

GUJARAT TECHNOLOGICAL UNIVERSITY

BE- SEMESTER- VII EXAMINATION – SUMMER 2026

Subject Code:3171611

Date:29-05-2026

Subject Name: Graph Theory and Combinatorics

Time: 02:30 PM TO 05:00 PM

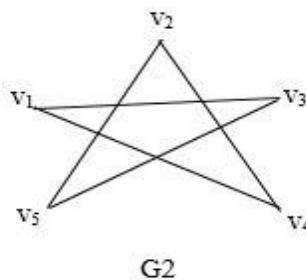
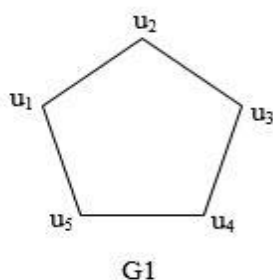
Total Marks:70

Instructions:

1. Attempt all questions.
2. Make suitable assumptions wherever necessary.
3. Figures to the right indicate full marks.
4. Simple and non-programmable scientific calculators are allowed.

MARKS

- Q.1**
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|--|------------|--|-----------|
| | (a) | Define isolated vertex, pendant vertex and a null graph. | 03 |
| | (b) | Define isomorphism. Determine whether the following pair of graphs are isomorphic. | 04 |



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| | | <p>(c) Define Hamilton cycle. How many edge disjoint Hamilton cycles exist in the complete graph with seven vertices? Also draw the graph to show these Hamilton cycles.</p> | 07 |
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| Q.2 | (a) | Draw the two simplest non-planar graphs and also mention their properties. | 03 |
| | (b) | Prove the statement, "Every circuit has an even number of edges in common with any cut-set". | 04 |
| | (c) | For a Eulerian graph G, prove the following properties. | 07 |
| | | i) The degree of each vertex of G is even. | |
| | | ii) G is an edge-disjoint union of cycles. | |

OR

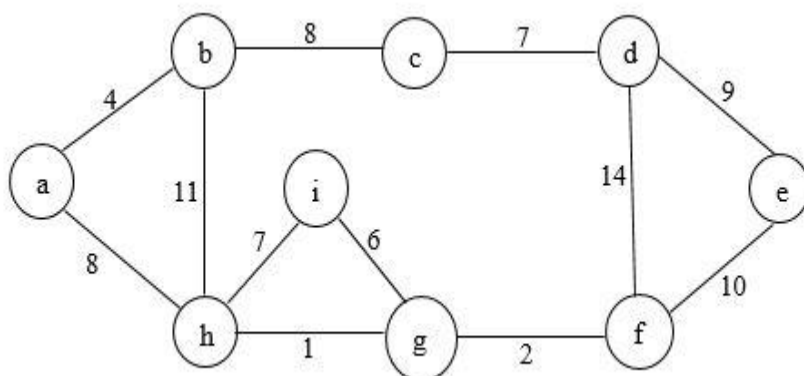
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| | | <p>(c) Define prefix code. Obtain an optimal prefix code for the message ROAD IS GOOD. Indicate the code.</p> | 07 |
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| Q.3 | (a) | How can a binary search tree be used to sort a list of elements? | 03 |
| | (b) | From seven consonants and five vowels how many sets consisting of four different consonants and three different vowels can be formed. | 04 |
| | (c) | State and Prove max-flow and min-cut Theorem. | 07 |

OR

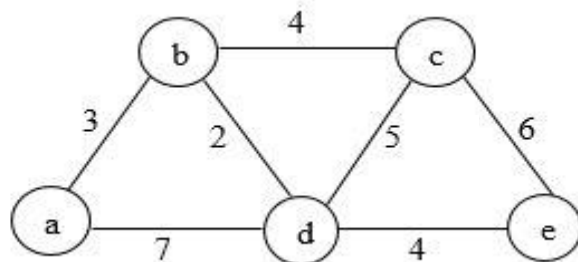
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|------------|------------|--|-----------|
| Q.3 | (a) | Define edge vertex connectivity and edge connectivity. Give the relation between them. | 03 |
| | (b) | In how many ways a team of 11 be chosen from 20 students of a class so that 2 particular students are always included and 5 are always excluded? | 04 |

[P.T.O.]

- (c) Write Kruskal's algorithm for finding minimum spanning tree. Find the minimum spanning tree for the weighted graph shown below using Kruskal's algorithm. 07



- Q.4** (a) Explain Inclusion – Exclusion Principle. 03
 (b) What is Rook Polynomial? Explain expansion formula of it. 04
 (c) Apply Dijkstra's algorithm to the digraph shown in figure and determine the shortest distance from vertex a to each of the other vertices in the graph. 07



OR

- Q.4** (a) Describe Binomial Theorem. 03
 (b) Find the number of solutions to $x_1 + x_2 + x_3 + x_4 = 20$, where $x_1 \geq -5$, $x_2 \geq 3$, $x_3 \geq 0$, $x_4 \geq 1$. 04
 (c) Explain Catalan numbers with suitable examples. 07
- Q.5** (a) Define de Bruijn graph. 03
 (b) Explain the Exponential Generating Function. 04
 (c) Solve the recurrence relation : $a_n + 4a_{n-1} + 4a_{n-2} = 8$ for $n \geq 2$ and $a_0 = 1, a_1 = 2$. 07

OR

- Q.5** (a) Define Derangements. 03
 (b) The number of bacteria in a culture is 1000 (approximately) and this number increases 250% every two hours. Use a recurrence relation to determine the number of bacteria present after one day. 04
 (c) Solve the recurrence relation : $a_n = 3a_{n-1} - 3a_{n-2}$ $n \geq 3, a_0 = a_1 = 1, a_2 = 2$ 07
