *a*  *c* and  *a*  *b*  *a*  *c* then show that *b*  *c* | 10 | CO3 |
| b. | Obtain the principle disjunctive and conjunctive normal forms of the formula ( *p*  *r*)  (*q*  *p*) | 10 | CO3 |

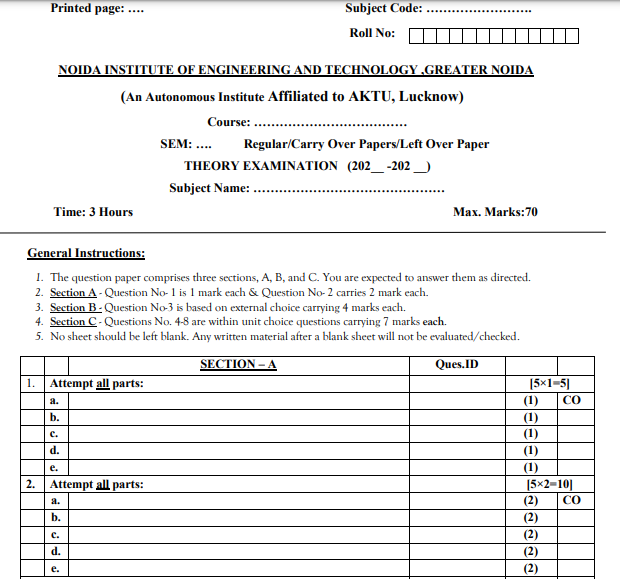
**6. Attempt any *one* part of the following 1 x 10 = 10**

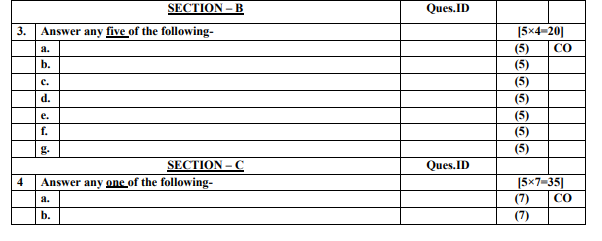
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| Qno. | Question | Marks | CO |
| a. | Explain various Rules of Inference for Propositional Logic. | 10 | CO4 |
| b. | Prove the validity of the following argument “if the races are fixed so the casinos are crooked, then the tourist trade will decline. If the tourist trade decreases, then the police will be happy. The police force is never happy.  Therefore, the races are not fixed. | 10 | CO4 |

**7. Attempt any *one* part of the following: 1 x 10 = 10**

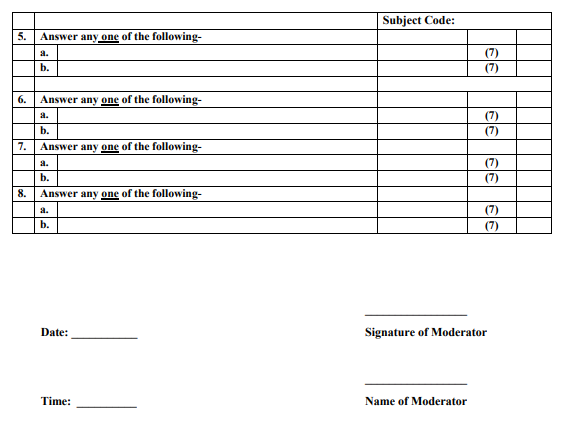
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| Qno. | Question | Marks | CO |
| a. | Solve the following recurrence equation using generating function G (K) -7 G (K-1) + 10 G (K-2) = 8K + 6 | 10 | CO5 |
| b. | A collection of 10 electric bulbs contain 3 defective ones   1. In how many ways can a sample of four bulbs be selected? 2. In how many ways can a sample of 4 bulbs be selected which contain 2 good bulbs and 2 defective ones? 3. In how many ways can a sample of 4 bulbs be selected so that either   the sample contains 3 good ones and 1 defectives ones or 1 good and 3 defectives ones? | 10 | CO5 |

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|  | Question Papers Template | SESSION-2022-23 |
| SEM-3rd (ODD) |





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|  | Question Papers Template | SESSION-2022-23 |
| SEM- 3rd(ODD) |



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|  | Student List-AIML A | SESSION-2022-23 |
| SEM-3rd (ODD) |

