KATHMANDU UNIVERSITY
End Semester Examination
July/August, 2024

Level : B.Sc. Course : MCSC 201
Year : II 1 1 AUG 2024 Semester : I
Time : 2 hrs. 30mins. F. M. : 55

SECTION "C"
[3 Q. × 7 = 21 marks]

1. Define prime number. If a and b are any two positive integers, prove that: GCD (a, b).LCM (a, b) = ab. Use Euclidean algorithm to find GCD (a, b) for a = 77 and b = 128. [1 + 3 + 3]

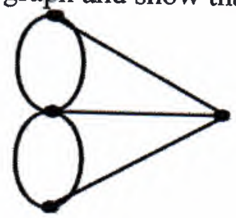
2. Define matrix of a relation and an equivalence relation. Let R be an equivalent relation on a set A then for each a, b ∈ A, prove that a R b if and only if R(a) = R(b). Find M_{R^2}, if R be the relation on set A whose matrix is

$$M_R = \begin{bmatrix} 1 & 1 & 0 \\ 0 & 0 & 1 \\ 1 & 0 & 1 \end{bmatrix}.$$

[2 + 3 + 2]

OR

Define a graph, sub-graph, Euler path and Hamiltonian Circuit. Find the degree of all the vertices of following graph and show that there is no Euler circuit.



[1+1+1+1+3]

3. Define simi-group, group and monoid. Let f be a homomorphism from a semi-group (S, *) to (T, *'). If S' is a submonoid of S, then show that f(S') = { t ∈T : t = f(s), for some s in S'}, the image of S' under f is a submonoid of T. [1 + 1 + 1 + 4]

SECTION "D"
[6 Q. × 4 = 24 marks]

4. Define the permutation function. Let A = {a, b, c, d, e, f}. Compute (a, c, e) o (b, f, c) and check the resultant permutation is even or odd.

5. Define the recurrence relation. Find an explicit formula for the sequence defined by $a_n = 2a_{n-1} + 1$ with initial condition $a_1 = 7$.

6. If $A = \begin{bmatrix} 0 & 0 & 1 \\ 0 & 1 & 0 \\ 1 & 0 & 0 \end{bmatrix}$ and $B = \begin{bmatrix} 1 & 0 & 1 \\ 1 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}$, then compute $A \vee B$, $A \wedge B$ and A⊕B, where the symbols have their usual meanings.

7. If (A, ≤) and (B, ≤) posets, then show that (A × B, ≤) is poset with partial order ≤ define by (a, b) ≤ (a', b') if a ≤ a' in A and b ≤ b' in B.

OR

Define Characteristic function. Prove that $f_{A\cup B} = f_A + f_B - f_A f_B$, where the symbols have their usual meaning

8. State the principle of Mathematics induction and use it to prove: $n! \geq 2^{n-1}$ for all $n \geq 1$

9. Verify that the function $f : \Re \rightarrow \Re$ defined by $f(x) = 2x + 10$ satisfy the property $f^{-1} o f = I_{\Re}$ an identity on $\Re$.

SECTION "E"

[5 Q. × 2 = 10 marks]

10. Let A and B be subsets of U, then prove that $\overline{A \cap B} = \bar{A} \cup \bar{B}$.

11. If (G, *) is a group where G is the set of all non -zero real numbers and $a*b = \frac{ab}{5}$ for all a, b in G. Find the identity element of G.

12. If p and q are two statements. Show that $(p \Rightarrow q) \equiv (\sim p) \vee q$.

13. Let A = {p, q, r}and R be relations on A, define as following matrices ~

14. $M_R = \begin{pmatrix} 1 & 0 & 1 \\ 1 & 1 & 1 \\ 1 & 0 & 0 \end{pmatrix}$. Find the $M_{R^{-1}}$ and $M_{\bar{R}}$.

