

Satyug Darshan Institute of Engineering & Technology, Faridabad

Department of Computer Science

Academic year 2025-26

Programme: BCA DS/ GEN	Year & Semester: 1 st Year, Sem I
Course Name: Mathematics Foundations to Computer Science - I	Course Code: BCG-101-V1
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Unit I

Short answer questions

Q.N.	Question	KL
1	If $A = \{3,6,9,12,18,21\}$ and $B = \{4,8,12,16,20\}$. Find $(A \cap B)$ and $(B - A)$.	KL3
2	Write the given set in Roster form $B = \{x: 4x-3 < 6, x \in \mathbb{N}\}$.	KL3
3	Let $A = \{2,3,4\}$ and $B = \{3,6,8\}$. Find R where R is the relation 'x divides y' from set A to set B. Also, find R^{-1} .	KL3
4	If $f: \mathbb{R} \rightarrow \mathbb{R}$ is defined by $f(x) = 3x^2 - 8x + 1$, find $f(f(x))$.	KL3
5	Write the difference between Antisymmetric Relation and Asymmetric Relation.	KL2
6	Define Cartesian Product of sets with example.	KL1
7	Let $A = \{1,2,3,4\}$. Then investigate the following relation for reflexive, symmetric, anti-symmetric or transitive where $R = \{(1,1), (2,1), (2,2), (2,3), (2,4), (3,1), (3,2), (3,3), (3,4)\}$	KL3
8	Explain one-to-one and onto function?	KL2
9	If $A = \{1,2,3\}$, $B = \{3,4\}$ and $C = \{4,5,6\}$, determine the $A \times (B \cup C)$	KL3
10	Represent $A \cup B \cup C$ with the help of Venn diagram.	KL2

Long answer questions

Q.N.	Question	KL
1	Determine whether the relation R in the set $A = \{4,5,6,7\}$ and defined as $R = \{(4,5), (5,4), (7,6), (6,7), (5,5), (6,6)\}$ is reflexive, symmetric, transitive or antisymmetric.	KL3
2	If $A = \{1,2,3,4,5\}$, $B = \{4,5,6,7\}$, $C = \{5,6,7,8,9\}$, $D = \{1,3,5,7,9\}$, $E = \{2,4,6,8\}$, $F = \{1,5,9\}$. Find out: (i) $A \cup B$ and $A \cap B$ (ii) $C \cup D$ and $C' \cap B$ (iii) $A \cap (B \cup E)$ (iv) $(B \cap F) \cup (C \cap E)$	KL3
3	If $f: \mathbb{R} \rightarrow \mathbb{R}$; $f(x) = \frac{4x-3}{5}$; Show that f is one- one and onto function and hence find out its inverse.	KL3
4	Let $A = \{1,2,3,4,6,8,9,12,18,24\}$ be ordered by a relation "x divides y". Determine whether the Relation R is reflexive, symmetric, transitive or antisymmetric.	KL3
5	Explain Partial Order Relation and Equivalence Relation.	KL2
6	(a) If $f(x)$ and $g(x)$ be the function from the set of integers defined as $f(x) = 2x^2 + 2$ and $g(x) = 3x^2 + 3$ then determine the following: (i) fog (ii) gof	KL3

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7	In a class of 1000 students, 625 students pass in Mathematics and 525 pass in English. How many students pass in Mathematics only and how many students pass in English only?	KL3
8	In a pollution study of 200 cities has revealed the following report, 70 were polluted by Sulphur compounds, 60 were polluted by lead and 80 were polluted by fly ash, 40 were polluted by Sulphur and fly ash, 30 were polluted by Sulphur and lead, 35 were polluted by lead and fly ash and 10 cities were polluted by all three compounds. Then find: (i) How many were polluted by one of the three impurities? (ii) How many cities are only Sulphur, lead and fly ash? (iii) How many of the cities are not polluted at all?	KL3
9	If $A = \{a, b\}$, $B = \{c, d\}$ and $C = \{e, f\}$. Show that $A \times B \neq B \times A$. Also, find $(A \times B) \cup (A \times C)$.	KL3
10	State and Prove Demorgan's law and Distributive law.	KL3
11	Let $A = \{4, 6, 8, 10\}$ and $R = \{(4, 4), (4, 10), (6, 6), (6, 8), (8, 10)\}$ is a relation on set A. Determine the transitive closure of R using Warshall's Algorithm.	KL3

Unit II

Short answer questions

Q.N.	Question	KL
1	Find the value of a_4 for the recurrence relation: $a_n = 2a_{n-1} + 3$ with $a_0 = 6$.	KL3
2	Define Recursion.	KL1
3	How many 11 letter words can be formed using letters from the word "INSTITUTION"?	KL3
4	Differentiate between Homogenous and Non-Homogenous recurrence relations.	KL3
5	Find the number of ways that a party of seven persons can arrange themselves around a circular table.	KL3
6	In how many ways can a committee consisting of three man and two women be chosen from seven men and five women?	KL3
7	In a group of 50 people, how many minimum number of people have their birthday in the same month?	KL3
8	Three red balls are to be placed in ten distinguishable boxes but one box can contain exactly one ball. Find the number of distinct ways in which the balls are to be placed?	KL3
9	If $P(n, 4) = 20 \cdot P(n, 2)$. Find out n.	KL3
10	If ${}^nC_8 = {}^nC_6$. Find out nC_2	KL3
11	Expand $(x^2 + 2y)^6$.	KL3
12	Explain The Tower of Hanoi Problem	KL2