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| **S.No.** | **Roll Number** | **Name of Student** |
| 41 | 2101331530002 | AAMIR KHAN |
| 47 | 2101331530003 | ABDULLAH |
| 22 | 2101331530005 | ABHINAV DUBEY |
| 45 | 2101331530006 | ADARSH GUPTA |
| 63 | 2101331530008 | ADITYA KUKRETI |
| 86 | 2101331530009 | ADITYA SHAHI |
| 81 | 2101331530013 | AKANSHA CHAUDHARY |
| 5 | 2101331530014 | AKHIL PANDEY |
| 51 | 2101331530016 | ALAKSHYENDRA PANDEY |
| 10 | 2101331530017 | AMBUJ SHARMA |
| 87 | 2101331530018 | ANANNYA TIWARI |
| 16 | 2101331530022 | ANKUSH CHAUHAN |
| 66 | 2101331530023 | ANKUSH KUMAR SHUKLA |
| 35 | 2101331530024 | ANMOL RATAN SRIVASTAVA |
| 57 | 2101331530026 | ANURAG MISHRA |
| 64 | 2101331530027 | ANURAG PATHAK |
| 54 | 2101331530031 | ARYAN |
| 31 | 2101331530034 | AYUSH |
| 21 | 2101331530035 | AYUSH MANI |
| 44 | 2101331530036 | AYUSH MANI TRIPATHI |
| 59 | 2101331530037 | AYUSH RAJ |
| 85 | 2101331530038 | AYUSH SHUKLA |
| 78 | 2101331530040 | BHAVYA GAJJAR |
| 74 | 2101331530041 | DHEER SINHA |
| 24 | 2101331530043 | DIVYA AWASTHI |
| 65 | 2101331530045 | GAGAN SHARMA |
| 2 | 2101331530046 | GARVIT GARG |
| 58 | 2101331530047 | GAURAV PANDEY |
| 19 | 2101331530048 | GAURAV PORWAL |
| 27 | 2101331530049 | GAURAV SINGH |
| 46 | 2101331530050 | GIRISH UMESH SAWANT |
| 20 | 2101331530051 | HARSH DUBEY |
| 3 | 2101331530053 | HARSH VARDHAN CHAUHAN |
| 9 | 2101331530055 | HARSHIT CHAUHAN |
| 90 | 2101331530056 | HARSHIT SHARMA |

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|  | Student List-AIML B | SESSION-2022-23 |
| SEM-3rd (ODD) |

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| **S.NO.** | **Student Roll No** | **Student Name** |
| **1** | 2101331530039 | BAIBHAV SINGH |
| **2** | 2101331530134 | SIDDHARTH R SHARAN |
| **3** | 2101331530103 | RAHUL YADAV |
| **4** | 2101331530094 | PRASHANT SHARMA |
| **5** | 2101331530102 | RAHUL KUMAR |
| **6** | 2101331530083 | NAVYA NIDHI |
| **7** | 2101331530032 | ARYAN GUPTA |
| **8** | 2101331530030 | ARPIT GUPTA |
| **9** | 2101331530044 | FARAZ SAMI RIZVI |
| **10** | 2101331530104 | RAJAT MEHRA |
| **11** | 2101331530147 | YASH RAMPAL |
| **12** | 2101331530054 | HARSH VERMA |
| **13** | 2101331530142 | TISHA GUPTA |
| **14** | 2101331530065 | KHUSHI SHARMA |
| **15** | 2101331530074 | MANAS GUPTA |
| **16** | 2101331530135 | SIDDHARTHA DWIVEDI |
| **17** | 2101331530007 | ADHYA AGARWAL |
| **18** | 2101331530010 | ADITYA SINGH |
| **19** | 2101331530098 | PRIYANSHU KUMAR |
| **20** | 2101331530028 | ARJUN BHUSHAN |
| **21** | 2101331530101 | RAGHWENDRA PRATAP SINGH |
| **22** | 2101331530131 | SHUBHAM JOSHI |
| **23** | 2101331530100 | Raghav Mittal |
| **24** | 2101331530057 | HEMRAJ |
| **25** | 2101331530011 | ADITYA YADAV |
| **26** | 2101331530091 | OJASHVI |
| **27** | 2101331530033 | ARYAN MATHUR |
| **28** | 2101331530025 | ANURADHA BHARTI |
| **29** | 2101331530070 | KULDEEP KUMAR |
| **30** | 2101331530015 | AKSHAY PRATAP SINGH |
| **31** | 2101331530068 | KRISHNA MISHRA |
| **32** | 2101331530148 | YASH SHARMA |
| **33** | 2101331530012 | AGRIM VASHIST |
| **34** | 2101331530001 | Aakanksha Singh |
| **35** | 2101331530121 | SHIVAM SHARMA |
| **36** | 2101331530107 | RETESH KARMAKAR |

