2025

MATHEMATICS — HONOURS

Paper : SEC-2

(Python Programming and Introduction to LaTeX)

Full Marks : 75

The figures in the margin indicate full marks.

Candidates are required to give their answers in their own words as far as practicable.

Group - A

[Python Programming]

(Marks : 50)

1. Answer ***any five*** questions :

(a) What is a function in Python? Mention any one type of function with an example. 1+2

(b) What is `len()` function and explain how it is used on strings with an example. 3

(c) Write the output of the following code : 3

```
i, j, k = 4, –1, 0
x = i and j and k
y = i or j and k
z = i and j or k
print (x, y, z)
```

(d) Write the output of the following Python code : 3

```
L = ['This', 'is', 'our', 'first', 'exam']
print (L[–3])
print (L[– 4 : 4])
L[3] = 'second'
print(L)
```

(e) Compare a list and a tuple in Python. 3

(f) Write code using SymPy to compute the following expression :

$x^2e^{3y} + y \log x$, for $x = 2$ and $y = 3$. 3

(g) What will be the output of the following Python code? 3

(i) `x = 5 + 4 / 2 * 3 – 16`

(ii) `y = 8 + 2 ** 3 ** 2 // 4`

2. Answer ***any seven*** questions :

(a) What are the outputs of following Python codes?

(i)
```
i = 15
while 1 :
    print (i, end = ';')
    i -= 3
    if i < 0:
        break
```

(ii)
```
print (5/3*4//2**2)
```

(iii)
```
n = 22/7; print (f "The value of n is :{n:5.4f}")
```
2+1+2

(b) Write a program in Python to find the binary equivalent to a given positive integer with or without recursion. 5

(c) (i) Write Python codes to solve the following equations using SymPy :

$x + 2y + z = 1$ and $x + 3y + 2z = 3$

(ii) Write a Python program to print the multiplication table of 9. 3+2

(d) Write code to plot the following two functions in one graph using SymPy :

(i) $f(x) = x^2 - 1$ in $(-3, 3)$ in color blue.

(ii) $g(x) = x^2 + 2$ in $(-3, 3)$ in color black. 5

(e) Write the output of the following Python codes :

(i)
```
s1 = "Good Morning"
s2 = s1.lower()
print (s2)
```

(ii)
```
ℓ = [1, 3, 5, 7, 9]
print (ℓ [2])
print (ℓ [-2])
```

(iii)
```
m = [2, 6, 2, 4, 2, 6]
C1 = m.count(2)
C2 = m.count(8)
print (C1)
print (C2)
```
1+2+2

(f) Write a Python program to test whether a given positive integer (> 1) is prime or not. 5

(g) Write a Python program to find the roots of a quadratic equation $ax^2 + bx + c = 0$. 5
(a, b, c : real and $a \neq 0$)

(h) (i) Write code using SymPy to simplify $\frac{x^3 - 1}{x - 1}$.

(ii) Write code using SymPy to find the roots of the equation $x^2 - 5x + 6 = 0$. 2+3

(i) Write Python codes to input two 3×3 matrices A and B and find their sum and display it. 5

(j) Write a Python function to find factorial of a number. Use it to compute

1! 2! + 2! 3!+ 3! 4! + ... + 10! 11! 3+2

Group - B

[Introduction to LaTeX]

(Marks : 25)

3. Answer ***any five*** questions : 2×5

(a) Write command in LaTeX for writing the following :

$f : \mathbb{R} \to \mathbb{R}$ s.t. $f(x) = 2x + 9$, $x \in \mathbb{R}$.

(b) Write code in LaTeX to insert an image as input in the document.

(c) Write LaTeX command for the following output :

$$\begin{vmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \\ 7 & 8 & 9 \end{vmatrix} = 0.$$

(d) What is the ouput of the following LaTeX code?

$$\$ f(x) = \sum_{n = 0}^{\infty}\frac{f^ {(n)}\ (a)}\ \{n!\}\ (x - a)^ n\ \$$$

(e) Write LaTeX commands to create the following equation with equation number :

$$x^{\alpha} + e^{2x^2} - \beta^x = 0 \qquad (1)$$

(f) Write the command in LaTeX to generate the expression $\nabla^2 f(x, y) = \frac{\partial^2 f}{\partial x^2} + \frac{\partial^2 f}{\partial y^2}$.

(g) Explain the difference between the outputs of the following two LaTeX source codes :

(i) Suppose that $x = 25$ is a solution.

(ii) Suppose that $$x = 25$$ is a solution.

4. Answer ***any three*** questions :

(a) What is the wrong with the following input in LaTeX command? What is the right way to do it?

```
\Documentclass{article}
\usepackage{amsmath}
\begin{document}
We have following options
\begin{itemize}
\item $$ x\ ge y$
\item $x  \le y$
\item x = y
\end {document}
```

3+2

(b) Write a block of codes in LaTeX to typeset the following :

A system of linear equation in three variables x_1, x_2 and x_3 can be represented as :

$$\begin{pmatrix} a_{11} & a_{12} & a_{13} \\ a_{21} & a_{22} & a_{23} \\ a_{31} & a_{32} & a_{33} \end{pmatrix} \begin{pmatrix} x_1 \\ x_2 \\ x_3 \end{pmatrix} = \begin{pmatrix} 2 \\ 3 \\ 4 \end{pmatrix}$$

5

(c) Write a block of LaTeX source code to create the following table :

Planet	Maximum	Minimum
Mercury	69.4	46.8
Venus	109.0	107.6
Earth	152.6	147.4

5

(d) Write a block of LaTeX code to display the mathematical expression :

$$\begin{pmatrix} \sec\theta & \sec^2\theta & \sec\dfrac{\theta}{2} \\ 1 & \lambda & \lambda^2 \\ \sqrt{\tan\theta} & \cos\phi & \sin\psi \end{pmatrix}$$

5

(e) Write a block of LaTeX code to print the following system of equations in its present form :

$$x\tan(\alpha) + y\cos(\gamma) + z\delta = \log(3\psi)$$
$$ax + by - \alpha\beta = 1$$
$$C_P - C_V = \frac{VT\beta^2}{K_T}$$

5