15. Define the maximal element of poset. What are the least and greatest elements of P(S) if S = {a, b, c, d}.

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SECTION "A"

[10 Q. × 1 = 10 marks]

Fill in the blank space(s) by most appropriate words or symbol(s):

1. If q is a statement, the negation of q is detonated by ____________________.

2. If * is a binary operation with identity element e and y is inverse of x for *. Then x * y = y * x = ____________________

3. If U = {a, b, c, d, e, f} and A = {b, c, f}, then the finite sequence f_A is ____________________

4. The range of the characteristics function defined on subset A of universal set U is ____________________

5. A relation R on asset A is asymmetric if whenever aRb then ____________________

6. If A and B are subsets of universal set U. f_A and f_B are characteristic function of A and B respectively. Then $f_{A \cap B}$ = ____________________

7. A path in a graph G is called a ____________________ if it includes every edge exactly ones.

8. $\lfloor \lfloor -1.6 \rfloor =$ ____________________

9. A group (G, *) is said to be abelian if ____________________ for each x, y in G.

10. If the function $f: \Re \rightarrow \Re$ be defined by $f(x) = 5x - 1$, then $f^{-1}(-1) =$ ____________________

SECTION "B"

[10 Q. × 1 = 10 marks]

*Fill in the blank space(s), **DO NOT TICK,** by selecting the most appropriate answers from among the given ones.*

11. If 21 pigeons are assigned to 5 pigeonholes then one of the pigeonholes must contain at least ____________________ pigeons.
[3 ; 4; 5; 6]

12. If a set A = {a, b}. The Cartesian product A×A =
[{(a, a), (b, b), (a, b)(b, a)} ; {(a, a), (b, b), (a, b), (b, c)}; {(a, a), (b, b), (a, b)}; ; {(a, a), (b, b), (a, b), (b, d)};]

13. If $A = \begin{bmatrix} 2 & 1 \\ 3 & -2 \end{bmatrix}$ and $B = \begin{bmatrix} 1 & -1 \\ 2 & -3 \end{bmatrix}$, then 2B - A = ________________

[$\begin{bmatrix} 0 & 3 \\ -5 & 8 \end{bmatrix}$; $\begin{bmatrix} 0 & -3 \\ 5 & 8 \end{bmatrix}$; $\begin{bmatrix} 0 & -3 \\ 1 & 4 \end{bmatrix}$; $\begin{bmatrix} 0 & 3 \\ -5 & -8 \end{bmatrix}$]

14. If LCM (a, b) = 56, HCF (a, b) = 3 and a = 7 , find b = ________________
[8 ; 9; 12; 24 ;]

15. Let *L* be a lattice. Then, for each a, b and c in *L*, a ≤ c and b ≤ c if and only if ________________
[$a > b \vee c$; $a \geq b \vee c$; $a \vee b < b$; $a \vee b \leq c$]

16. The matrix $M_R = [m_{ij}]$ is symmetric relation R has the property that if m_{ji} = , then ________________
[$m_{ji} = 1$; $m_{ji} = -1$; $m_{ji} = 0$; $m_{ii} = 0$]

17. If f is the mod- 5 function, then f(111111115) = ________________
[0 ; 1 ; 2 ; 3]

18. In the group S_3, inverse of $\begin{bmatrix} 1 & 2 & 3 \\ 1 & 2 & 3 \end{bmatrix}$ is ________________

[$\begin{bmatrix} 1 & 2 & 3 \\ 3 & 1 & 2 \end{bmatrix}$; $\begin{bmatrix} 1 & 2 & 3 \\ 2 & 3 & 1 \end{bmatrix}$; $\begin{bmatrix} 1 & 2 & 3 \\ 2 & 1 & 3 \end{bmatrix}$; $\begin{bmatrix} 1 & 2 & 3 \\ 1 & 2 & 3 \end{bmatrix}$]

19. If A = {a, b, c}, then n(P(A)) ________________
[8 ; 16 ; 24 ; 32]

20. If the mappings $f : \Re \rightarrow \Re$, $g : \Re \rightarrow \Re$ are defined by f(x) = 2x + 3 and g(x) = 2x then $gof^{-1}(-1)$ = ________________
[2; 4; -2; - 4]