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|  | Individual Time Table of the Faculty Members | SESSION-2022-23 |
| SEM-3rd (ODD) |

**Faculty Name: ANAMIKA TIWARI**

|  |  |  |  |  |  |  |  |  |
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| **Noida Institute of Engineering & Technology, Greater Noida** | | | | | | | | |
| Time Table ODD Semester 2022 – 23 | | | | | | | | |
| **Faculty Name : Ms. ANAMIKA TIWARI** | | | | | | | | |
|  | | | | | | | | |
| Day/Time | | 9:00 to  10:00 | 10:00  to 11:00 | 11:00 to  12:00 | 12:00 to  1:00 | 2:00 to  3:00 | 3:00 to  4:00 | 4:00 to  5:00 |
| MON TUE WED THU  FRI | Sub. |  | | **DIS(L)-A** |  | **MOOCS-B** | **DAA Lab** | |
| Class |  |  | **AMT** |  | **AMT, LAB**  **001** | **SCH, AMT (Lab-**  **001)** | |
| Sub. |  |  | **DIS(L)-A** | **DIS(L)-B** | **DIS(L)-B** |  |  |
| Class |  |  | **AMT** | **AMT** | **AMT** |  |  |
| Sub. |  |  | **DIS(L)** |  | **MOOCS** |  |  |
| Class |  |  | **AMT-A** |  | **LAB 003** |  |  |
| Sub. |  |  | **Competitive Coding** | | **DIS(L-B)** |  |  |
| Class |  |  | **ACG, AMT LAB-003** | | **AMT** |  |  |
| Sub. |  |  | **IA/MOOCS/PROJECT** | | **DIS(L)-B** |  | **DIS(L)-A** |
| Class |  |  | **MYP, AMT (Lab-324)** | | **AMT** |  | **AMT** |

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|  | CT-1 Question Papers with solutions | SESSION-2022-23 |
| SEM-3rd (ODD) |

**NOIDA INSTITUTE OF ENGINEERING AND TECHNOLOGY ,GREATER NOIDA**

**(An Autonomous Institute Affiliated to AKTU, Lucknow)**

**B.Tech**

**(SEM:III, SESSIONAL EXAMINATION –I )(2021-2022)**

**Subject Name: Discrete Structure**

**Time: 1.15Hours Max. Marks:30**

**General Instructions:**

* All questions are compulsory. Answers should be brief and to the point.
* This Question paper consists of …………pages & …5………questions.
* It comprises of three Sections, A, B, and C. You are to attempt all the sections.
* **Section A** -Question No- 1 is objective type questions carrying 1 mark each, Question No- 2 is very short

answer type carrying 2 mark each. You are expected to answer them as directed.

* **Section B** - Question No-3 is Short answer type questions carrying 5 marks each. You need to attempt

any two out of three questions given.

* **Section C** -Question No. 4 &5are Long answer type (within unit choice) questions carrying 6marks

each. You need to attempt any one part *a* or *b.*

* Students are instructed to cross the blank sheets before handing over the answer sheet to the invigilator.

No sheet should be left blank. Any written material after a blank sheet will not be evaluated/checked.

