



Department: Mathematics & Statistics  
Semester/Year: First /1436-1437  
Duration: 1 H

Course Elements of sets and structures  
Course Code: MAT 220

Midterm 2 (A)

**QUESTION 1 [10=5+3+2 marks]**

1. Let the universe set be the set  $U = \{1, 2, 3, a, b, c, m\}$ ,  $A = \{1, a, 2, m\}$ ,  $B = \{2, b, c\}$  and  $C = \{1, 2\}$ . Determine (a)  $A \cup B$  (b)  $A \cap B'$  (c)  $A - C$  (d)  $A \times C$  (e) All proper subsets of the set  $B$

2. Let  $A$  and  $B$  be subsets of the universal set  $U$ . Prove the following statement using only the stated laws:  $(A - B) \cup (B - A) = (A \cup B) - (A \cap B)$ . (Hint: You may use  $A - B = A \cap B'$ ).

3. Let  $A = \{1, \{2\}\}$  and  $B = \{\{1\}, 2\}$ . Which of the following statements are true?  
(i)  $A = B$  . (ii)  $\{2\} \subseteq A$ . (iii)  $1 \in B$  (iv)  $(\{2\}, \{1\}) \in A \times B$ .

**QUESTION 2 [10=(2+4)+2+2 marks]**

1. Let  $R$  and  $S$  be two relations defined on the set  $A = \{1, 2, 4, 6\}$  as follows

$R = \{(x, y) \mid x + y \text{ is an odd integer}\}$ ,  $S = \{(x, y) \mid x < y\}$ . Determine (a)  $\text{Dom}(R)$  and  $\text{Rng}(S)$ ,  
(b)  $R^{-1} \circ S^{-1}$

2. If  $R$  is an equivalence relation defined on  $\mathbb{Z}$  as follows :  $(x, y) \in R \Leftrightarrow x - y = 10k$  for some  $k \in \mathbb{Z}$ . Find the equivalence classes  $[1]$  and  $[-1]$ .

3. Is  $R = \{(x, y) \in \mathbb{N} \times \mathbb{N} \mid \frac{x}{y} \in \mathbb{N}\}$  an equivalence relation on  $\mathbb{N}$ ? Justify your answer.

**Extra exercise (bonus) [ 2 marks ]:**

Let  $A$  and  $B$  be subsets of the universal set  $U$ . Prove that  $A \cap B = \phi$  if and only if  $B \subseteq A'$