

2024

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) Suppose in Python $a = \text{False}$, $b = \text{True}$, $c = \text{True}$, then evaluate the value of the following expressions : 3
- a or b
 - $(a \text{ and } b)$ or c
 - a and $(b \text{ or } c)$.
- (b) What is a list in Python? How can you check if 3 is an element of the list $[1, 7, 5, 3, 4]$? 1+2
- (c) Write down the syntax of an if-else statement in Python. Write a Python program using if-else statements to check whether a number is even or odd. 1+2
- (d) Given a list :
 $\text{primes} = [2, 3, 5, 7, 11, 13, 17, 19, 23, 29]$.
 How do you obtain the first four primes? 3
- (e) Define dictionary with example in Python. 3
- (f) Use SymPy to compute the expression $x^3 + xe^y$ for $x = 1.5$, $y = 0.75$. 3
- (g) Write a Python program to find the surface area ($4\pi r^2$) of a sphere, where radius of sphere is given. 3

2. Answer **any seven** questions :

(a) Write the output of the following codes in Python :

- `x = 'Hello'; print(x+x)`
- `print(len(["Math", 2, 4, 6]))`
- `print(4%2+5**2**2+5/2)`.

2+1+2

Please Turn Over

- (b) Explain the importance of “break” and “continue” statements with examples in Python. 5
- (c) (i) Write a Python program to calculate the sum of three given numbers. If the values are equal, print “The numbers are all equal”.
(ii) Write the values of y in following code :

```
y = [x for x in range(10) if x%2 == 0]
print(y).
```

 3+2
- (d) Write a Python function to compute

$$S = \sum_{n=1}^{30} \frac{1}{u_n^2 + 1}$$

where $u_1 = 1$, $u_2 = 1$ and $u_{n+1} = u_n + u_{n-1}$, $n \geq 2$. 5

- (e) Write a Python program to generate a list of all primes number between two positive integers 20 and 50. 5
- (f) (i) Find the value of python code $2**6 - 35//6\%7$.
(ii) Use SymPy to find the roots of the equation $x^4 - x^2 + 1 = 0$.
(iii) Use SymPy to simplify the expression $(x^3 + y^3)(x^3y + 2y^2)$. 1+2+2
- (g) Write short notes on the list operations :
(i) sort ()
(ii) append ()
(iii) pop (). 5
- (h) Write a Python program to check whether a year is a leap year or not. 5
- (i) Plot the functions $f(x) = x^2$ and $g(x) = x^3$ on the same graph over the interval $[-2, 2]$ using a dashed line for $f(x)$ and a dotted line for $g(x)$. Also add labels to the axes and a title to the graph. 2+2+1
- (j) Plot the following two functions in one graph using SymPy :
(i) $f(x) = x^2$ in $(-2, 2)$ in color black.
(ii) $g(x) = x^3 - 2$ in $(-2, 2)$ in color blue. 5

Group - B

(Introduction to LaTeX)

(Marks : 25)

3. Answer *any five* questions : 2×5
- (a) What is the output of the LaTeX command :

$$\frac{d}{dx} \left(\int_0^x f(t) dt \right) = f(x)$$

- (b) What is the wrong with the following input in LaTeX command? What is the right way to do it?
If $\text{\$theta} = \text{\$pi}$ then $\text{\$sin theta} = 0$.

- (c) Write down codes in LaTeX to produce the following output :

$$\left| \frac{1}{1+x} \right|.$$

- (d) Write three LaTeX commands for font size and style of a tex.
(e) Write the command in LaTeX to generate the expression $\forall x \in \mathbb{R}$.
(f) Write LaTeX command for the following output :

$$\alpha^2 + \beta^2 = \gamma^2.$$

- (g) What is the command for an underlined text in LaTeX? Give one example.

4. Answer **any three** questions :

5×3

- (a) Write the following statement in LaTeX :

“The well-known Pythagorean theorem $x^2 + y^2 = z^2$ was proved to be invalid for other exponents. Meaning the next equation has no integer solutions :

$$x^n + y^n = z^n, \quad x, y, z \in \mathbb{N}.”$$

- (b) Write a block of LaTeX code to display the mathematical expressions :

$$\begin{pmatrix} \alpha & \lambda & \sqrt{\tan \theta} \\ \beta & \beta^2 & \beta^3 \\ \frac{1}{3} & -10 & \sqrt{3} \end{pmatrix}.$$

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

| | Amount (kg) | Rate/kg | Delivery place |
|----------|-------------|---------|----------------|
| Item I | 2500 | 370 | Kolkata |
| Item II | 750 | 251 | Chennai |
| Item III | 350 | 75 | Mumbai |

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

$$20x + 7y + 45z + 11u = 1$$

$$15z + 9u = 7$$

$$5x + 17y + 5z + 9u = 1$$

$$13y + 6z + 3u = 2.$$

(e) Write code in LaTeX for typesetting the following :

$$f(x) = \begin{cases} -1 & x < 0 \\ 0 & x = 0 \\ +1 & x > 0. \end{cases}$$
