

PRN No.	Total No. of Questions: 09
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QP code

**JSPM's**  
**Rajarshi Shahu College of Engineering, Tathawade, Pune- 411033**  
 (An autonomous institute affiliated to Savitribai Phule, Pune University)

**Examination: Mid Semester (MSE)**  
**Academic Year: 2024-25 Semester: I**

**Examination Class: F. Y. B. Tech.(Comp)**

**Subject Code: ES1204T**

**Subject Name and Pattern: Discrete Mathematics (2023 Pattern)**

**Duration: 1 Hour 15 Mins**

**Max. Marks: 30 Marks**

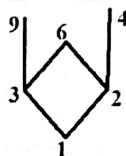
**Instructions to the Candidates:**

1. Attempt Q.1, Q.2 and Q.3 from section-A.
2. Attempt Q.4 or Q.5, Q.6 or Q.7 and Q.8 or Q.9 from section-B.
3. Figures to the right indicate full marks.
4. Assume suitable data if necessary.
5. Use of non-programmable electronics pocket calculator is allowed.
6. Neat diagrams must be drawn wherever necessary.

### Section-A

- Q.1** a) Write down the rule of inference of hypothetical syllogism. [01] CO1 BL1  
 b) Translate each of the following statements into symbols, using quantifiers, variables and predicate: [02] CO1 BL2  
 i) There is a student who can speak Tamil and who knows C ++.  
 ii) Every student either can speak Tamil or knows C ++.

- Q.2** a) Find  $\text{lub}\{4,9\}$  and maximal element of the poset  $(A, |)$ , in the following Hasse diagram here  $aRb$  if  $a | b$  where,  $A = \{1,2,3,4,6,9\}$ . [01] CO2 BL1



- b) Let  $Z$  be the set of all integers and  $f : Z \rightarrow Z$  and  $g : Z \rightarrow Z$  are the functions defined as  $f(x) = x^2$ ,  $g(x) = x + 1$  then find  $(f \circ g)(x)$  and  $(g \circ f)(x)$ . [02] CO2 BL2  
 $\text{Handwritten: } f(g(x)) = (x+1)^2, g(f(x)) = x^2 + 1$
- Q.3** a) Let  $(M, +)$  be an abelian group, where  $M$  is the set of  $2 \times 2$  matrices with elements as any real numbers and the operation  $+$  on set  $M$  is usual addition of matrices. Find the identity element of  $(M, +)$ . [01] CO3 BL1  
 b) Let  $N$  be the set of natural numbers and  $*$  be the binary operation defined on  $S = N \times N$  by  $(a, b) * (c, d) = (ac, bd)$ . The set  $S$  forms a group under binary operation  $*$ . If the mapping  $f : (S, *) \rightarrow (Q, \times)$  is defined as  $f(a, b) = a + b$ ; where  $(Q, \times)$  is the group under usual multiplication. Determine whether  $f$  is homomorphism or not. [02] CO3 BL2

### Section-B

- Q.4** a) Obtain the principal conjunctive normal form (PCNF) and principal disjunctive normal form (PDNF) of the statement  $(p \rightarrow q) \leftrightarrow (\sim q \vee \sim p)$  by using Truth table method. [04] CO1 BL3



- b) Find the converse, inverse, and contrapositive of the statement: "If a quadrilateral is a rectangle, then it has two pairs of parallel sides." [03] CO1 BL3

OR

- Q.5 a) i) Obtain conjunctive normal form (CNF) of the statement  $q \vee (p \wedge r) \wedge \sim ((p \vee r) \wedge q)$  by algebraic method. [04] CO1 BL3  
ii) Obtain disjunctive normal form (DNF) of the statement  $(p \rightarrow q) \wedge (\sim p \wedge q)$  by algebraic method.

- b) Check the validity of the argument: "If the lecture is not boring, then students like to attend the classes. If the lecturer is prepared for the topic, then the lecture is good. Either the lecture is not boring or not good. The students do not like to attend classes. Therefore, the lecturer is not prepared and students do not like to attend the classes." [03] CO1 BL3

- Q.6 a) In a survey, 2000 people were asked whether they read India Today or Business Times. It was found that 1200 read India Today, 900 read Business Times and 400 read both. Using principle inclusion exclusion find how many read at least one magazine and how many read neither. [04] CO2 BL3

- b) Let  $A = \{1, 2, 3, 4, 6, 9\}$  and relation  $R$  defined on  $A$  be such that " $a$  divides  $b$ ",  $a, b \in R$ . Find the relation  $R$  on set  $A$  and represent the relation  $R$  using matrix and diagram. [03] CO2 BL3

OR

- Q.7 a) Draw Hasse diagram of poset  $(\{1, 2, 4, 8, 16\}, |)$  and hence determine whether the given poset is lattice. [04] CO2 BL3

- b) Let  $R$  be the set of all real numbers. Determine whether the function  $f: R \rightarrow R$  defined by  $f(x) = 7 - x$ ,  $x \in R$  is bijective. If yes then find  $f^{-1}(x)$ . [03] CO2 BL3

- Q.8 a) Show that the set  $Q^+$  of all positive rational numbers forms an abelian group under the operation  $*$  defined by  $a * b = \frac{ab}{2}$ ,  $a, b \in Q^+$ . [04] CO3 BL3

- b) Let  $(Z_7, +_7)$  be a group. Show that  $Z_7$  is a cyclic group under addition modulo 7. Write all its generators? [03] CO3 BL3

OR

- Q.9 a) Find the code words generated by the encoding function  $e: B^2 \rightarrow B^5$  with respect to parity check matrix  $H = \begin{bmatrix} 1 & 1 & 1 & 0 & 0 \\ 1 & 0 & 0 & 1 & 0 \\ 0 & 1 & 0 & 0 & 1 \end{bmatrix}$ . [04] CO3 BL3

- b) Let  $G = \{-1, 1, -i, i\}$  be group under multiplication. Let  $H = \{-1, 1\}$  be a subgroup of  $G$ . Show that  $H$  is normal subgroup of the group  $G$  under the operation usual multiplication? [03] CO3 BL3