

[This question paper contains 4 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 9254

J

Unique Paper Code : 2353010015

Name of the Paper : Research Methodology

Name of the Course : **Hons./Prog. Mathematics (NEP-UGCF 2022)**

Semester : VI – DSE

Duration : 3 Hours

Maximum Marks : 90

Instructions for Candidates

1. Write your Roll No. on the top immediately on receipt of this question paper.
2. Attempt **all** questions by selecting **two** parts from each question.
3. **All** questions carry equal marks.

1. (a) Discuss the importance of assignments and homework in the context of mathematics.

- (b) Give any three goals of mathematical learning. Explain your answer.

- (c) Correct the flaws, if any, in the following sentences with respect to mathematical writing :

(i) We claim that if we subtract a from b we get a number greater than or equal 9.

(ii) x is the positive real number, so x has a real square root.

(iii) let $m = 6$, Then $m - 10 = -4$.

P.T.O.

2. (a) Write a short note on usefulness of Wikipedia as a web resource for mathematical research.
- (b) If an individual wishes to pursue research in mathematics, explain in detail how a suitable research topic can be identified and selected.
- (c) Discuss any three challenges faced by mathematicians while doing research work and how to overcome these challenges.
3. (a) Discuss the key differences between a poster presentation and an oral presentation in terms of their effectiveness for engaging an audience and conveying complex information. Give two examples- one example of each situation where one type of presentation is preferred over the other type of presentation.
- (b) Write a LaTeX code to display the following :

$$\begin{aligned}
 \prod_p \left(1 - \frac{1}{p^2}\right) &= \prod_p \frac{1}{1 + \frac{1}{p^2} + \frac{1}{p^4} + \dots} \\
 &= \left(\prod_p \left(1 + \frac{1}{p^2} + \frac{1}{p^4} + \dots\right) \right)^{-1} \\
 &= \left(1 + \frac{1}{2^2} + \frac{1}{3^2} + \frac{1}{4^2} + \dots\right)^{-1} \\
 &= \frac{6}{\pi^2}
 \end{aligned}$$

Explain which environment is used and why.

- (c) Discuss traditional 'chalk-and-board' method versus modern technology-based tools (such as LaTeX Beamer or digital slides) for teaching and presenting mathematics. Highlight the strengths and drawbacks of each approach with suitable examples.

4. (a) Compare the use of LaTeX Beamer and PowerPoint for presenting mathematical content. Discuss the key benefits of LaTeX Beamer for mathematics presentations and explain three specific LaTeX features that make it particularly suitable for mathematical content.
- (b) Describe the purpose of the following LaTeX commands with examples :
- (i) `\text{}` in math mode
- (ii) `\left()`
- (c) Write a LaTeX code to display the following mathematical expressions clearly and properly formatted. Use appropriate math environments where necessary.

(i)
$$\sqrt{\frac{x^2 + \sqrt{5}}{2^3}}$$

(ii)
$$\begin{bmatrix} 4 & 3 \\ 3 & 4 \end{bmatrix} + \begin{bmatrix} x^2 & y \\ \sqrt{y} & y^3 \end{bmatrix}$$

5. (a) What does the SIAM aim to do, and how does it help in research in mathematics?
- (b) What role does arXiv play in the field of mathematics, and how does it differ from peer-reviewed journals.
- (c) Discuss the relevance of Mathematical Citation Quotient (MCQ) and Impact Factor of a journal and how they are calculated.

6. (a) Explain the role of MathSciNet and Scopus in academic research, and how do they help researchers?
- (b) Discuss research ethics with respect to research writing and publication.
- (c) Discuss any three common unethical practices in research. What can be the possible consequences of following such unethical practices?