M. A. COLLEGE OF ENGINEERING, KOTHAMANGALAM-686666
(GOVERNMENT AIDED AUTONOMOUS ENGINEERING COLLEGE)
DEPARTMENT OF MATHEMATICS
SECOND SESSIONAL EXAMINATION, OCTOBER 2026
B24MA2T03C: DISCRETE MATHEMATICS
THIRD SEMESTER (CS, DS, AI & ML)

Time: 1.5 Hours **Maximum Marks: 40**

*Answer **all** questions.*

PART A

1. Construct a truth table for the statement $\neg(p \vee \neg q) \rightarrow \neg p$ where p, q are primitive statements. Check whether it is a tautology. **(CO 3) ··· (3 marks)**
2. Write the converse, inverse and contrapositive of the statement 'If P is a square then P is a rectangle'. **(CO 3) ··· (3 marks)**
3. If $A = \{1, 2, 3\}$ and $B = \{a, b\}$ find $A \times B$ and cardinality of $P(A \times B)$. **(CO 4) ··· (3 marks)**
4. Let $A = \{1, 2, 3, 4\}$ give an example of a relation which is
   a) reflexive, symmetric but not transitive
   b) symmetric but not anti-symmetric. **(CO 4) ··· (3 marks)**

PART B

5. (a) If Raichel gets the supervisor's position and work hard, then she will get a raise. If she gets the raise, then she will buy a new car. She has not purchased a new car. Therefore either Raichel did not get the supervisor's position or she did not work hard. Establish the validity of the statements. **(CO 3) ··· (7 marks)**

   (b) Determine the truth value of each statement if the universe is all non-zero integers.
   i. $\exists x\, \exists y\, [xy = 2]$
   ii. $\forall x\, \forall y\, [x^2 < y + 1]$
   iii. $\exists x\, \exists y\, [(2x + y = 5) \wedge (x - 3y = -8)]$
   iv. $\exists x\, \exists y\, [(3x - y = 7) \wedge (2x + 4y = 3)]$

   (CO 3) ··· (7 marks)

6. (a) If $\mathcal{R}$ is a relation on the set $\mathbf{Z}$ defined by $\mathcal{R} = \{(x, y) \mid x, y \in \mathbf{Z}, x - y \text{ is divisible by } 3\}$. Prove that $\mathcal{R}$ is an equivalence relation. Describe the distinct equivalence classes of $\mathcal{R}$. **(CO 4) ··· (7 marks)**

   (b) If $\mathcal{R}$ is a relation on the set $\mathbf{Z}^+$ defined by $a\, \mathcal{R}\, b$ if $a|b$ (a divides b). Prove that $\mathcal{R}$ is a partial order relation. Also draw a Hasse diagram for $(D_{12}, |)$. **(CO 4) ··· (7 marks)**

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