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| --- | --- | --- | --- | --- |
|  |  | **SECTION – A** | **[8]** |  |
|  |  |  |  |  |
|  | **Attempt all parts** | | **(4×1=4)** | **CO1** |
|  | **a.** | Represent the set {1,3,5,7,9} in Set Builder Form. | **(1)** |  |
|  | **b.** | Define: (i) Singleton set (ii) Void Set | **(1)** |  |
|  | **c.** | Give an example of difference on Multiset. | **(1)** |  |
|  | **d.** | Given the Set A = {1,2,3,4,5} with Relation R={(1,2),(3,4),(2,2)} and S={(4,2),(2,5),(3,1),(1,3)}. Find the Composition R**∘S.** | **(1)** |  |
|  |  |  |  |  |
| **2.** | **Attempt all parts** | | **(2×2=4)** | **CO** |
|  |  | |  |  |
|  |  | If A= {-3,0,1,2,4}, B= {1,2,3,4} calculate symmetric difference of A,B. | **(2)** |  |
|  |  | Let f: R ->R be such that f(x) = x2. . Is f invertible? | **(2)** |  |
|  |  |  |  |  |
|  |  |  |  |  |
| **SECTION – B** | | |  |  |
|  | | |  |  |
| **3.** | **Answer any two of the following-** | | **[2×5=10]** | **CO** |
|  | **a.** | Prove: (i) A ∩ B = B ∩ A, (ii) A ∪ B = B ∪ A | **(5)** |  |
|  | **b.** | The number of 2 letter words which can be formed by using the letters in a word 'GREAT' are? | **(5)** |  |
|  | **c.** | Find the generating function of numeric function (2,3,5,9,17,33,….) | **(5)** |  |
|  |  |  |  |  |
|  |  |  |  |  |
| **SECTION – C** | | |  |  |
|  | | |  |  |
| **4** | **Answer any one of the following-(Any one can be applicative if applicable)** | | **[2×6=12]** | **CO** |
|  | **a.** | **Question-** Solve the Recurrence Relation ar **– 7**ar-1 + 10ar-2=0. Given that a0=0, a1=3. Find the value of a5. | **(6)** |  |
|  |  |  |  |  |
|  | **b.** | **By using mathematical induction prove that the given equation is true for all positive integers.**  **1 x 2 + 3 x 4 + 5 x 6 + …. + (2n - 1) x 2n = [*n(n+1)(4n-1)/3]*** | **(6)** |  |
| **5.** | **Answer any one of the following-** | |  |  |
|  | **a.** | Let f:R →R be defined by f(x) = x3-4 , g(x) = 1/(1+x2) , h(x) = x4 then  find the following composition function  (f o g o h)(x)  (g o g)(x)  (g o h )(x) | **(6)** |  |
|  |  |  |  |  |
|  | **b.** | (i) Let A = {1,2,3} and R = {(1,2), (2,3), (3,3)} is a relation on set A. Determine transitive closure of R.  (ii) (a) Let A= {1,2,3,4,5} And B = {2,3,4,5,6,7}.Find the power set of (AUB).  (b) State pigeonhole principle with suitable Example.  (c) What do you mean by Law Of Duality? | **(6)** |  |

**Solution – Sessional – I**

**Section A**

*1*.

1. A={x: x is an odd number,1 ≤ x ≤ 9}
2. A set consisting of no element is called the **empty set or null set or void set.**

**Singleton Set** : A set which has only one element is called a singleton set.

1. The difference of two multisets A and B, is a multiset such that the multiplicity of an element is equal to the multiplicity of the element in A minus the multiplicity of the element in B if the difference is +ve, and is equal to 0 if the difference is 0 or negative.

Let A = {l, m, m, m, n, n, n, p, p, p}

 B = {l, m, m, m, n, r, r, r}

A - B = {n, n, p, p, p}

1. R**∘S = {(1,5),(3,2),(2,5)}**

2.

(a) (AUB)-(A∩B) = {-3,0,3}

(b)no, f is not invertible as since it is not one-one and Onto or Bijective.

**Section B**

3**.**

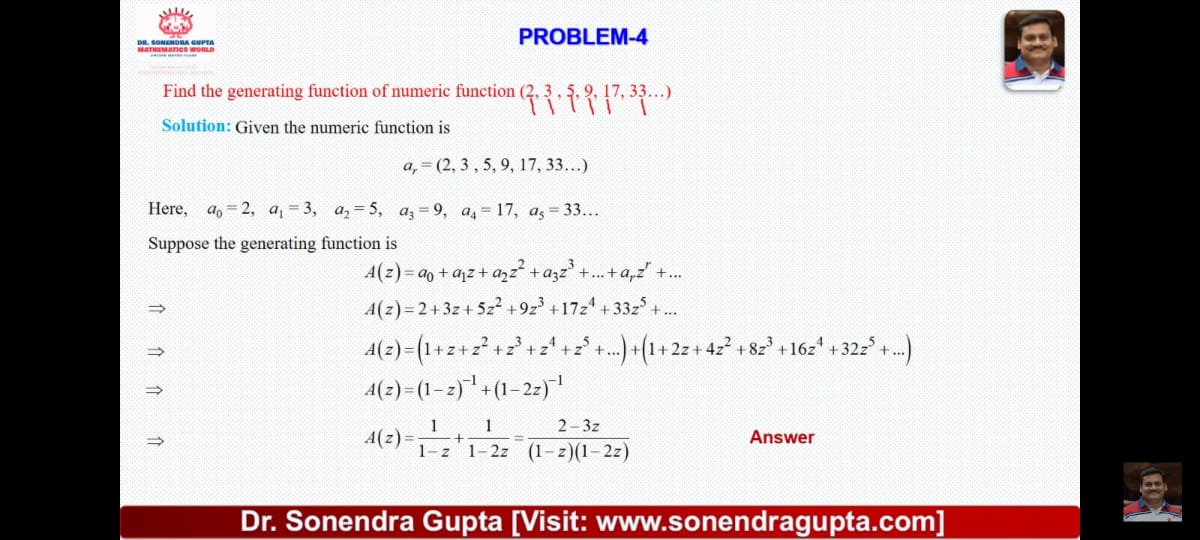
(a)

