B.Sc. 2nd Semester (Honours) Examination, 2019 (CBCS)

Subject : Computer Science

Paper : CC-4

(Discrete Structure)

Time: 4 Hours **Full Marks: 60**

The figures in the margin indicate full marks.

Candidates are required to give their answers in their own words as far as practicable.

1. Answer *any ten* questions from the following: 2×10=20

(a) What is onto function? Give example.

(b) If $A = \{x \mid x \leq 5\}$ then find $A \times A$.

(c) Show that $n^2 > 2n + 1$ for all $n \geq 3$ by mathematical induction.

(d) Define CNF. Find CNF of $p \leftrightarrow q$.

(e) What is recurrence tree? Give example.

(f) What is chromatic number of a graph? Give example.

(g) In how many ways can 5 programmers and 3 software engineers sit around a table so that no two software engineers are together?

(h) What are the order of the following recurrences:

(i) $a_n = -2a_{n-1}$

(ii) $a_n = 3a_{n-1} - 2a_{n-2}$

(i) What is Hamiltonian path? Give example.

(j) What is homomorphic graph? Give example.

(k) What is Eulers Graph? Give example.

(l) What is Incidence matrix? Give example.

(m) What is complement of a graph? Give example.

(n) What is bipartite graph? Give example.

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2. Answer *any four* questions from the following: 5×4=20

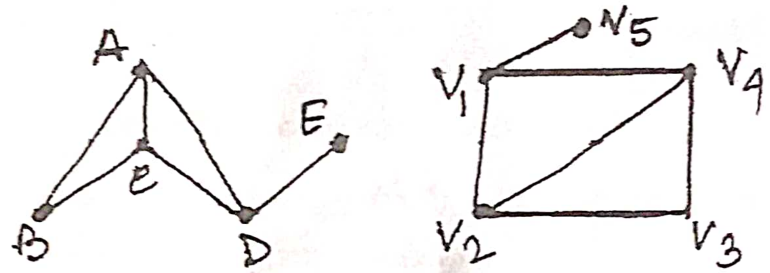
(a) Solve the recurrence $a_{n+2} - 5a_{n+1} + 6a_n = 2$ with initial condition $a_0 = 1$ and $a_1 = -1$.

(b) Obtain the PDNF of $(p \wedge q) \vee (\neg p \wedge r) \vee (q \wedge r)$ using law of proposition.

(c) Convert into dual of the following proposition:

$\neg (p \vee q) \wedge (p \vee \neg (q \wedge \neg s))$

(d) Examine whether the following two graphs are isomorphic or not:



(e) Prove that $max\{f(n), g(n)\} = (\text{H}) \big(f(n) + g(n)\big)$.

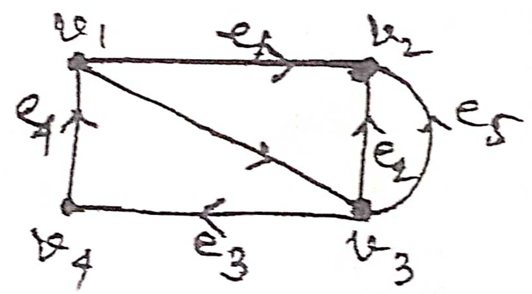
(f) If the two function $f: R \to R$ and $g: R \to R$ be defined by $f(x) = 3x + 2$ and $g(x) = x^2 + 1$, then find $f o g$ and $g o f$.

3. Answer *any two* of the following: 10×2=20

(a) (i) Draw the graph whose incidence matrix is given below:

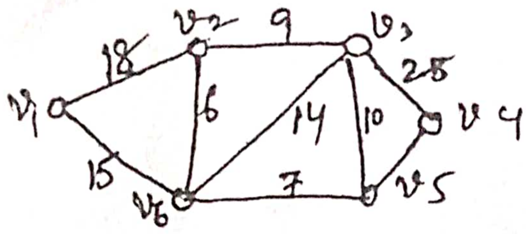
$$\begin{pmatrix} 0 & 0 & 1 & -1 & 1 \\ -1 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 \\ 1 & 0 & 0 & 0 & -1 \\ 0 & -1 & 0 & 0 & 0 \\ 0 & 1 & -1 & 1 & 0 \end{pmatrix}$$

(ii) Find the incidence matrix of the following graph: 5+5=10



(b) (i) If a simple regular graph has n vertices and 24 edges, find all possible values of n.

