KATHMANDU UNIVERSITY
End Semester Examination
March/April, 2025

Marks Scored:

Level : B.E.
Year : II
Course : MCSC 201
Semester : I

Exam Roll No. :
Time: 30 mins.
F. M. : 20

Registration No.:
Date : 08 APR 2025

SECTION "A"
[10 Q. × 1 = 10 marks]

Fill in the blank space(s) by writing the most appropriate word(s) or symbol(s).

1. In the implication "p $\Rightarrow$ q", the statement q is called ________________ .

2. The range of the characteristics function defined on subset A of universal set U is ____________

3. If U = {1, 2, 3, 4, 5} and A = {1, 3, 5}, then the finite sequence f_A is ______________

4. A pictorial representation of a relation on a finite set is _______ of the relation.

5. A path in a graph G is called a __________________ if it includes every edges exactly ones.

6. The least element of a poset, if it exists, is called a(an) _____________ element.

7. A cycle of length two in permutation function is known as _______________

8. $\lfloor -2.3 \rfloor$ = ____________

9. A group (G, *) is said to be abelian if _____________________ for each a, b in G.

10. If the function f : $\Re \rightarrow \Re$ be defined by $f(x) = x^2 + 1$, then f o $f^{-1}(71)$ = _____________

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

12. The number of distinguishable permutations of letters in "SUNDAY" is ________________.
[720 ; 760 ; 770 ; 780]

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

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

14. If LCM (a, b) = 60, HCF (a, b) = 5 and a = 25 , find b = ____________________
[8 ; 9; 12; 24]

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

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

17. If $M_R = M_R^T$, then the relation is ________________
[reflexive ; symmetric ; asymmetric ; antisymmetric]

18. The group S_3 is a group of order ________________
[2 ; 3 ; 6 ; 9]

19. If $f_2(n) = 2^n - 8$, then $f_2(5)$ = ____________________
[8 ; 16 ; 24 ; 32]

20. If the mappings $f : \Re \to \Re$, $g : \Re \to \Re$ are defined by $f(x) = 2x$, $g(x) = x + 3$, then $(f \circ g)(1)$ = ________________
[2; 4; 6; 8]

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SECTION "C"
[3 Q. × 7 = 21 marks]

1. Define prime number of two positive integers. If a | b or a | c, then prove that a | bc. Also, find the GCD of the integers a = 120 and b = 500 and then write GCD (a, b) as s a + t b, where s and t are any integers. [1+2+4]

2. Define a relation. For any two relations R and S from A to B, prove that [1+4+2]

a. $(R \cup S)^{-1} = R^{-1} \cup S^{-1}$ and b. $\overline{(R \cap S)} = \overline{R} \cup \overline{S}$.

Also, let A = {1, 2, 3} and consider two relations $R = \{(1, 1), (1, 2), (1, 3), (2, 2), (3, 3)\}$ and $S = \{(1, 1), (1, 2), (2, 2), (3, 2), (3, 3)\}$, then verify that
$(SoR)^{-1} = R^{-1} o S^{-1}$.

OR

What is meant by an equivalence relation on a set? Let R be an equivalent relation on a set A then for each a, b in A, prove that a R b if and only if R(a) = R(b). Also, R be the relation on A whose matrix is $M_R = \begin{bmatrix} 1 & 1 & 1 \\ 0 & 0 & 1 \\ 0 & 1 & 1 \end{bmatrix}$. Find M_{R^2}, $M_{R^{-1}}$ and $\overline{M_R}$. [1+3+3]

3. Define a poset. If (A, ≤) and (B, ≤) posets, then show that (A × B, ≤) is poset with partial order ≤ define by $(a, b) \leq (a', b')$ if $a \leq a'$ in A and $b \leq b'$ in B. Also determine the greatest and least elements, if they exists, of the poset A = {2, 4, 6, 8, 12, 18, 24, 36, 72} with the partial order of divisibility. [1+4+2]

P.T.O.

SECTION "D"

[6Q. × 4 = 24 marks]

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

5. Let A = {1, 2, 3, 4, 5, 6} and $p = (1 \;\; 2 \;\; 4 \;\; 3)$ and q = (5 6) be a permutation of A. Compute p^{-1}, p^2, p o q and q o p.

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

7. If f is an isomorphism from (S, ∗) and (T, ∗'), then show that f^{-1} is an also isomorphism. Also, show that the semi groups (**Z**, +) and (2**Z**, +) are isomorphism, where **Z** is the set of all even integers.

OR

Let (G, ∗) be a group . Then prove the following:

(i) Identity element of a group (G, *) is unique and

(ii) Inverse of any element of a group (G, *) is unique.

8. What is Mathematical Induction method? Use Mathematical Induction to prove that $2 + 2^2 + 2^3 + \ldots + 2^n = 2^{n+1} - 2$, for all non-negative integer n.

9. Define Euler path and Hamiltonian path. Draw a graph which is
   a. Both Euler Circuit and Hamiltonian circuit
   b. Euler path but not Euler circuit

SECTION "E"

[5Q. × 2 = 10 marks]

10. If $n(A) = a$ and $n(B) = b$, then prove that $n(A \times B) = a \times b$.

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. Show that the $(p \wedge (p \Rightarrow q)) \Rightarrow q$ is a tautology.

13. If R be the relation on set A whose matrix is $M_R = \begin{bmatrix} 1 & 1 & 1 \\ 0 & 0 & 1 \\ 0 & 0 & 1 \end{bmatrix}$. Prove that R is transitive.

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