**National School of Business Management**
**BSc in Software Engineering / Computer Networks / Computer Security (Plymouth)**
**BSc in Management Information Systems**
**BSc in Computer Science Degrees – 16.1 / 16.2**
**1st Year 1st Semester**
**Mathematics-1: Sample Paper**

**Calculators are allowed.** **Time: 3 hours**
**Answer any 5 questions.** **Date: xx/xx/xxxx**

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**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 $\phi$ 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}, D={2,3} find the following.

i. A ∩ C (2 marks)
ii. B ∩ (A ∪ C') (2 marks)
iii. A' – C' (2 marks)
iv. A x D (2 marks)
v. Find all subsets of A. (3 marks)

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? (4 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 (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 4 (Coordinate Geometry)** **[20 marks]**

1. The general form of the equation of a straight line($L_1$) is 6x-2y-5=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 (5, 2) (2 marks)

2. Suppose the lines **$L_1$**: $2x - y - 3 = 0$, **$L_2$**: $x + 2y - 4 = 0$, and **$L_3$**: $7x + 4y - 48 = 0$ are sides of a triangle. Answer the questions given below.
   - i. Find the vertices of the triangle. (4 marks)
   - ii. Find the equation of the circle that goes through the above three vertices. (6 marks)
   - iii. Hence show that the radius of the circle is given by $\frac{\sqrt{65}}{2}$ (2 marks)

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

1. Use the Laws of Logarithms to expand each expression.
   - i. $\log_3 3x^2$ (2 marks)
   - ii. $\log_2(x^2y^{-3})$ (3 marks)
   - iii. $\ln\left(\frac{a^2\sqrt{b^3}}{\sqrt[5]{c^2}}\right)$ (3 marks)

2. Evaluate the following:
   - i. $\log_7 5$ (4 marks)
   - ii. $\log_3 81 \log_5 0.008 \log_8 0.125$ (4 marks)

3. Solve the following equation

$$2\log_2(x+15) - \log_2 x = 6$$ (4 marks)

**Question 6** **20 marks**

1. Briefly describe 'Median' and 'Mode' giving examples? (2 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:

   a. Median (2 marks)
   b. Mode (2 marks)
   c. Interquartile range (3 marks)

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

| Profit (Rs.) | Number of companies |
|---|---|
| 20,000 – 30,000 | 12 |
| 30,000 – 40,000 | 20 |
| 40,000 – 50,000 | 35 |
| 50,000 – 60,000 | 25 |
| 60,000 – 70,000 | 8 |

   Calculate the following statistical parameters:

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

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

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