(ii) Apply Dijkstra's Algorithm to find the shortest path from the vertex v_1 to v_4 in the following simple graph: 4+6=10



(c) (i) Using rules of inference, show that $s \vee r$ is tautologically implied by $p \vee q, p \rightarrow r, q \rightarrow s$.

(ii) Solve the recurrence $T(n) = 3T(^{n}/_{4}) + n lg\, n$ using Master's theorem. 5+5=10

(d) (i) Use a recursion tree to solve the recurrence $T(n) = T(\alpha n) + T((1-\alpha)n) + n$ where α is a constant in the range $0 < \alpha < 1$.

(ii) Show that the tree with n vertices has $(n-1)$ edges. 5+5=10

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B.Sc. (H) Semester -II Examination 2022 (CBCS)
Subject: Computer Science
Paper: CC-4 (Discrete Structure)

Time: 3 Hours **Full Marks: 60**

The figures in the margin indicate full marks
Candidate are required to give their answer in their own words as far as practicable

1. Answer any 10 (ten) questions **10 x 2 =20**

a) Give example of an equivalence relation on the set of positive integers.

b) Define Big-Ω notation. Give example.

c) Define Graph Isomorphism. Give example.

d) How many ways are there to select five players from a 10-member tennis team?

e) Consider set A= {1, a, 2, b}. Find power set P(*A)*.What is the cardinality of *P(A)?*

f) Consider two simple propositions: *p* and *q*. State truth tables of $p \leftrightarrow q$ *and* $p \rightarrow q$.

g) "***The number of vertices of odd degree in a graph is always even***" – True or False? Justify.

h) "***There is one and only one path between every pair of vertices in a tree T***" – True of False? Justify.

i) Check whether the graphs K_5 *and* $K_{3,3}$ are planar or not.

j) "***The chromatic number of a planar graph G is 4***" -- Explain the statement with example.

k) Using Venn diagram show : i) A U B, ii) A ∩ B, iii) A^c , iv) A - B

l) Consider set A={1,2,3} and set B={x,y,z} and relation R= {(1,y), (1,z), (3,y)} on A x B. Find R^{-1} .

m) State the Master Theorem.

n) Define branch and chord of a spanning tree in a graph. Give example.

o) How many permutations of the letters *ABCDEFGH* contain the string *ABC*?

2. **Answer any 4 (four) questions** **4 x 5= 20**

a) State and proof The HANDSHAKING Theorem. 5

b) Consider a set A= {*1,2,3,4*}. Give example of reflexive, symmetric, asymmetric, and transitive and equivalence relations on set A. 5

c) Solve the recurrence relation : $a_n = 6a_{n-1} - 9a_{n-2}$ 5

d) Consider the proposition p → q. Find its logical equivalence. 5

e) Proof "***A connected graph G is an Euler graph iff it can be decomposed into circuits***". 5

f) Explain the functions with example: injective, surjective. (2.5 + 2.5) =5

3. **Answer any 2 (two) questions** **2 x10 =20**

a) Given the recurrence relation $f_n = f_{n-1} + f_{n-2}$ of Fibonacci series, find an explicit formula. 10

b) Discuss the adjacency matrix and incidence matrix representation of graph. State and prove the Generalized Pigeonhole Principle. (5+5)

c) In a survey of 120 people, it was found that :
65 read magazine M1, 45 read magazine M2, 42 read magazine M3, 20 read both M1 and M2, 25 read both M1 and M3, and 15 read both M2 and M3.
 i) Find the number of people who read at least one of the three magazines. 5
 ii) Find the number of people who read exactly one magazine. 5

d) Explain the *Königsberg* Bridge problem with suitable diagrams. 10

B.Sc. 2nd Semester (Honours) Examination, 2023 (CBCS)

Subject : Computer Science

Course : CC-IV

Discrete Structures

Time: 3 Hours **Full Marks: 60**

The figures in the margin indicate full marks.
Candidates are required to give their answers in their own words as far as practicable.

1. Answer *any ten* questions from the following: 2×10=20

(a) What is the chromatic number of a graph?

(b) How many edges are there in graph K_5 and N_6?