A ∪ B = {x: x ∈ A or x ∈ B} = {x: x ∈ B or x ∈ A**}** (∵ Order is not preserved in case of sets) A ∪ B = B ∪ A. Hence Proved. Solution: To Prove A ∩ B = B ∩ A A ∩ B = {x: x ∈ A and x ∈ B} = {x: x ∈ B and x ∈ A} (∵ Order is not preserved in case of sets) A ∩ B = B ∩ A.

(b)

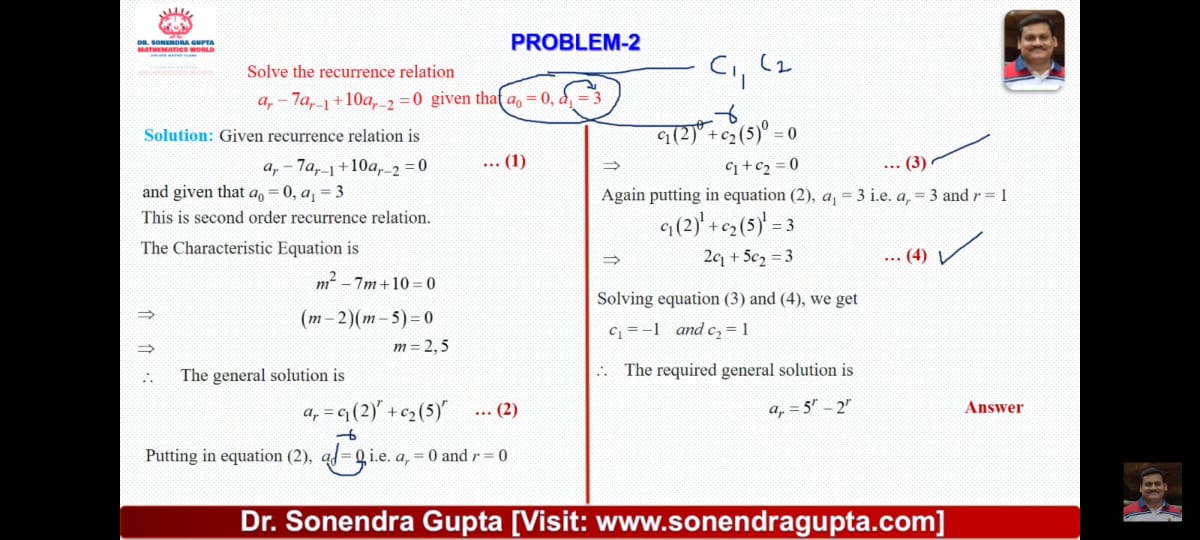
When repetition of the letters is not allowed 1st letter can be selected in 5 ways. 2nd letter can be selected in 4 ways. ∴ By using the fundamental principle of multiplication, the total number of 2-letter words = 5 × 4 = 20

(b)



**Section C**

4

(a) 

(b)

From the statement formula

When n = 1,

LHS =1 x 2 = 2

RHS = 1(1+1)(4x1−1)31(1+1)(4x1−1)3 = 6363 = 2

Hence it is proved that P (1) is true for the equation.

Now we assume that P (k) is true or 1 x 2 + 3 x 4 + 5 x 6 + …. + (2k - 1) x 2k = k(k+1)(4k−1)3k(k+1)(4k−1)3.

