

**DO NOT WRITE ANYTHING ON QUESTION PAPER EXCEPT YOUR NAME, DEPARTMENT AND ENROLMENT No.**

Name of Student ----- Enrolment No. -----

Department / School -----

**BENNETT UNIVERSITY, GREATER NOIDA**

**Mid Term Examination, Fall SEMESTER 2019-20**

COURSE CODE: **ECSE209L**

MAX. DURATION: **1 Hour**

COURSE NAME: **Discrete Mathematical Structures**

MAX. MARKS: **20**

**Note: Attempt all the questions. All the questions are compulsory.**

**Q.1** It is known that at a university 60% of the professors play tennis, 50% of them play bridge, 70% prefer jogging, 20% play tennis and bridge, 30% play tennis and jog and 40% play bridge and jog. If someone claimed that 20% of the professors play all the 3 games, would you believe this claim? Justify your answer. **(2 Marks)**

**Q.2 (a)** Show that  $(A - B) = \emptyset$  if  $A \subseteq B$  **(1 Mark)**

**(b)** Let  $S = \{2, 5, \sqrt{2}, 25, \pi, \frac{5}{2}\}$  and  $T = \{4, 25, \sqrt{2}, 6, \frac{3}{2}\}$ . Compute  $T \times (S \cap T)$ . **(1 Mark)**

**Q.3 (a)** Let  $R$  be the relation from  $S = \{1, 2, 3, 4\}$  to  $T = \{a, b, c\}$  represented as

$$M_R = \begin{bmatrix} 1 & 0 & 1 \\ 0 & 0 & 1 \\ 1 & 0 & 0 \\ 0 & 1 & 0 \end{bmatrix}$$

Determine whether  $R \circ R^{-1} = R^{-1} \circ R$  using graphical representation. **(2 Marks)**

**(b)** Consider the set  $S = \{1, 2, 3\}$  and the relation  $R$  defined by the following matrix  $M_R$ :

$$M_R = \begin{bmatrix} 1 & 1 & 1 \\ 1 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}$$

Determine whether  $R$  is an equivalence relation. Justify your answer. **(2 Marks)**



**Q.4 (a)** A town in Uttar Pradesh charges each household a minimum of Rs. 75 for up to 4000 cubic feet of water every 6 months. In addition, each household must pay Rs. 0.60 for every 100 cubic feet of water more than 4000 cubic feet. State the water bill  $f(x)$  as a function of cubic feet of water  $x$  used for 6 months. **(1 Mark)**

**(b)** Consider the functions  $f$  and  $g: R \rightarrow R$ . These functions are defined as:

$$f(x) = x + 2$$

$$g(x) = \frac{1}{(x^2 + 1)}$$

Compute  $f^{-1} \circ g \circ f(x)$ .

**(2 Marks)**

**Q.5 (a)** Suppose that  $a$  is a non-zero rational number and that  $b$  is an irrational number. Prove that  $ab$  is irrational. **(2 Marks)**

**(b)** Show that  $\sum_{i=1}^n (2i - 1) = n^2$  using mathematical induction. **(2 Marks)**

**Q.6** Consider the statement: "A theorem in calculus states that every differentiable function is continuous." **(1.5 + 0.5 = 2 Marks)**

**(a)** State the derived implications of the given statement.

**(b)** Assuming that the given statement is TRUE, comment on the truth value of the derived implications.

**Q.7** State whether the following are TRUE or FALSE: **(1 Mark)**

**(a)** If  $B$  is a tautology and  $A$  is a contradiction, then  $(\neg A) \vee B$  is a tautology.

**(b)** If  $A$  and  $B$  are both contradictions, then  $A \rightarrow B$  is a tautology.

**Q.8** Determine the validity of the following argument using rules of inference: **(2 Marks)**

*If I study, then I will pass.*

*If I do not go to a movie, then I will study.*

*I failed.*

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*Therefore, I went to a movie*