TDC (CBCS) Odd Semester Exam., 2020
held in March, 2021

COMPUTER APPLICATION

(1st Semester)

Course No. : BCACC–102T

(Discrete Structures)

Full Marks : 70
Pass Marks : 28

Time : 3 hours

The figures in the margin indicate full marks for the questions

SECTION—A

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

(a) What is compound proposition? Give example.

(b) When are two propositions said to be logically equivalent?

(c) What are universal and existential quantities? Give examples.

(d) What are normal forms? Define the different types of normal forms.

(e) Give examples of relations R on $A = \{1, 2, 3\}$ with (i) R being both symmetric and antisymmetric and (ii) R being neither symmetric nor anti-symmetric.

(f) Explain with example equivalence relation.

(g) What are grammar and language? Give examples.

(h) What are Polish and Reverse Polish notations? Give examples.

(i) Define POSET with example.

(j) Differentiate between bounded and distributed lattice.

(k) What is Hasse diagram? Why is it used?

(l) Define sum of product and product of sum with example.

(m) Differentiate between path and circuit.

(n) Draw a complete graph with 5 and 6 vertices.

(o) What are planar and bipartite graphs? Give examples.

(p) Write down the properties of a tree.

(q) Define cut sets and cut vertices with example.

(r) How to define centre of tree?

(s) What is rooted binary tree?

(t) Write down the difference between Eulerian and Hamiltonian graphs.

SECTION—B

Answer *any* **five** questions

2. (a) Show that

$$\alpha = (P \Rightarrow (Q \Rightarrow R)) \Rightarrow ((P \Rightarrow Q) \Rightarrow (P \Rightarrow R))$$

is a tautology. 2

(b) Show that

$$(P \Rightarrow Q) \wedge (R \Rightarrow Q) \equiv (P \vee R) \Rightarrow Q$$ 3

(c) Express the following sentences involving Predicates in symbolic form : 1×5=5

All students are clever.

Some students are not successful.

Every clever student is successful.

There are some successful students who are not clever.

Some students are clever and successful.

3. *(a)* Define converse, contrapositive and inverse. Show that contrapositives are logically equivalent, i.e.,

$$\neg Q \Rightarrow \neg P \equiv P \Rightarrow Q$$ 3+2=5

(b) Test the validity of each argument : 5

If it rains today, then we will not have a party today

If we do not have party today, then we will have a party tomorrow

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Therefore, if it rains today, then we will have a party tomorrow

4. *(a)* In a group of 1000 people, there are 750 who can speak Hindi and 400 who can speak Bengali.

(i) How many can speak Bengali only?

(ii) How many can speak Hindi only?

(iii) How many can speak both? 3

(b) Prove that

$$A \cap (B - C) = (A \cap B) - (A \cap C)$$ 3

(c) Given $f(x) = 2x + 3$ and $g(x) = 3x + 2$. Check if commutative law holds good for composition of functions. 4

5. *(a)* Which of the following relations on {1, 2, 3, 4} is symmetric and transitive? 4

(i) R_1 = {(1, 1), (1, 2), (2, 1), (2, 2), (3, 4), (4, 1), (4, 4)}

(ii) R_2 = {(1, 1), (1, 2), (1, 4), (2, 1), (2, 2), (3, 3), (4, 1), (4, 4)}

(iii) R_3 = {(1, 2), (2, 3), (1, 3), (2, 4), (4, 3)}

(iv) R_4 = {(1, 3), (3, 2), (3, 3), (3, 4)}

(b) Given a grammar G defined by the production rules

$S \rightarrow AB$

$A \rightarrow Aa$

$B \rightarrow Bb$

$A \rightarrow a$

$B \rightarrow b$

Show that the word $w = a^2b^4 \in L(G)$, where L is a language determined by G. 4

(c) Evaluate the following RPN : 2

$$362 + * 4 - 37 + /$$

6. *(a)* Define Boolean algebra. Show that the following statements are equivalent in a Boolean algebra : 1+4=5