Long answer questions

Q.N.	Question	KL
1	Find the homogenous solution of the differential equation $4F_n - 20F_{n-1} + 17F_{n-2} - 4F_{n-3} = 0$.	KL3
2	What is linear recurrence relation? What are different scenarios that need to be considered while finding roots?	KL2
3	Solve the following recurrence: $t_n = 5t_{n-1} - 8t_{n-2} + 4t_{n-3}$ for $n \geq 3$ subject to the initial conditions $t_n = n$ if $n=0, 1$ and 2 .	KL3

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4	Hemant deposits Rs. 10,000 in a saving account at bank. The annual interest rate of bank is 9%. Define recurrence relation to compute the amount A_n Hemant will have in his account at the end of n th years.	KL3
5	Give recurrence definition of the following sequence: (i) $1, 5, 5^2, 5^3, 5^4, \dots$ (ii) $5, 3, 1, -1, -3, \dots$ (iii) $16, 8, 4, 2, 1, 1, 1, \dots$ (iv) $1, 3, 7, 15, 31, 63, \dots$	KL3
6	Solve the second order Homogenous Recurrence Relation: $a_n = 6a_{n-1} - 9a_{n-2}$ where $a_0 = 1, a_1 = 1$.	KL3
7	Seven women and nine men are faculty in mathematics department in a university. In how many ways a committee of five members of the department can be constructed if at least one woman and at least one man must be in the committee?	KL3
8	State Pigeon hole principle. Find the minimum number of students in a class to be sure that three of them are born in the same month.	KL3
9	In how many ways 5 boys and 3 girls can be seated in a row so that no two girls are together.	KL3
10	Find the coefficient of x^{40} in the expansion of $(1+x)^{54}$.	KL3
11	Find the 6 th term in the expansion of $\left(\frac{4x}{5} - \frac{5}{2x}\right)^9$	KL3
12	Using the binomial theorem, expand $[(x+y)^5 + (x-y)^5]$ and hence find the value of $[(\sqrt{2}+1)^5 + (\sqrt{2}-1)^5]$.	KL3
13	Find the middle term of the expansion $(x^2 + \frac{1}{x})^9$ and $(x - \frac{1}{2y})^{10}$	KL3
14	Find the particular solution of the difference equation $a_n - 4a_{n-1} + 5a_{n-2} = 2$. Hence, find the total solution of this recurrence relation.	KL3
15	Find the total solution of the recurrence relation $a_{r+2} - 4a_{r+1} + 5a_r = 5^r$.	KL3
16	Find the total solution of the recurrence relation $a_n - a_{n-1} - 2a_{n-2} = 2n^2$.	KL3

Unit III

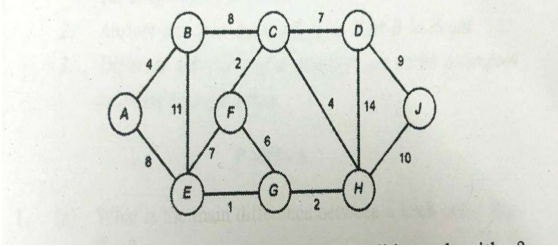
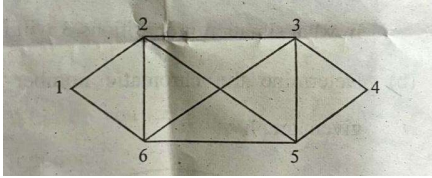
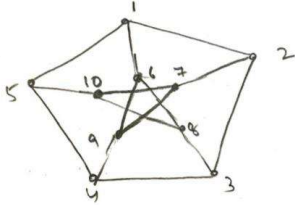
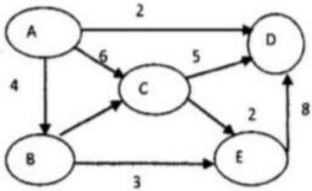
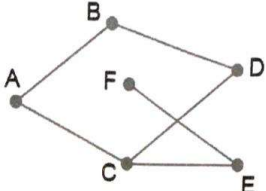
Short answer questions

Q.N.	Question	KL
1	How do you calculate degree of a vertex in an undirected graph?	KL2
2	Differentiate between path and circuit.	KL2
3	Explain Planar Graph and Non-Planar Graph?	KL2
4	Define weighted and un-weighted Graph?	KL1
5	Explain Euler Formula with example.	KL2
6	List the applications of trees.	KL2
7	Differentiate between graph and Tree.	KL2
8	What do you mean by Connected Directed Graph?	KL2
9	What do you mean by rooted and non-rooted tree?	KL2

