National School of Business Management
BSc in Management Information Systems/ Software Engineering (UGC) –16.1
Mathematics: Sample Paper

Time: 3 hours

Answer any 5 questions. **Date: xx-xx-xxxx**

Question 1 (Set Theory) **20 marks**

1. Fill in the blanks with $\in$, $\notin$, $\subseteq$, = or $\neq$. Recall that Z is the set of all integers and ϕ is the empty set. (5 marks)

i.	Ø	----------	{1, 3, 7}
ii.	-5	----------	Z^+
iii.	{1,3,7}	----------	Z
iv.	51	----------	{204, 187, 170, …}
v.	20	----------	{4, 8, 12}

2. Given the universal set U= {a, b, c, d, e, f, g, h, i, j}, A= {a, e, i},
B= {b, c, d, f, g, h, j}, C= {b, d, e, h, i}, find the following. (5 marks)

i. A ∩ C
ii. B ∩ (A ∪ C')
iii. A' – C'
iv. A x B
v. Find all subsets of A.

3. In a class of 30 students, 21 students like Science, 16 like English, 6 students do not like Science or English. How many Students like both Science and English? (5 marks)

4. Given that p , q and r are propositions, construct a truth table and verify the following:

$$\sim (\sim (p \vee q) \vee \sim (p \vee r)) \equiv p \vee (q \wedge r)$$ (5 marks)

Question 2 (Matrix Algebra) **20 marks**

If $A = \begin{bmatrix} 4 & -1 \\ 3 & 2 \end{bmatrix}$ and $B = \begin{bmatrix} 3 & 2 \\ -5 & 1 \end{bmatrix}$

1. Find the following:
   i. A + B (2 marks)
   ii. Determinant of A – B (3 marks)
   iii. AB (3 marks)

2. Solve the following system of linear equations using matrix inversion. (12 marks)

$$3x - y + z = 8$$
$$x - 3y + 2z = 9$$
$$-x + y - 4z = -1$$

Question 3 (Propositional Logic) **20 marks**

1. Given that p, q and r are propositions, construct truth tables and verify the following:
   i. $\sim (p \wedge q) = \sim p \vee \sim q$ (De Morgan's Law) (3 marks)
   ii. $p \wedge (q \wedge r) = (p \wedge q) \wedge r$ (Associative law) (3 marks)
   iii. $p \wedge (q \vee r) = (p \wedge q) \vee (p \wedge r)$ (Distributive law) (4 marks)

2. State whether the following compound propositions are tautologies, contradictions or contingent propositions?
   i. $p <=> (\sim p \wedge q)$ (5 marks)
   ii. $[\,(p => q) \wedge (q => r)\,] => (p => r)$ (5 marks)

Question 4 (Coordinate Geometry) **20 marks**

1. The general form of the equation of a straight line(L_1) is 2x-4y-7=0.
   i. Write L_1 in y=mx+c format. (2 marks)
   ii. What is the slope? (2 marks)
   iii. What is the intercept? (2 marks)
   iv. Find the line equation perpendicular to L_1 going through the point (1, 3) (2 marks)
2. Suppose (2,4), (-4,1) and (2,-3) are vertices of a triangle.
   i. Represent the above three points on a Cartesian coordinate system. (2 marks)
   ii. Find line equations of the sides of the triangle formed by the above three points. (6 marks)
   iii. Show that the area of the triangle is equal to 21. (4 marks)

Question 5 (Coordinate Geometry) **20 marks**

1. Write the equation of a circle given the center C(2,3) and radius 5 (4 marks)
2. Find coordinates of any two points on the above circle (4 marks)
3. Find the circle that goes through the points (4,0), (0,4) and $(2\sqrt{2}, 2\sqrt{2})$ (6 marks)
4. Show that line tangents to the above circle from an outside point (8, 0) is given by $y = \frac{x}{\sqrt{3}} - \frac{8}{\sqrt{3}}$ and $y = \frac{-x}{\sqrt{3}} + \frac{8}{\sqrt{3}}$ (6 marks)

Question 6 (Statistics) **20 marks**

1. What is meant by 'Mean', 'Median' and 'Mode'? Identify which of the above measures of central tendency is/are affected by outliers. (4 marks)
2. The scores of a batsman who played 11 consecutive 20 over matches in a tournament are given below.

   31, 27, 30, 32, 29, 34, 20, 27, 28, 27 and 23

   Find the following:

   i. Mean (3 marks)
   ii. Mode (3 marks)
   iii. Interquartile range (6 marks)
   iv. If this batsman plays another match, what score is required to maintain the previous standard deviation of 11 scores? (4 marks)

Question 7 (Statistics) **20 marks**

The table given below is a frequency distribution that shows the profit made by 100 businesses.

Profit (Rs.)	Number of companies
20,000 – 25,000	07
25,000 – 30,000	10
30,000 – 35,000	17
35,000 – 40,000	25
40,000 – 45,000	20
45,000 – 50,000	14
50,000 – 55,000	05
55,000 – 60,000	02

Calculate the following statistical parameters:

1. Mean (5 marks)
2. Median (5 marks)
3. Mode (5 marks)
4. Standard Deviation. (5 marks)

Note: Median, Mode and Standard Deviation for grouped data are calculated as follows:

$$Median = L + \frac{\left(\frac{n}{2}\right) - m}{f} \times c \quad Mode = L + \frac{(f_1 - f_0)}{(f_1 - f_0) + (f_1 - f_2)} \times c \quad Std = \sqrt{\frac{\sum f_i (x_i - \bar{x})^2}{n-1}}$$