For P(k + 1)

LHS = 1 x 2 + 3 x 4 + 5 x 6 + …. + (2k - 1) x 2k + (2(k + 1) - 1) x 2(k + 1)

= k(k+1)(4k−1)3k(k+1)(4k−1)3 + (2(k + 1) - 1) x 2(k + 1)

= (k+1)3(k+1)3(4k2 - k + 12 k + 6)

= (k+1)(4k2+8k+3k+6)3(k+1)(4k2+8k+3k+6)3

= (k+1)(k+2)(4k+3)3(k+1)(k+2)(4k+3)3

= (k+1)((k+1)+1)(4(k+1)−1)3(k+1)((k+1)+1)(4(k+1)−1)3 = RHS for P (k+1)

Now it is proved that P (k + 1) is also true for the equation.

So the given statement is true for all positive integers.

5

(a)

https://tex.z-dn.net/?f=%5Cpink%20%5Cbigstar%5Cbf%7B(1)%20%5C%3A%20f(g(h(x)%20%5Cto%7D

https://tex.z-dn.net/?f=%5Cimplies%20%5Cbf%7Bf(g(h(x))%20%3D%20f(g(%20%7Bx%7D%5E%7B4%7D%20)%20%3D%20f(%20%5Cfrac%7B1%7D%7B%20%7Bx%7D%5E%7B6%7D%20%2B%201%20%7D%20)%20%7D

(b)

(i) transitive closure of R = RUR2UR3 = {(1,2),(2,3),(3,3),(1,3)}

(ii) power set of (AUB) = 27= 128

(iii) the pigeonhole principle states that if n items are put into m containers, with n > m, then at least one container must contain more than one item.

(iv) Duality principle states that for any true statement, the dual statement obtained by interchanging unions into intersections (and vice versa) and interchanging Universal set into Null set (and vice versa) is also true. If dual of any statement is the statement itself, it is said self-dual statement.

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|  | CT-2 Question Papers with solutions | SESSION-2022-23 |
| SEM-3rd (ODD) |

**Printed page: 2 Subject Code: ACSE0306/AMICSE0306/ACSEH0306**

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**Roll No:**

**NOIDA INSTITUTE OF ENGINEERING AND TECHNOLOGY ,GREATER NOIDA**

**(An Autonomous Institute Affiliated to AKTU, Lucknow)**

**B.Tech (CSE/IT/CS/AI/AIML/DS/IOT/M.TECH.(INT)/CS(R))**

**(SEM:III, SESSIONAL EXAMINATION –II )(2022-2023)**

**Subject Name: Discrete Structure**

**Time: 1.15Hours Max. Marks:30**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  |  | **SECTION – A** | **[8]** |  |
|  |  |  |  |  |
|  | **Attempt all parts** | | **(4×1=4)** | **CO** |
|  | **a.** | A Poset in which every pair of elements has both a least upper bound and a greatest lower bound is termed as \_\_\_\_\_\_\_ a) sublattice b) lattice  c) trail d) walk | **(1)** | **CO3** |
|  | **b.** | Define algebraic structure | **(1)** | **CO2** |
|  | **c.** | Condition for monoid is \_\_\_\_\_\_\_\_\_\_.  a) (a+e)=a b) (a\*e)=(a+e) c) a=(a\*(a+e) d) (a\*e)=(e\*a)=a | **(1)** | **CO2** |
|  | **d.** | What is the identity element In the group G = {2, 4, 6, 8) under multiplication modulo 10?  A. 5 B. 9 C. 6 D. 12 | **(1)** | **CO2** |
|  |  |  |  |  |
| **2.** | **Attempt all parts** | | **(2×2=4)** | **CO** |
|  |  | |  |  |
|  |  | What is a Poset? | **(2)** | **CO3** |
|  |  | Define Group and write its properties | **(2)** | **CO2** |
|  |  |  |  |  |
|  |  |  |  |  |
| **SECTION – B** | | |  |  |
|  | | |  |  |
| **3.** | **Answer any two of the following-** | | **[2×5=10]** | **CO** |
|  | **a.** | Let set A={1,2,3,12 ,24,36,} consider the partial order of divisibility on A. Draw the corresponding Hasse Diagram. Find out the following into the Hasse diagram:-   1. Maximum 2. Minimum 3. Maximal 4. minimal | **(5)** | **CO3** |
|  | **b.** | What is homomorphism and isomorphism with example? | **(5)** | **CO2** |
|  | **c.** | Define rings and write its properties | **(5)** | **CO3** |
|  |  |  |  |  |
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| **SECTION – C** | | |  |  |
|  | | |  |  |
| **4** | **Answer any one of the following-(Any one can be applicative if applicable)** | | **[2×6=12]** | **CO** |
|  | **a.** | The set G = {1,2,3,4,5,6,7,8} is a abelian group with respect to multiplication   modulo 9. | **(6)** | **CO2** |
|  |  |  |  |  |
|  | **b.** | (i) What is a cosets.  (ii) Find all the cosets of H ={0,5} in the group G =(Z8 ,+8). | **(6)** | **CO3** |
| **5.** | **Answer any one of the following-** | |  |  |
|  | **a.** | (i) Define fields.  (ii) Show that the set ‘N’ is a monoid with respect to addition.  (iii) Draw the Hasse diagram for (D60, /). | **(6)** | **CO2**  **CO3** |
|  |  |  |  |  |
|  | **b.** | (i) Define the followings:-  (a) Monoid  (b) Sub group  (c) Integral domain  (ii) Show that G = {1, w, w2} is an abelian group under multiplication. Where 1, w, w2 are cube roots of unity. | **(6)** | **CO2**  **CO2** |

