**24U3124** (Pages: 2) Name : .....

Reg. No : .....

**THIRD SEMESTER UG DEGREE EXAMINATION, NOVEMBER 2025**

(FYUGP)

**CC24UMAT3MN204 - BOOLEAN ALGEBRA AND SYSTEM OF EQUATIONS**

(Mathematics - Minor Course)

(2024 Admission - Regular)

Time: 2.0 Hours Maximum: 70 Marks

Credit: 4

**Part A** (Short answer questions)

Answer ***all*** questions. Each question carries 3 marks.

1. Define complement of an element in a lattice with an example. [Level:2] [CO1]

2. Write the dual of each statement: [Level:2] [CO1]
   (a) $(a \wedge b) \vee c = (b \vee c) \wedge (c \vee a)$. (b) $(a \wedge b) \vee a = a \wedge (b \vee a)$.

3. Consider the lattices $D_{70}, D_{40}$ . [Level:3] [CO2]
   (a) Which of these is a Boolean algebra? Justify your answer.
   (b) Find atoms of that Boolean algebra.

4. Define Boolean algebra with an example. [Level:2] [CO2]

5. Prove that $0' = 1$ and $1' = 0$. [Level:2] [CO2]

6. When we say that the system **AX=B** is consistent? [Level:2] [CO3]

7. State the condition under which two matrices are conformable for multiplication. [Level:3] [CO3]

8. Define rank of a matrix. [Level:2] [CO3]

9. Find the cofactors $C_{11}$, $C_{21}$, $C_{32}$ of the matrix $\begin{bmatrix} 1 & 1 & 4 \\ 5 & 3 & 2 \\ 2 & 1 & 0 \end{bmatrix}$ [Level:2] [CO4]

10. Evaluate $\begin{vmatrix} cos\alpha & sin\alpha \\ sin\beta & cos\beta \end{vmatrix}$ [Level:3] [CO4]

**(Ceiling: 24 Marks)**

**Part B** (Paragraph questions/Problem)

Answer ***all*** questions. Each question carries 6 marks.

11. Let N = {1, 2, 3,...} be ordered by divisibility. State whether each of the following subsets of N are linearly ordered. [Level:3] [CO1]
    (a) {24, 2, 6}; (b) {3, 15, 5};
    (c) N = {1, 2, 3 ...}; (d) {2, 8, 32, 4} (e) {15, 5, 30}.

12. Let A = {1, 2, 3, 4, 6, 8, 9, 12, 18, 24} be ordered by the relation " x divides y ". [Level:3] [CO1]

(a) Draw the Hasse diagram for this set.

(b) Write first element and last element if exist.

(c) Write maximal and minimal elements if exist.

13. (a) Define complete sum-of-products form. [Level:3] [CO2]

(b) Express E in its complete sum-of-products form $E = x(xy + y' + x'y)$.

14. Convert $E = ((xy)'z')'((x' + z)(y' + z'))'$ into sum-of-products expression. [Level:3] [CO2]

15. Write down a linear system of m equations in n unknowns $x_1, x_2, x_3, \ldots, x_n$. [Level:3] [CO3]

16. Find the resultant of the vectors $\bar{u}, \bar{v}, \bar{w}$ which represents the forces in space . [Level:3] [CO3]

$$\bar{u} = \begin{bmatrix} 1.2 \\ 0 \\ -2.5 \end{bmatrix}, \bar{v} = \begin{bmatrix} 2 \\ -1 \\ 3 \end{bmatrix}, \bar{w} = \begin{bmatrix} -4 \\ -10 \\ 8 \end{bmatrix}$$

17. If $A = \begin{bmatrix} 1 & 2 \\ 3 & 4 \end{bmatrix}$, [Level:3] [CO4]

$B = \begin{bmatrix} 5 & 6 \\ 7 & 8 \end{bmatrix}$, show that $|AB| = |A||B|$

18. Is it true that AB=BA. Justify your answer. [Level:3] [CO4]

**(Ceiling: 36 Marks)**

**Part C** (Essay questions)

Answer any ***one*** question. The question carries 10 marks.

19. (a) Consider the set Z of integers. Define $aRb$ if there is a positive integer r such that $b = a^r$. Check whether the relation R is a partial order on the set Z of integers. [Level:2] [CO1]

(b) Let N = {1, 2, 3,...} be ordered by divisibility. State whether each of the following subsets of N are linearly ordered.

(i) {24, 2, 6} (ii) {3, 15, 5} (iii) N = {1, 2, 3 ...} (iv) {2, 8, 32, 4}

20. Find the eigen values and eigen vecyors of the matrix If $A = \begin{bmatrix} -2 & -8 & -12 \\ 1 & 4 & 4 \\ 0 & 0 & 1 \end{bmatrix}$ [Level:3] [CO4]

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**(1 × 10 = 10 Marks)**

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