

KATHMANDU UNIVERSITY
End Semester Examination
March, 2025

Marks Scored:

Level : B.Sc.

Year : II

Exam Roll No. :

Time: 30 mins.

Registration No.:

Course : MCSC 201

Semester : I

F. M. : 20

Date : 07 MAR 2025

SECTION "A"

[10 Q. \times 1 = 10 marks]

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

1. A statement that is always true is called _____
2. If $*$ is a binary operation and x is inverse of y for $*$. Then $x * y = \underline{\hspace{2cm}} = e$, where e is an identity element.
3. If $U = \{a, b, c, d, e, f\}$ and $A = \{a, c, e\}$, then the finite sequence f_A is _____
4. The range of the characteristics function defined on subset A of universal set U is _____
5. If $|A| = n$ and $|B| = m$. $|A \times B| = \underline{\hspace{2cm}}$
6. $p \rightarrow q$ (conditional statement) is consider false if p is _____ and q is false.
7. A path in a graph G is called a _____ if it includes every vertices exactly ones.
8. $[-5.4] = \underline{\hspace{2cm}}$
9. A group $(G, *)$ is said to be abelian if _____ for each a, b in G .
10. If the function $f: \mathbb{R} \rightarrow \mathbb{R}$ be defined by $f(x) = 5x + 1$, then $f \circ f^{-1}(100) = \underline{\hspace{2cm}}$

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 32 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 "COMPUTER" is _____.
[40320 ; 30240 ; 40330 ; 40230]
13. If $A = \begin{bmatrix} 2 & 1 \\ 3 & -2 \end{bmatrix}$ and $B = \begin{bmatrix} 1 & -1 \\ 2 & -3 \end{bmatrix}$, then $B - A =$ _____
[$\begin{bmatrix} -1 & 3 \\ -5 & 8 \end{bmatrix}$; $\begin{bmatrix} -1 & -3 \\ 5 & 8 \end{bmatrix}$; $\begin{bmatrix} -1 & -3 \\ 1 & 4 \end{bmatrix}$; $\begin{bmatrix} -1 & -2 \\ -1 & -1 \end{bmatrix}$]
14. If $\text{LCM}(a, b) = 50$, $\text{HCF}(a, b) = 3$ and $a = 25$, find $b =$ _____
[8 ; 9 ; 12 ; 24]
15. Let L be a bounded lattice. Then, for each a in L , $0 \leq a \leq$ _____
[a ; 1 ; I ; L]
16. The matrix $M_R = [m_{ij}]$ is symmetric relation R has the property that if $m_{ij} =$, then _____
[$m_{ji} = 1$; $m_{ji} = -1$; $m_{ji} = 0$; $m_{ii} = 0$]
17. If f is the mod - 2 function, then $f(1217530) =$ _____
[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 $f: \mathcal{R} \rightarrow \mathcal{R}$, $g: \mathcal{R} \rightarrow \mathcal{R}$ are defined by $f(x) = x$, $g(x) = x + 3$, then $(g \circ f^{-1})(-6) =$ _____
[2 ; 3 ; -2 ; -3]

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Level : B.Sc.
Year : II
Time : 2 hrs. 30 mins.

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F. M. : 550

07 MAR 2025

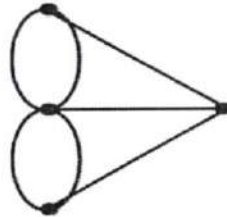
SECTION "C"

[3 Q. × 7 = 21 marks]

1. Define relative prime numbers. Let a, b, c be integer, $a | b$ or $a | c$ then prove that $a | b + c$. Also, use Euclidian algorithm to find GCD of 273 and 98 and express it as combination of given numbers. [1+2+4]
2. Define anti-symmetric and equivalence relation. 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 $R(a) = R(b)$. 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. [2+3+2]

OR

Define a graph, sub-graph and Hamiltonian path. Find the degree of all the vertices and total degree of following graph and show that there is no Euler circuit. [1+1+1+4]



3. Define group and homomorphism function. Let f be a homomorphism from a semi-group $(S, *)$ to $(T, *)$. If S' is a sub-semigroup of S , then show that $f(S') = \{ t \in T : t = f(s), \text{ for some } s \text{ in } S' \}$, the image of S' under f is a sub-semigroup of T . If $(G, *)$ is a group then prove that for all a, b in G , $(a * b)^{-1} = b^{-1} * a^{-1}$ [1+1+2+2]

SECTION "D"

[6Q. × 4 = 24 marks]

4. Let $A = \{1, 2, 3, 4, 5\}$ and $p = (1, 2, 4, 3)$ and $q = (4, 5)$ be a permutation of A . Compute p^{-1} , p^2 and $p \circ q$ and $q \circ p$.
5. Define the characteristic function and prove that $f_{A \cup B} = f_A + f_B - f_A f_B$, symbols have their usual meaning.
6. State the principle of Mathematics induction and use it to prove: $\overline{\bigcup_{i=1}^n A_i} = \bigcap_{i=1}^n \overline{A_i}$

P.T.O.

7. If $A = \begin{bmatrix} 1 & 0 & 1 \\ 0 & 1 & 0 \\ 1 & 0 & 1 \end{bmatrix}$ and $B = \begin{bmatrix} 0 & 0 & 1 \\ 1 & 1 & 0 \\ 0 & 1 & 1 \end{bmatrix}$, then compute $A \vee B$, $A \wedge B$ and $A \odot B$, where the symbols have their usual meanings.
8. If (A, \leq) and (B, \leq) posets, then show that $(A \times B, \leq)$ is poset with partial order \leq define by $(a, b) \leq (a', b')$ if $a \leq a'$ in A and $b \leq b'$ in B .
9. Prove that $(G, *)$ is a abelian group where G is the set of all non-zero real numbers and $a * b = \frac{ab}{7}$ for all a, b in G .

OR

Define binary operation and Unary operation. If $*$ is an associative operation and y is inverse of x then prove that y is unique.

SECTION "E"
[5Q. \times 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 and a and b are elements of G , find the solution of $a * x = b$ and prove that solution is unique.
12. Show that the statement $(p \wedge q) \Rightarrow p$ is a tautology.
13. Let $A = \{a, b, c\}$ and R be relations on A , define as following matrices
- $$M_R = \begin{pmatrix} 1 & 0 & 0 \\ 1 & 1 & 1 \\ 1 & 0 & 0 \end{pmatrix}. \text{ Find the } M_{R^{-1}} \text{ and } M_{\bar{R}}.$$
14. Define the minimal element of poset. What are the least and greatest elements of $P(S)$ if $S = \{1, 2, 3, 4\}$.