(c) Define tautology and contingency.

(d) What are disjoint sets? Give example.

(e) Find the value of a_4 for the recurrence relation, $a_n = 2a_{n-1} + 3$, given $a_0 = 6$.

(f) A graph G contains x vertices and y edges. Find the total number of sub-graphs of G.

(g) What is the Substitution method for solving recurrences?

(h) How many words can be formed using 4 letters from the word "BENGALURU"?

(i) "Graph K_n is always regular of degree $n-1$". Justify the statement.

(j) What is Recurrence Relation?

(k) How many numbers between 1 and 1000, including both, are divisible by 3 or 4?

(l) Given, X = {a, b, c, d} and Y = {f, b, d, g}, determine the value of X – Y and Y – X.

(m) A connected planar graph G has n vertices and e edges, find the number of regions.

(n) Given S = {1, 3, 5, 7, 9, 4}, find the total number of proper subsets.

(o) Define Cut-Vertex using example.

2. Answer *any four* questions from the following: 5×4=20

(a) Discuss the various asymptotic notations in detail.

(b) What are the necessary conditions for two graphs to be isomorphic? What is a spanning tree? 3+2

(c) State the Generalized Pigeonhole principle. In how many ways can a group of 5 members be formed by selecting 3 boys out of 6 boys and 2 girls out of 5 girls? 2.5+2.5

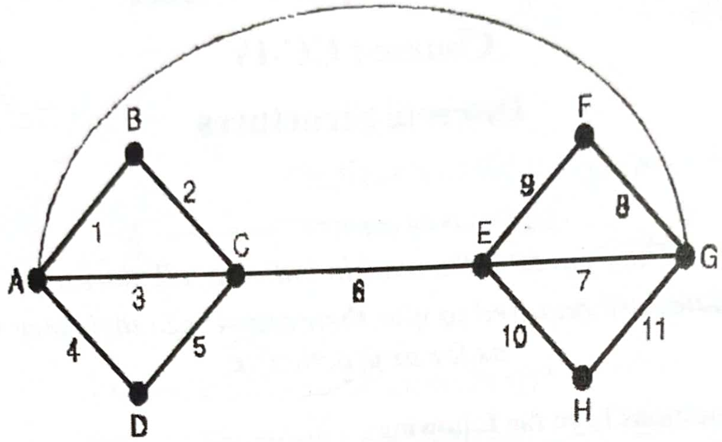
(d) Verify De Morgan's first and second law using truth tables. 2.5+2.5

(e) What are generating functions? Find the generating function for the following 2, 6, 18, 54, 162 ... 1+4

(f) Check whether $((\sim p) \leftrightarrow (q \lor (p \land \sim r))) \rightarrow (\sim q)$ is valid. 5

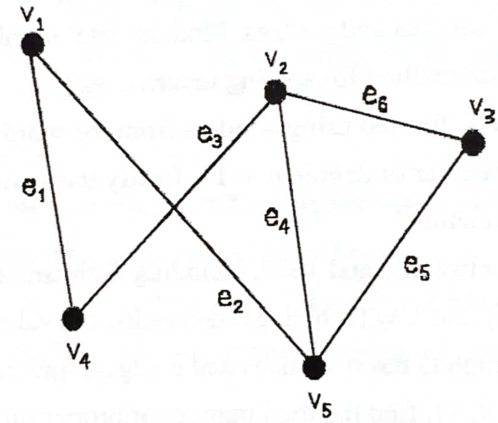
3. Answer *any two* questions from the following: 10×2=20

(a) What is a Hamiltonian path? Find the Euler Circuit for the following graph: 2+8



(b) What are the 3 cases of the master theorem? Solve the following recurrence relation using Master's theorem, $T(n) = 3T\left(\frac{n}{2}\right) + n^2$. 5+5

(c) A complete graph is always a connected graph but a connected graph is not always a complete graph. Justify the statement. A Null graph only consists of isolated nodes. Justify the statement. Write the Incidence matrix for the given graph. 4+3+3



(d) Discuss Identity, Inverse, Reflexive, Symmetric and Transitive relation using examples. Show that $(p \rightarrow q) \wedge (q \rightarrow p)$ is logically equivalent to $p \leftrightarrow q$. 7+3