

PRN No.	Total No. of Questions: 12
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QP Code:

JSPM's
Rajarshi Shahu College of Engineering, Tathawade, Pune- 411033
(An autonomous institute affiliated to Savitribai Phule Pune University)
Examinations: End Semester (ESE) Nov/Dec24-25
Semester: I Academic Year: 2024-25
Class: F. Y. B. Tech. (CS)
Department: Engineering Sciences and Humanities

Course Code: ES1204T

Course Name and pattern: Discrete Mathematics (2023 Pattern)

Duration: 2 Hours.

Max. Marks: 50 Marks

Instructions to the Candidates

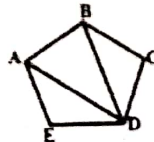
1. Attempt Q.1, Q.2 and Q.3 from section-A.
2. Attempt Q.4, Q.5, Q.6, Q.7 or Q.8, Q.9 or Q.10, Q.11 or Q.12 from section-B.
3. Figures to the right indicate full marks.
4. Assume suitable data if necessary.
5. Use of non-programmable electronics pocket calculator is allowed.

Section A

Q.1 a) In how many ways can the letters in the word 'MISSISSIPPI' be arranged [01] BL1 CO4 so that 'S' are always together?

b) Find the generating functions of the sequence 1, -1, 1, -1, 1, ... [01] BL1 CO4

Q.2 a) Determine, if the following graph is having the Eulerian circuit. Justify the [01] BL1 CO5 answer.



b) Determine the number of edges in a graph with 5 vertices out of which two [02] BL2 CO5 vertices of degree 3 and three vertices with degree 2.

Q.3 a) How many edges will be there in a tree with n nodes? [01] BL1 CO5

b) How many total numbers of vertices are there in a full 4-ary tree having 19 [02] BL2 CO5 pendant vertices?

Q.4 Solve (any one):

a) Obtain the principal conjunctive normal form (PCNF) and principal [04] BL3 CO1 disjunctive normal form (PDNF) of the statement $(\sim(p \vee q)) \leftrightarrow (p \wedge q)$ by using Truth table method.

- b) Translate each of the following statement into symbols, using quantifiers, [04] BL3 CO1
variables and predicate:
For the universe of all integers.

- i) There exists a positive integer that is even.
- ii) If x is even then x is not divisible by 7.

Q.5 Solve (any one):

- a) Let M_R be the matrix representation of a partial ordered relation R defined [04] BL3 CO2
on set $A = \{a, b, c, d, e\}$

$$M_R = \begin{bmatrix} 1 & 0 & 1 & 1 & 1 \\ 0 & 1 & 0 & 1 & 1 \\ 0 & 0 & 1 & 1 & 1 \\ 0 & 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 0 & 1 \end{bmatrix}.$$

Draw its Hasse diagram and also find its maximal elements.

- b) Let f and g be the functions from the set of all real numbers to real numbers [04] BL3 CO2
defined by $f(x) = x - 1$ and $g(x) = x^2$. Find
(i) $(f \circ g)(x)$ (ii) $(g \circ f)(x)$ (iii) $(g \circ f)(2)$
(iv) $(f \circ g)(2)$

Q.6 Solve (any one):

- a) Show that the set Q^+ of all positive rational numbers forms an abelian [04] BL3 CO3
group under the operation $*$ defined by $a * b = \frac{ab}{3}$, $a, b \in Q^+$.

- b) Given the parity check matrix $H = \begin{bmatrix} 1 & 1 & 0 & 1 & 0 & 0 \\ 0 & 1 & 1 & 0 & 1 & 0 \\ 1 & 0 & 1 & 0 & 0 & 1 \end{bmatrix}$ corresponding to [04] BL3 CO3
the encoding function $e: B^3 \rightarrow B^6$, use it to decode the following received
words and hence, to find the original message.

- i) 111001
- ii) 100101.

- Q.7 a)** In a box, there are 40 pen drives of which 4 are defective. Determine [05] BL3 CO4

- i) In how many ways we can select five pen drives?
- ii) In how many ways we can select five non defective pen drives?
- iii) In how many ways we can select five pen drives containing exactly three defective pen drives?