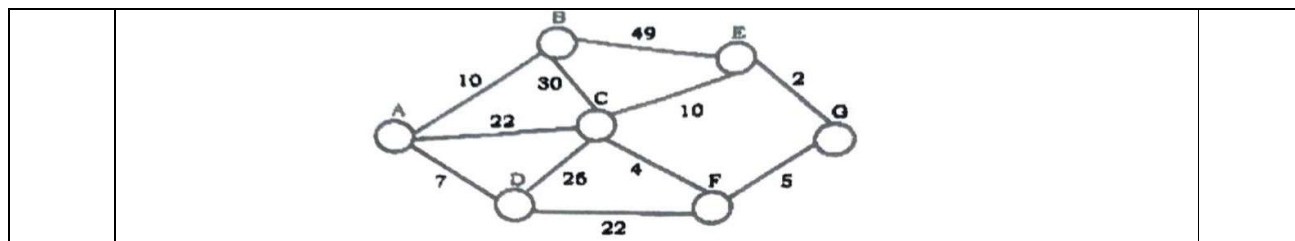
Long answer questions

Q.N.	Question	KL
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1	Discuss the key characteristics of trees. Find the minimum weight spanning. 	KL3
2	Define the following terms with suitable example: (a) Hamiltonian Graph (b) Regular Graph (c) Bipartite Graph (d) Self-complementary Graphs (e) Handshaking Lemma (f) Eulerian Graph (g) Complementary Graph (h) Complete Graph (i) Complete Bipartite Graph	KL2
3	Find the Eulerian Path in the given graph. 	KL3
4	Consider the following simple graph and find whether it is a Hamiltonian graph or Euler graph or both. 	KL3
5	Draw the Minimum Spanning tree for following graph: 	KL3
6	Write down the adjacent and incidence matrices for the given graph. 	KL2
7	Define trees. Find the minimum weight spanning tree for the following graph using prim's algorithm? Consider 'C' as the source vertex.	KL3

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Unit IV

Short answer questions

Q.N.	Question	KL
1	Find the rank of the matrix $A = \begin{bmatrix} 1 & 1 & 2 \\ 1 & 2 & 2 \\ 2 & 2 & 3 \end{bmatrix}$.	KL3
2	State Cayley Hamilton's Theorem.	KL1
3	Write a 2×2 matrix $A = [a_{ij}]$ whose elements are given by $a_{ij} = \frac{(i+j)^2}{2}$.	KL2
4	Find k for which the matrix $A = \begin{bmatrix} 2k+3 & 4 & 5 \\ -4 & 0 & -6 \\ -5 & 6 & -2k-3 \end{bmatrix}$ is skew symmetric.	KL3
6	Define symmetric and skew-symmetric matrix with examples.	KL1
7	Find the Eigen value of the given matrix $A = \begin{bmatrix} 1 & -2 \\ -5 & 4 \end{bmatrix}$.	KL3
8	Prove that the given matrix $\frac{1}{3} \begin{bmatrix} 1 & 2 & 2 \\ 2 & 1 & -2 \\ 2 & -2 & 1 \end{bmatrix}$ is orthogonal.	KL3
9	Find out the sum and product of Eigen values of $B = \begin{bmatrix} 2 & 3 & -2 \\ -2 & 1 & 1 \\ 1 & 0 & 2 \end{bmatrix}$.	KL3
10	Define Rank of a matrix.	KL1

Long answer questions

Q.N.	Question	KL
1	Find the Eigen values and Eigen vectors of the matrix $\begin{bmatrix} 8 & -6 & 2 \\ -6 & 7 & -4 \\ 2 & -4 & 3 \end{bmatrix}$	KL3
2	Verify Cayley- Hamilton Theorem for the matrix $A = \begin{bmatrix} 2 & -1 & 1 \\ -1 & 2 & -1 \\ 1 & -1 & 2 \end{bmatrix}$. Also, Find A^{-1} .	KL3
3	Test the consistency and solve $5x + 3y + 7z = 4$, $3x + 26y + 2z = 9$, $7x + 2y + 10z = 5$.	KL3
4	If $A = \begin{bmatrix} 0 & a & b \\ -a & 0 & c \\ -b & -c & 0 \end{bmatrix}$, then show that the matrix is skew symmetric. Also, find $\frac{1}{2}(A - A')$ and $\frac{1}{2}(A + A')$.	KL3

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5	If $A = \begin{bmatrix} 0 & 3 \\ -2 & 5 \end{bmatrix}$, then find k such that $kA^2 = 5A - 6I$.	KL3
6	Determine the Rank of the given matrix $\begin{bmatrix} 1 & 2 & 3 \\ 3 & 4 & 6 \\ 4 & 5 & 6 \end{bmatrix}$.	KL3
7	Find out the inverse of the matrix $C = \begin{bmatrix} 3 & -3 & 4 \\ 2 & -3 & 4 \\ 0 & -1 & 1 \end{bmatrix}$.	KL3