X/K/TY

VIT
Vellore Institute of Technology

Final Assessment Test – November 2025

Course: BMAT205L - Discrete Mathematics and Graph Theory

Class NBR(s): 0687 / 0868 / 0874 / 0886 / 0888 / 0892 / 0897 / 0899 / 0901 / 0903 / 0905 / 0906 / 0908 / 0910 / 0912 / 0915 / 0920 / 0922 / 2430 / 2454 / 2548 / 4419

Slot: C2+TC2+TCC2

Time: **Three Hours**

Max. Marks: **100**

- KEEPING MOBILE PHONE/ANY ELECTRONIC GADGETS, EVEN IN 'OFF' POSITION IS TREATED AS EXAM MALPRACTICE
- DON'T WRITE ANYTHING ON THE QUESTION PAPER

COs	CO Statements
CO1	Learn proof techniques and concepts of inference theory.
CO2	Use algebraic structures in applications.
CO3	Counting techniques in engineering problems.
CO4	Use lattice and Boolean algebra properties in Digital circuits.
CO5	Solve Science and Engineering problems using Graph theory

BL – Blooms Taxonomy Level (1 – Remember, 2 – Understand, 3 – Apply, 4 – Analyse, 5 – Evaluate, 6 – Create)

Answer ALL Questions

(10 X 10 = 100 Marks)

1. Obtain the principal disjunctive normal form and the principal conjunctive normal form for the following statement: $p \vee \left(\neg p \rightarrow (q \vee (\neg q \rightarrow r))\right)$. **CO1 BL1**

2. Use predicate calculus to prove the following agreement. **CO1 BL2**
   (i) All mammals are animals. Some mammals are two-legged. Therefore, some animals are two-legged.
   (ii) No human being are quadrupeds. All women are human beings. Therefore, no women are quadrupeds.

3. Check whether the set {5, 15, 25, 35} is a group or not with respect to multiplication module 40. If so, **CO2 BL3**
   (i) form the Cayley's table,
   (ii) find the identity element of the group,
   (iii) find the order of each element in a group,
   (iv) find the inverse of each element in a group.

4. An encoding function $e: B^3 \rightarrow B^6$ is given by the generator matrix **CO2 BL2**

$$\begin{pmatrix} 1 & 0 & 0 & 1 & 1 & 0 \\ 0 & 1 & 0 & 1 & 1 & 1 \\ 0 & 0 & 1 & 0 & 1 & 1 \end{pmatrix}.$$

   (i) Determine all code words generated by the matrix.
   (ii) Find the associated parity check matrix H.
   (iii) Use H to decode the following received words 101100, 010100.

5.a) A man has 7 relatives, 4 of them are ladies and 3 gentlemen, his wife has 7 relatives and 3 of them are ladies and 4 gentlemen. In how many ways can they invite a dinner party of 3 ladies and 3 gentlemen so that there are 3 of man's relatives and 3 of wife's relatives? CO3 BL3

OR

5.b) Use generating functions to solve the recurrence relation $4a_{n-2} - 4a_{n-1} + a_n = 4^n, n \geq 2$ with initial conditions $a_0 = 2$ and $a_1 = 8$. CO3 BL3

6. Show that every chain is a distributive lattice. Also discuss about the converse of this statement with justification. CO4 BL1

7. Obtain the product of sums canonical form in three variables of the Boolean expression $x_1 * x_2$. Simplify the following on Boolean algebra. CO4 BL1

$$f(a,b,c) = a.b.c' + a.b'.c + a.b'.c' + a'.b.c + a'.b'.c$$

8. Obtain a graph G for the following adjacency matrix. CO5 BL2

$$A(G) = \begin{bmatrix} 0 & 1 & 0 & 1 & 0 & 0 \\ 1 & 0 & 0 & 1 & 1 & 1 \\ 0 & 0 & 0 & 0 & 1 & 1 \\ 1 & 1 & 0 & 0 & 1 & 0 \\ 0 & 1 & 1 & 1 & 0 & 1 \\ 0 & 1 & 1 & 0 & 1 & 0 \end{bmatrix}$$

Also find (i) the number of vertices in G.

(ii) the number of edges in G.

(iii) the degree of each vertex of G.

(iv) the number of loops in G and

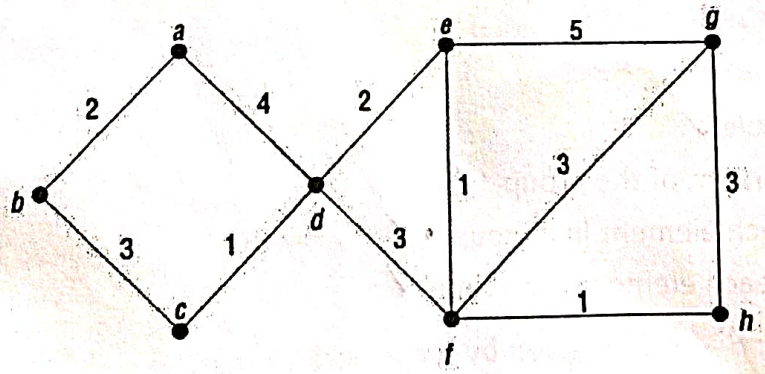
(v) the number of components in G.

9.a) Justify the statement: "Every tree has either one or two centers." Provide a suitable example to support your explanation. CO5 BL

OR

9.b) Use Prim's algorithm to find a minimum-cost spanning tree for the weighted graph shown below, starting from vertex e. Use alphabetical order to break any ties. CO5 BL

Your solution must how the final tree and its cost.



10. Explain Chromatic number and Chromatic Polynomial with an example. CO5 BL2

Prove that the chromatic polynomial of a complete graph with n vertices is $P_n(\lambda) = \lambda(\lambda-1)(\lambda-2)\ldots(\lambda-n+1)$.

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