- b) Solve the recurrence relation

$$a_n - a_{n-1} - 2a_{n-2} = 4, \text{ where } a_0 = -1 \text{ and } a_1 = 3.$$

[05] BL3 CO4



OR

[05] BL3 CO4

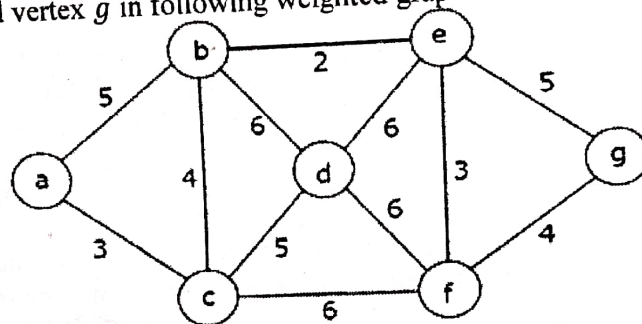
- Q.8 a) Use mathematical induction to prove that

$$\sum_{i=1}^n i = 1 + 2 + 3 + \dots + n = \frac{n(n+1)}{2}$$
 for all integers $n \geq 1$
 b) Solve the recurrence relation
 $a_n = -10a_{n-1} - 25a_{n-2} + 72$, where $a_0 = 3$ and $a_1 = 17$.

[05] BL3 CO4

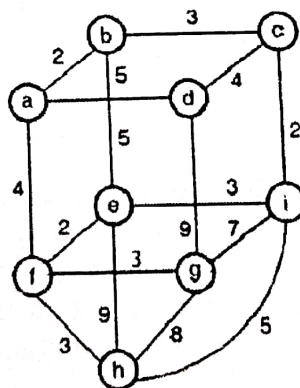
- Q.9 a) Determine whether the graphs K_7 and $K_{3,4}$ are isomorphic or not. Justify the answer. [05] BL3 CO5

- b) Use Dijkstra's algorithm, to find the shortest path and its length between vertex a and vertex g in following weighted graph. [05] BL3 CO5

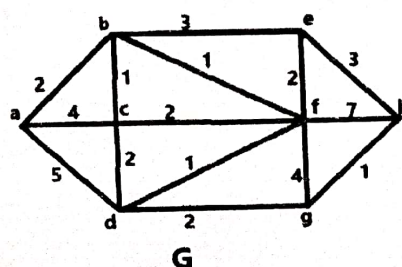


OR

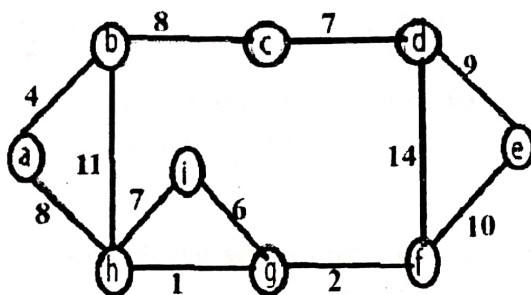
- Q.10 a) Find the solution to the travelling salesman problem for the following figure using nearest neighbor method, starting vertex h . [05] BL3 CO5



- b) Use Dijkstra's algorithm, to find the shortest path and its length between vertex a and vertex h in following weighted graph G . [05] BL3 CO5



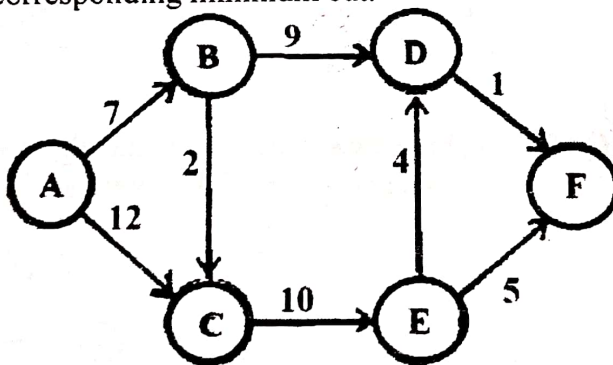
- Q.11 a)** Find the minimal spanning tree and its minimum weight using Kruskal's [05] BL3 C05 algorithm.



- b)** A file contains the string "ENGINEERING". If Huffman Coding is used for [05] BL3 C05 data compression, then determine
- Huffman Code for each character
 - Average code length
 - Length of Huffman encoded message (in bits).

OR

- Q.12 a)** Find maximum flow in the transport network using labeling procedure. [05] BL3 C05 Determine the corresponding minimum cut.



- b)** A file contains the string "DATAANALYST". If Huffman coding is used [05] BL3 C05 for data compression, then determine
- Huffman Code for each character.
 - Average code length.
 - Length of Huffman encoded message (in bits).