Hall Ticket No | | | | | | | | | | | Question Paper Code: AHS013

INSTITUTE OF AERONAUTICAL ENGINEERING
(Autonomous)

MODEL QUESTION PAPER

B.Tech III Semester End Examinations (Regular), November – 2017

Regulation: IARE–R16

DISCRETE MATHEMATICAL STRUCTURES
(Common to CSE/IT)

Time: 3 Hours **Max Marks: 70**

Answer ONE Question from each Unit
All Questions Carry Equal Marks
All parts of the question must be answered in one place only

UNIT – I

1. (a) Explain about logical equivalence and tautological implications. Specify the laws of logic. **[7M]**

   (b) Determine a valid conclusion from the given premises: **[7M]**

   i. $P \to (Q \to S), \sim R \vee P, Q \Leftrightarrow R \to S$

   ii. $P \vee Q,\ Q \to R,\ P \to M and \sim M \Leftrightarrow R \wedge (P \vee Q)$

2. (a) Explain about principle conjunctive normal form and principle disjunctive normal form with its procedural steps. Obtain the principal disjunctive normal form of $P \to ((P \to Q) \wedge \sim (\sim Q \vee \sim P))$. **[7M]**

   (b) Prove the following logical equivalences: **[7M]**

   i. $[(p \leftrightarrow q) \wedge (q \leftrightarrow r) \wedge (r \leftrightarrow p)] \Leftrightarrow [(p \wedge q) \wedge (q \to r) \wedge (r \to p)]$

   ii. $p \to (q \to r) \Leftrightarrow p \to (\sim q \wedge r) \Leftrightarrow (p \wedge q) \to r \Leftrightarrow (p \to r) \vee (q \to r)$.

UNIT – II

3. (a) Let R and S be relations from a set A to a set B and T be a relation from the set B to a set C. Prove that if $R \subseteq S$ then $R \circ T \subseteq S \circ T$. **[7M]**

   (b) Consider sets A=$\{a, b, c\}$ and B=$\{1, 2, 3\}$, and relations from A to B are $R = \{(a, 1), (b, 1), (c, 2), (c, 3)\}$ and $S = \{(a, 1), (a, 2), (b, 1), (b, 2)\}$. Compute the following: **[7M]**

   i. $R \cup S$

   ii. $R \cap S$

   iii. R^c

   iv. S^c

4. (a) Let $X \to Y$ be a function and A and B be arbitrary non-empty subsets of X. Then: **[7M]**

   i. If $A \subseteq B$, then $f(A) \subseteq f(B)$.

   ii. $f(A \cup B) = f(A) \cup f(B)$.

   iii. $f(A \cup B) = f(A) \cup f(B)$. and the equality holds if f is one-to-one.

   (b) Construct the hasse diagram for the divisibility relation on following sets. **[7M]**

   i. $A = \{3, 6, 12, 36, 72\}$

   ii. $A = \{1, 2, 3, 5, 6, 10, 15, 30\}$

UNIT – III

5. (a) Describe Binomial theorem. Find the coefficient of x^5y^7 in the expansion of $(x + 3y)^{12}$. **[7M]**

   (b) A chain letter is sent to 10 people in the first week of the year. The next week each person who received a letter sends letters to 10 new people and so on. How many people have received the letters at the end of the year? **[7M]**

6. (a) Solve that $(Z, *)$ is an abelian group where Z is a set of integers and the binary operations * is defined as $a * b = a + b - 3$. **[7M]**

(b) Construct the co-efficient of $a^2b^3c^3d^5$ in the expansion of $(a + 2b - 3c + 2d + 5)^{16}$. **[7M]**

UNIT – IV

7. (a) Identify the generating function for the following sequence : **[7M]**

i. $1^2, 2^2, 3^2, \ldots\ldots\ldots$

ii. $0^2, 1^2, 2^2, 3^2 \ldots\ldots\ldots$

iii. $1^3, 2^3, 3^3 \ldots\ldots\ldots$

(b) Solve the recurrence relation given below : **[7M]**

i. $a_n + a_{n-1} + n^3, n >= 1$ where $a_0 = 5$ by using substitution method.

ii. $a_n + 4a_{n-1} + 4a_{n-2} = 8 for n \geq 2$, and $a_0 = 1, a_1 = 2$ by using non-homogeneous recurrance relation.

