Sample Paper
Answer 5 questions

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

1. Fill in the blanks with $\in$, $\notin$, $\subseteq$, = or $\neq$. Recall that $\mathbb{Z}$ is the set of all integers and ϕ is the empty set. (10 marks)

i.	2	----------	{2, 4, 7}
ii.	7	----------	$\mathbb{Z}^+$
iii.	{1, -2, 8}	----------	$\mathbb{Z}$
iv.	21	----------	{168, 147, 126, …}
v.	{16}	----------	{4, 8, 12}

2. Given the universal set U= {1, 2, 3, 4, 5, 7, 9, 11, 13, 15} , A= {1, 3, 9, 15}, B= {3, 9, 11}, D={2, 4} find the following.
   i. A ∩ B (2 marks)
   ii. (A ∪ D)' (2 marks)
   iii. D x B (2 marks)
   iv. Find all subsets of A. (2 marks)

3. In a class of 30 students, 16 like English, 13 students like Science and English, 6 students do not like Science or English. How many Students like only Science? (2 marks)

Question 2 (Propositional Logic) **[20 marks]**

1. Given that p, q and r are propositions, construct truth tables and verify the following:
   i. $\sim (p \vee q) = \sim p \wedge \sim q$ (4 marks)
   ii. $p \wedge (q \wedge r) = (p \wedge q) \wedge r$ (4 marks)
   iii. $\sim ((p \vee q) \wedge r) = (\sim p \wedge \sim q) \vee \sim r$ (4 marks)

2. Determine whether the following compound propositions are tautologies, contradictions or contingent propositions?
   i. $p \wedge (q \wedge \sim q)$ (4 marks)
   ii. $p <=> (\sim p \wedge q)$ (4 marks)

Question 3 (Coordinate Geometry) **[20 marks]**

1. The general form of the equation of a straight line(L_1) is 8x-2y-6=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 parallel to L_1 going through the point (3, 2) (2 marks)

2. **L_{XY}:** $x - y + 1 = 0$ **L_{XZ}:** $3x + y - 13 = 0$ **L_{YZ}:** $x + 3y - 7 = 0$ are line equations of the sides of the triangle XYZ.

   i. Find the vertices (X, Y and Z) of the triangle. (6 marks)

   ii. Determine equation of the circle through X, Y and Z points. (6 marks)

Question 4 (Matrix Algebra) **[20 marks]**

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

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)

$$x - 2y + z = 7$$
$$2x + y - 2z = -3$$
$$x + 2y - 3z = -9$$

Question 5 (Logarithms) **[20 marks]**

1. Use the Laws of Logarithms to expand each expression.

   i. $\log_2 2x^2$ (3 marks)

   ii. $\log_3(x^2y^{-3})$ (3 marks)

   iii. $\ln\left(\frac{a^2\sqrt{b^3}}{\sqrt[5]{c^2}}\right)$ (3 marks)

2. Evaluate the following:

   i. $\log_7 5$ (2 marks)

   ii. $\log_3 81 \log_5 0.008 \log_8 0.125$ (4 marks)

3. Solve the equation $5^{2x} - 12(5^x) + 35 = 0$. Find the value of x for three decimal places. (5 marks)

Question 6 (Statistics) **[20 marks]**

1. Briefly describe the terms 'Median', and ''Mode''? (4 marks)

2. The Bookstall Inc. is a special bookstore selling used books. Paperbacks are $ 1.00 each and hardcover books are $ 3.50 each. Last Tuesday morning 50 books were sold. Out of that 40 were paperbacks and the rest were hardcover. What was the weighted mean price of a book sold? (3 marks)

3. The following data selected randomly, represent the daily temperature measurements (in Celsius degrees) of eleven days of a town.

   27, 23, 28, 19, 34, 28, 32, 20, 28, 25 and 18

   Find the following:

   a. Mean (2 marks)
   b. Median (2 marks)
   c. Mode (2 marks)
   d. Interquartile range (3 marks)
   e. Standard Deviation (4 marks)

Question 7 (Statistics) **[20 marks]**

1. Explain the following terms briefly
   a. Population (2 marks)
   b. Census (2 marks)

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

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

   Calculate the following statistical parameters:

a. Mean (3 marks)
b. Median (4 marks)
c. Mode (4 marks)
d. Standard Deviation. (5 marks)

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

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

End of Paper