(i) $a + b = b$

(ii) $a * b = a$

(iii) $a' + b = 1$

(iv) $a * b' = 0$

(b) If a and b be any elements in a Boolean algebra B, then show that 2

$$a*(a+b)=a$$

(c) Express each of the following Boolean expression $E(x, y, z)$ as a sum of products and then in its complete sum of products form : 1½+1½=3

(i) $E(x, y, z)=x(xy'+x'y+y'z)$

(ii) $E(x, y, z)=z(x'+y)+y'$

7. (a) Define supremum and infimum with examples. 3

(b) Let $(L, \leq)$ be a lattice for any $a, b \in L$. Prove the following are equivalent : 3

(i) $a \leq b$

(ii) $a \wedge b=a$

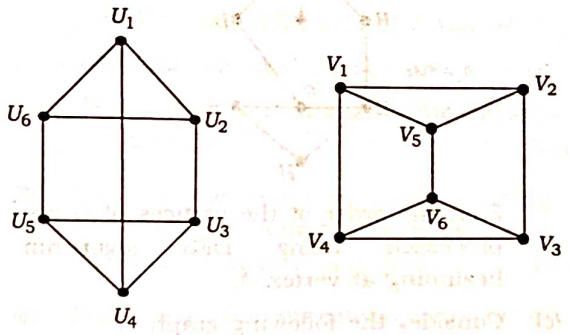
(iii) $a \vee b=b$

(c) Consider the lattice

D_{60} = {1, 2, 3, 4, 5, 6, 10, 12, 15, 20, 30, 60}

The divisors of 60 ordered by divisibility. Draw the Hasse diagram of D_{60}. Find complements of 2 and 10, if they exist. 4

8. (a) Define isomorphic graph. Check whether the following two graphs are isomorphic or not : 1+3=4



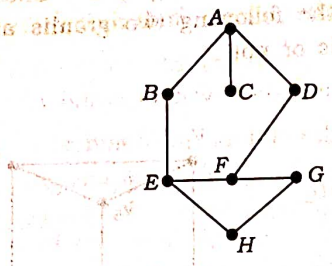
(b) Draw the graph G for the following adjacency matrix : 3

$$A=\begin{bmatrix} 0 & 1 & 0 & 1 & 0 \\ 1 & 0 & 0 & 1 & 1 \\ 0 & 0 & 0 & 1 & 1 \\ 1 & 1 & 1 & 0 & 1 \\ 0 & 1 & 1 & 1 & 0 \end{bmatrix}$$

(c) Define walks, paths and circuits with diagram. 3

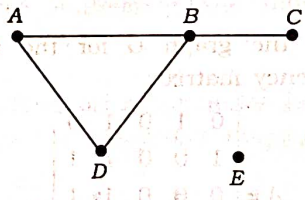
9. (a) Write the algorithm of Depth First Search (DFS). 3

(b) Consider the following graph G :



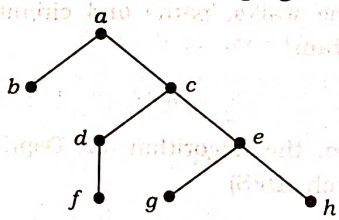
Find the order of the vertices of G are processed using DFS algorithm beginning at vertex A. 5

(c) Consider the following graph G :



Find the linked representation of a graph G. 2

10. (a) What are rooted trees? Consider the rooted tree in following figure :



(Continued)

(i) What is the root of T?

(ii) Find the leaves and the interval vertices of T.

(iii) What are the levels of c and e?

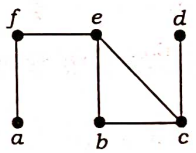
(iv) Find the children of c and e.

(v) Find the descendants of the vertices a and c. ½+2½=3

(b) What is the minimum cost spanning tree? Take any suitable example to find minimum cost spanning tree. 1+4=5

(c) Prove that the maximum number of vertices in a binary tree of height h is $2^{n+1}-1$, $h \geq 0$. 2

11. (a) Find all spanning tree of the graph G shown in the figure : 3



(b) "A graph is a tree if and only if it is minimally connected." Prove. 3

(c) How to traverse binary tree? Explain the procedures. 4

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