8. (a) Solve the recurrence relation $a_n - 6a_{n-1} + 12a_{n-2} - 8a_{n-3} = 0$ for $n \geq 3$ using generating functions. **[7M]**

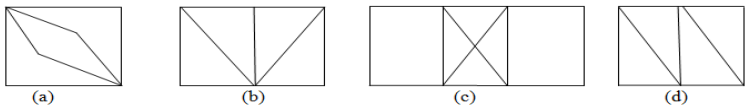
(b) Solve the co-efficient of x^{27} of the following functions: **[7M]**

i. $\left(x^4 + x^5 + x^6 + \ldots\ldots\ldots\ldots\right)^5$

ii. $\left(x^4 + 2x^5 + 3x^6 + \ldots\ldots\ldots\ldots\right)^5$

UNIT – V

9. (a) Describe Euler and Hamilton graphs. Which of the following graphs are Euler graphs and Hamilton graphs? **[7M]**



(b) Construct the spanning tree by using (i) Breadth First Search (ii) Depth First Search of graph G shown in Figure 1. **[7M]**

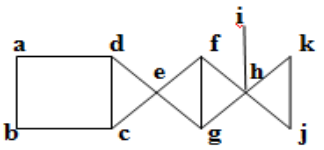


Figure 1

10. (a) Find the union, intersection and the ring sum of the graphs G1 and G2 given below: **[7M]**

(b) Eight cities A, B, C, D, E, F, G, H are required to be connected by a new railway network. The possible tracks and the cost of involved to lay them (in crores of Rupees) are summarized in the below given table: **[7M]**

Track Between	Cost	Track Between	Cost
A and B	155	D and F	100
A and D	145	E and F	150
A and G	120	F and G	140
B and C	145	F and H	150
C and D	150	G and H	160
C and E	95		

Determine a Railway network of minimal cost that connects all these cities.

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COURSE OBJECTIVES:

The course should enable the students to:

1	Describe the logical and mathematical foundations and study the predicate logic.
2	Be familiar with the basic terminology of functions, relations, and sets and demonstrate knowledge of their associated operations.
3	Be familiar with the practical applications the use of basic counting principles of permutations, combinations, inclusion/exclusion principle and the pigeonhole methodology.
4	Master to solve advanced mathematical problems on recurrence relations.
5	Recognize the patterns that arise in graph problems and use this knowledge for constructing the trees and spanning trees.

COURSE LEARNING OUTCOMES:

Students, who complete the course, will have demonstrated the ability to do the following:

CAHS013.01	Understand logical connectives and compound prepositions for building compound statements.
CAHS013.02	Learn the formal symbols and use the preposition logic and predicate logic to solve problems on logical equivalences and implications.
CAHS013.03	Memorize different scientific notations to simplify the logical statements.
CAHS013.04	Prepare valid arguments from the given propositional statements by using rules of inference.
CAHS013.05	Identify ordered pairs to form a binary relation from the given sets.
CAHS013.06	Construct directed graph and a matrix representation using a binary relation on finite order pairs.
CAHS013.07	Identify the properties of relations to check for equivalence relation and partial order relation and compute relations using operations on relations.
CAHS013.08	Construct a hasse diagram to recognize the relevant partial ordered sets from the given binary relation.
CAHS013.09	Describe the types of functions (one to one, on-to, bijective, Identity and constant function).
CAHS013.10	Implement the concept of the inverse and recursive functions to get an optimized solution for an appropriate problem.
CAHS013.11	Use the concept of lattices (Greatest Lower Bound (GLB) and Least Upper Bound (LUB) to represent a defined finite set in multi-dimension applications.
CAHS013.12	Explain about the properties and types of lattices (bounded and distributive lattice).
CAHS013.13	Construct different algebraic structures by using concepts of groups, sub groups, monoids and rings.
CAHS013.14	.Understand binomial and multinomial theorems to compute the coefficients for the given expansions.
CAHS013.15	Understand the concept of homomorphism and isomorphism of semi-groups.
CAHS013.16	Analyze the given sets by using inclusion and exclusion principle.
CAHS013.17	Identify the different counting techniques (permutations) related to mathematics and computer science.

