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M – 2738

Reg. No. :

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Second Semester B.C.A. Degree Examination, December 2021

Career Related First Degree Programme under CBCSS

Mathematics

Complementary Course

MM 1231.9 MATHEMATICS – II

(2020 Admission Regular)

Time : 3 Hours

Max. Marks : 80

SECTION – I

Answer **all ten** questions. They carry 1 mark each.

1. Give an example for a false proof.
2. Define Boolean Dictionary.
3. Define multiset and give an example.
4. What is null string?
5. Define Algebra.
6. Define 'subgroup' of a group.
7. What do you mean by weight of a path?

P.T.O.

8. What is the basic idea behind 'depth-first search'?
9. Explain the ambiguity of a Context free grammar.
10. Define A^* of a set A .

SECTION – II

Answer **any eight** questions from among the questions 11 to 26. They carry **2** marks each.

- ✓11. Give a direct proof for the statement "If x and y are odd integers, then $x + y$ is even".
- ✓12. Define
 - (a) Conjunction
 - (b) Disjunction.
- ✓13. Construct the truth table for " $(p \wedge q) \vee \neg p$ ".
14. Define 'resolution' with an example.
- ✓15. Let $A = \{3, 8, 11, 13\}$, $B = \{4, 7, 8, 15\}$ and $U = \{1, 2, 3, \dots, 20\}$. Find
 - (a) $A \oplus B$
 - (b) $A \times B$
 - (c) A^2
- ✓16. (a) Define Reflexive closure of A
 - (b) Show that
 - (i) \cap, \oplus are commutative and associative.
 - (ii) \times is neither commutative nor associative.

17. With the help of an example, prove that the composition of relations will be associative but not commutative. ✓
18. Define Ring with an example.
19. ✓ Let a, b, c be any elements in a Boolean algebra, then show that $(a * b) * c = a * (b * c)$.
20. ✓ Check whether the set of all natural numbers under ordinary multiplication forms a group or not.
21. Define the terms :
- (a) Biconnected components
 - (b) Strongly connected components.
22. ✓ Define adjacency matrix of a graph and illustrate it with an example.
23. ✓ Which are the four classes into which a depth-first search partitions the edges of a directed graph?
24. Define :
- (a) Type 0 Grammar
 - (b) Regular Grammar
25. Describe 'decision problem' with an example.
26. What do you mean by 'concatenation'?

$$\begin{aligned}
 nC_0 &= k^3 \cdot 1^0 \\
 nC_1 &= k^2 \cdot 1^1 \\
 nC_2 &= k \cdot 1^2 \\
 nC_3 &= k^0 \cdot 1^3
 \end{aligned}$$

SECTION – III

Answer **any six** questions from among the questions 27 to 38. They carry **4** marks each.

✓ 27. By using the Principle of Mathematical Induction, prove that " $\forall n \in \mathbb{N}, n \geq 0, 6$ divides $(n^3 - n)$ ".

28. What is truth value assignment? Explain.

29. When do we say that an argument is

(a) Valid?

(b) Vacuously true?

Explain each with an example.

✓ 30. (a) State addition principle. Verify addition principle for $A = \{1, 2, 3, 4\}$ and $B = \{3, 4, 5, 6, 7, 8\}$

(b) Prove that $f_{A \oplus B} = f_A + f_B - 2f_A f_B$.

$$f_{A \oplus B} = (f_A + f_B - 2f_A f_B)^2$$

✓ 31. Prove that the transitive closure of a relation R is the set $S = \{(a, b) : \text{there is a walk from } a \text{ to } b \text{ in } R\}$.

32. Prove that Equality modulo m is an equivalence relation.

✓ 33. Let G be the set of all non-zero real numbers and let $a * b = \frac{ab}{2}$. Then show that $(G, *)$ is an abelian group.

34. Write a note on 'Hamming Codes'.

35. Define DAG. When does a Partial order become a DAG and vice versa?

36. Explain simple graph propagation algorithm with an example.

37. Explain the following terms with an example:

- (a) Alphabet
- (b) String
- (c) Σ^*

✓ 38. What is DFA? Give an example.

SECTION – IV

Answer **any two** questions from among the questions 39 to 44. They carry **15** marks each.

✓ 39. (a) Obtain Disjunctive Normal Form of $\neg(P \vee Q) \Leftrightarrow P \wedge Q$.

(b) Obtain the Principal Disjunctive Normal Form of

(i) $P \rightarrow Q$

(ii) $(P \wedge Q) \vee (Q \wedge R)$

(c) Obtain the Principal Conjunctive Normal Form of $(\neg P \neg R) \wedge (Q \Leftrightarrow P)$

40. (a) State and Prove Inclusion- Exclusion Theorem.

(b) Show that Congruent modulo 4' is an equivalence relation.

41. (a) Prove that the set $[a]$ for $a \in A$ constitute a partition of A .

(b) Define Poset with an example. Give an example for a set which is not a poset.

42. (a) Write a note on Communication system.

(b) Prove that a code can detect all combinations of k or fewer errors if and only if the minimum distance between any two code words is atleast $k + 1$.

43. (a) (i) What is a topological sort?
- (ii) When does a poset become a topological sort? Explain.
- (b) State and prove the Correctness of breadth-first search.
44. (a) Define Grammar. Give two examples.
- (b) Prove that $\forall x \in \Sigma^*, \hat{\delta}_3((p, q), x) = (\hat{\delta}_1(p, x), \hat{\delta}_2(q, x))$.
- (c) What is transition function?
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