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|  | CT-3 Question Papers with solutions | SESSION-2022-23 |

**Printed page: 2 Subject Code: ACSE0306/AMICSE0306/ACSEH0306**

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**Roll No:**

**NOIDA INSTITUTE OF ENGINEERING AND TECHNOLOGY ,GREATER NOIDA**

**(An Autonomous Institute Affiliated to AKTU, Lucknow)**

**B.Tech (CSE/IT/CS/AI/AIML/DS/IOT/M.TECH.(INT)/CS(R))**

**(SEM:III, SESSIONAL EXAMINATION –II )(2022-2023)**

**Subject Name: Discrete Structure**

**Time: 1.15Hours Max. Marks:30**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  |  | **SECTION – A** | **[8]** |  |
|  |  |  |  |  |
|  | **Attempt all parts** | | **(4×1=4)** | **CO** |
|  | **a.** | \_\_\_\_\_\_ and \_\_\_\_\_\_\_ are the two binary operations defined for lattices.  a) Addition, subtraction b) Join, meet  c) Union, intersection d) Multiplication, modulo division | **(1)** | **CO3** |
|  | **b.** | Let P: I am in Bangalore.; Q: I love cricket.; then q -> p(q implies p) is \_\_\_\_\_\_  a) If I love cricket then I am in Bangalore b) If I am in Bangalore then I love cricket c) I am not in Bangalore d) I love cricket | **(1)** | **CO4** |
|  | **c.** | Let P: We should be honest. Q: We should be dedicated. R: We should be overconfident. Then ‘We should be honest or dedicated but not overconfident.’ is best represented by \_\_\_\_\_\_\_\_\_\_.  a) ~P V ~Q V R b) P ∧ ~Q ∧ R c) P V Q ∧ R d) P V Q ∧ ~R | **(1)** | **CO4** |
|  | **d.** | In a graph, \_\_\_\_ refers to edges that can connect the same vertices over more than one edge.   1. Multigraph 2. Directed graph 3. Connected Graph 4. Disconnected Graph | **(1)** | **CO5** |
|  |  |  |  |  |
| **2.** | **Attempt all parts** | | **(2×2=4)** | **CO** |
|  |  | |  |  |
|  |  | Define bounded lattice and distribute lattice with example. | **(2)** | **CO3** |
|  |  | Explain the following: (i) Universal Quantifier (ii) Existential Quantifier | **(2)** | **CO4** |
|  |  |  |  |  |
| **SECTION – B** | | |  |  |
|  | | |  |  |
| **3.** | **Answer any two of the following-** | | **[2×5=10]** | **CO** |
|  | **a.** | Show that (p → q) ∨ (p → r) and p → (q ∨ r) are logically equivalent. | **(5)** | **CO4** |
|  | **c.** | Define planar graph also explain graph coloring with suitable example. What is its application? | **(5)** | **CO5** |
|  |  |  |  |  |
|  |  |  |  |  |
| **SECTION – C** | | |  |  |
|  | | |  |  |
| **4** | **Answer any one of the following-(Any one can be applicative if applicable)** | | **[2×6=12]** | **CO** |
|  | **a.** | What are the different ways to represent graphs? Define Euler Circuit and Euler graph. Give necessary and sufficient conditions for Euler circuits and path. | **(6)** | **CO5** |
|  |  |  |  |  |
|  | **b.** | Define tautology, contradiction and contingency.  (A∨B)∧[(¬A)∧(¬B)] ) is tautology, contradiction or contingency? | **(6)** | **CO4** |
| **5.** | **Answer any one of the following-** | |  |  |
|  | **a.** | (i) Define Inverse, Converse, and Contra-positive with suitable example.(ii) Use resolution to show the hypotheses “Allen is a bad boy or Hillary is a good girl” and “Allen is a good boy or David is happy” imply the conclusion “Hillary is a good girl or David is happy”. | **(6)** | **CO4**  **CO4** |
|  |  |  |  |  |
|  | **b.** | (i) Define the followings:-  (a) Sublattices.  (b) Find the complement of each element of D42.   |  | | --- | |  |   (ii) With given sequence of numbers, construct BST 34, 23, 67, 45, 12, 54, 87, 43, 98, 75, 84, 93, 31 | **(6)** | **CO3**  **CO5** |