CAHS013.18	Solve discrete probability and set problems by using permutations and combinatorics.
CAHS013.19	Identify the series of expansion to represent the sequence by using generating functions
CAIT001.20	Identify the general solution for first-order and second-order linear homogeneous recurrence relations.
CAHS013.21	Identify the roots of second and higher order linear non-homogeneous recurrence relations.
CAHS013.22	Understand the use of graphs and trees as representation tools in a variety of context.
CAHS013.23	Identify Euler's and Hamilton rule for a simple connected graph in NP-complete problems.
CAHS013.24	Construct a spanning tree by using search techniques (Depth First Search and Breadth First Search).
CAHS013.25	Construct a minimal spanning tree by using Kruskal's and Prim's algorithm in order to obtain a solution for a real time problem.
CAHS013.26	Possess the knowledge and skills for employablility and to succeed in national and international level competitive exams.

Mapping of Semester End Examinations to Course Learning Outcomes:

SEE Question No		Course Learning Outcomes		Blooms Taxonomy Level
1	a	CAHS013.03	Memorize different scientific notations to simplify the logical statements.	Remember
	b	CAHS013.04	Prepare valid arguments from the given propositional statements by using rules of inference.	Remember
2	a	CAHS013.01	Understand logical connectives and compound prepositions for building compound statements.	Understand
	b	CAHS013.02	Use the formal symbols to represent the preposition logic and predicate logic to solve problems on logical equivalences and implications.	Remember
3	a	CAHS013.05	Identify ordered pairs to form a binary relation from the given sets.	Understand
	b	CAHS013.07	Identify the properties of relations to check for equivalence relation and partial order relation and compute relations using operations on relations.	Understand
4	a	CAHS013.09	Describe the types of functions (one to one, on-to, bijective, Identity and constant function).	Remember
	b	CAHS013.08	Construct a Hasse diagram to recognize the relevant partial ordered sets from the given binary relation.	Understand
5	a	CAHS013.14	Understand binomial and multinomial theorems to compute the coefficients for the given expansions.	Understand
	b	CAHS013.17	Identify the different counting techniques (permutations) related to mathematics and computer science.	Understand
6	a	CAHS013.13	Construct different algebraic structures by using concepts of groups, sub groups, monoids and rings. Remember.	Remember
	b	CAHS013.14	Understand binomial and multinomial theorems to compute the coefficients for the given expansions. Understand	Understand
7	a	CAHS013.19	Identify the series of expansion to represent the sequence by using generating functions	Understand
	b	CAHS013.21	Identify the roots of second and higher order linear non-homogeneous recurrence relations.	Understand

8	a	CAHS013.19	Identify the series of expansion to represent the sequence by using generating functions	Understand
	b	CAHS013.14	Understand binomial and multinomial theorems to compute the coefficients for the given expansions.	Understand
9	a	CAHS013.23	Identify Euler's and Hamilton rule for a simple connected graph in NP-complete problems.	Understand
	b	CAHS013.24	Construct a spanning tree by using search techniques (Depth First Search and Breadth First Search).	Remember
10	a	CAHS013.22	Understand the use of graphs and trees as representation tools in a variety of context.	Understand
	b	CAHS013.25	Construct a minimal spanning tree by using Kruskal's and Prim's algorithm in order to obtain a solution for a real time problem..	Remember

Signature of Course Coordinator **HOD, CSE**