Course Code	**:**	**MCS-212**
Course Title	**:**	**Discrete Mathematics**
Assignment Number	**:**	**MCA_NEW(I)/212/Assign/2026**
Maximum Marks	**:**	**100**
Weightage	**:**	**30%**
Last Dates for Submission	**:**	**30th April 2026 (for January Session)** **31st October 2026 (for July Session)**

This assignment has twenty questions of 80 Marks; all questions carry equal marks i.e. 4 marks. Answer all questions. Rest 20 marks are for viva voce. You may use illustrations and diagrams to enhance the explanations. Please go through the guidelines regarding assignments given in the Programme Guide for the format of presentation.

Q1: Use Mathematical Induction to prove that : $1^2 + 2^2 + \ldots\ldots\ldots + n^2 = n(n+1)(2n+1)/6$

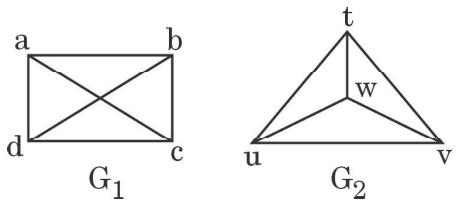
Q2: How many different permutations are possible of the letters, taken all at a time, of the word: ASSESSES?

Q3: A die is rolled once. What are the probabilities of the following events:

a. Gettinganoddnumber
b. Gettingatleastavalue2
c. Gettingatmostavalue2
d. Gettingatleast7

Q4: Draw a hypercube graph Q_3(also called the cubical hypercube). Check whether the hypercube Q3 is Hamiltonian

Q5: What is isomorphism? Find, if the following graphs G_1 and G_2 are isomorphicornot. Explain how you arrived at your answer.



Q6: What is a finite automata ? Why is it needed? How is a finite automata represented?. Also explain the term regular expression with the help of an example.

Q7: Differentiate between

a. Deterministic and Non-deterministic finite automata
b. Deterministic and Non-deterministic Turing Machine
c. Moore and Mealy Machine

Q8: Describe the divide-and-conquer approach to solve recurrences ? Explain how this approach can be used toapplybinarysearchinasortedlist.

Q9: What is proposition ? Explain with the help of an example. Explain Disjunction and Conjunction with the help of truth table for each.

Q10: Prove the following theoremby direct proof method: ‘‘The squareofanevenintegerisaneven integer.’’

Q11: Given the Boolean expression$(a' \vee (b \wedge c')) \vee (b \vee d')$,draw the corresponding circuit, where a, b, c and d

are the inputs to the circuitry.

Q12: Define the terms Domain, Co-domain and Range in the context of a function. Also find the domain, co-domain and range for a function A to B , where A={1,2,3,4}and B={1,4,9,16,25}.

Q13: A committee consisting of 2 male and 2 female workers is to be constituted from 8 male and 9 female workers. In how many distinct ways can this be done?

Q14: In a tennis tournament, each entrant plays a match in the first round. Next, all winners from the first round play a second-round match. Winners continue to move on to the next round, until finally only one player is left as the tournament winner. Assuming that tournaments always involve $n = 2^k$ players, for some k, find the recurrence relation for the number rounds in a tournaments of n players.

Q15: Show, using the pigeonhole principle, that in any group of 30 people, 5 people can always be found who were born on the same day of the week.

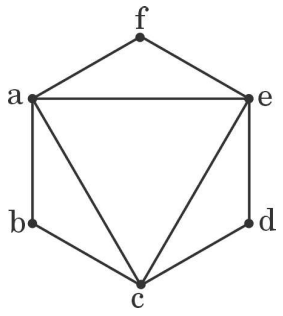
Q16: Define the following in the context of graph, with the help of an example:

a. Complete graph
b. Degree of a vertex
c. Cycle
d. Path
e. Circuit

Q17: What is a bipartite graph ? Explain with the help of an example. Give one or two applications of bipartite graphs.

Q18: How Hamiltonian graphs differ from the Eulerian graphs? Give Dirac's and Ore's criterion for the Hamiltonian graphs.

Q19: Differentiate between Eulerian graph and Eulerian circuit.Find the Eulerian circuit in the graph given below(if it exists).



Q20: Write Short notes on following.

a. Travelling Salesman Problem
b. Vertex Coloring
c. Edge Coloring
d. Planar graphs
e. Pascal's Formula

Q1: Use Mathematical Induction to prove that : $1^2 + 2^2 + ... + n^2 = n(n+1)(2n+1)/6$

Answer

Let P(n) be the statement $1^2 + 2^2 + ... + n^2 = n(n+1)(2n+1)/6$. We prove P(n) for every positive integer n by mathematical induction.

Base case

For n = 1, the left-hand side is $1^2 = 1$. The right-hand side is $1(1+1)(2\times1+1)/6 = 1\times2\times3/6 = 1$. Hence P(1) is true.

Induction step

Assume P(k) is true for some positive integer k. Thus, $1^2 + 2^2 + ... + k^2 = k(k+1)(2k+1)/6$. We must show that P(k+1) is true.

$1^2 + 2^2 + ... + k^2 + (k+1)^2 = k(k+1)(2k+1)/6 + (k+1)^2$

$= (k+1)[k(2k+1) + 6(k+1)]/6 = (k+1)(2k^2+7k+6)/6$

$= (k+1)(k+2)(2k+3)/6 = (k+1)[(k+1)+1][2(k+1)+1]/6.$

Therefore P(k+1) is true whenever P(k) is true. Since the base case is true, by mathematical induction the formula holds for all positive integers n.

Q2: How many different permutations are possible of the letters, taken all at a time, of the word: ASSESSES?

Answer

The word ASSESSES has 8 letters. Their repetitions are: A occurs once, E occurs twice and S occurs five times. If all letters were different there would be 8! arrangements, but arrangements obtained by interchanging identical E's or identical S's are not new.

Therefore, number of distinct permutations = $8!/(5! \times 2!) = 40320/(120 \times 2) = 40320/240 = 168$.

Hence, the word ASSESSES can be arranged in 168 different ways.