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|  | Non - Performing Students List | SESSION-2022-23 |
| SEM-3rd (ODD) |

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| **Roll.No** | **Name** | **Total Marks** |
| 2101331530009 | Aditya Sahi | 12 |
| 2101331530004 | Abhay Pratap | 10 |
| 2101331530038 | Ayush Shukla | 5 |
| 2101331530120 | Shivam Jha | 9 |
| 2101331530015 | Akashay pratap singh | 7 |
| 2101331530009 | Animesh Yadav | 3 |
| 2101331530021 | Ankit Kumar | 3 |
| 21013315300029 | Arnav Dixit | 4 |
| 2101331530052 | Harsh Kumar | 11 |
| 2101331530064 | Kartik Singh | 10 |
| 2101331530124 | Shivansh Rana | 10 |

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|  | Actions taken for the improvement of Non-performing students | SESSION-2022-23 |
| SEM-3rd (ODD) |

1. Students who have scored ≤40% marks in first sessional test shall be identified as Academically Weak Students (AWS).
2. Improvement test shall be conducted for AWS after first sessional test.
3. HOD shall arrange to conduct extra classes for AWS beyond institute hours preferably between 5:15 PM to 6:15 PM.
4. All AWS students must attend all lecture classes and maintain preferably 100% attendance.
5. AWS be allowed to appear in second sessional test and their pass percentage in second Sessional test will be monitored.
6. After the analysis of second test result, the result of AWS students who appeared in the second test will be again monitored and the progress of AWS students be sent to the Director.

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|  | End Semester Examination Question Paper Review & Expected Result | SESSION-2022-23 |
| SEM-3rd (ODD) |

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| **Session** | **Subject Code** | **Question Paper Level** | **Expected Result** | **Subject Coordinator Signature** |
| 2021-22 | ACSE0306 | Easy | 97% |  |
| 2021-22 | ACSE0306 | Moderate | 87% |  |

**Keywords:**

* Easy
* Easy to Moderate
* Moderate to Difficult
* Difficult

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|  | University Result Analysis | SESSION-2022-23 |
| SEM-3rd (ODD) |

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|  |  | **Section Wise Result** | | | | | | | |  |
| **Class/ Section** | **Number of students** | **Clear Pass students** | **Students with one back** | **Students with two backs** | **Students with three backs** | **Students with four backs** | **Students with five backs** | **Students with six backs** | **Students with Eight backs** | **Clear pass %** |
| **A** | **65** | **54** | **2** | **6** | **1** | **1** | **0** | **1** | **0** | **83.07** |
| **B** | **65** | **55** | **7** | **1** | **0** | **0** | **0** | **1** | **1** | **84.61** |
| **C** | **69** | **57** | **4** | **1** | **1** | **2** | **1** | **3** | **0** | **82.60** |

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|  | Reason for Difference between Expected Result and University Result | SESSION-2022-23 |
| SEM-3rd (ODD) |

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|  | Corrective Steps Taken for Difference in Results | SESSION-2022-23 |
| SEM-3rd (ODD) |

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|  | Cos and Pos Attainment Sheet | SESSION-2022-23 |
| SEM-3rd (ODD) |

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| **Session** | **Subject code** | **Subject Name** | **Attainment** | **Subject Coordinator Signature** | **HOD**  **Signature** |
| 2021-22 | ACSE0306 | DISCRETE STRUCTURES | 2.85 |  |  |
| 2022-23 | ACSE0306 | DISCRETE STRUCTURES | 2.9 |  |  |
|  |  |  |  |  |  |
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