[This question paper contains 4 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 5651 **J**

Unique Paper Code : 2223010023

Name of the Paper : Research Methodology

Name of the Course : **B.Sc. Hons.-(Physics)_NEP:UGCF-2022**

Semester : VI- Semester (DSE Paper)

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. Q1 is compulsory. Answer any SIX parts from Q1 and FIVE questions in ALL.
3. Use of a non-programmable calculator is allowed.
4. Attempt all the parts of questions together.
5. Z- and T- tables are permitted.

1. Attempt any six parts of the following: (3×6=18)

(a) Explain three types of biases that may occur in research.

(b) Discuss any two methods of data collection for qualitative research highlighting one of their merits.

(c) What is Source-Normalized Impact Per Paper (SNIP)? If SNIP is A/B, explain the terms A and B.

P.T.O.

(d) Name any two databases used in Physics/Astrophysics and also mention one of their capabilities.

(e) What is gnuplot? Write a code to plot sin(x) between -5 and 5. Include a title as "Fig.1" with font size 20.

(f) A person wishes to apply for a patent. Mention any three prerequisites which should be considered before filing a patent application.

(g) Discuss any fellowship scheme for students by the Council of Scientific & Industrial Research. What is its eligibility criterion and mention one benefit it provides?

2. (a) What is the purpose of a literature review? Smita does not know how to conduct a literature review. Give three reasons why she should conduct a literature review for her research. (4)

(b) You are given the following dataset taken during an experiment in their usual units.

x	2	5	7	9	10
y	5	12	20	24	30

(i) Compute the sample means $\bar{x}$ and $\bar{y}$

(ii) Use the least square fitting (for linear regression) formulas to compute β_1 and β_0

$$\beta_1 = \frac{\sum(x_i - \bar{x})\,(y_i - \bar{y})}{\sum(x_i - \bar{x})^2}$$

$$\beta_o = \bar{y} - \beta_1 \bar{x}$$

(iii) Write the final linear regression equation.

(iv) The instrument should have a reading (0,0). How can this data be used to indicate that the instrument was not set properly and needed calibration? (8)

(c) What are the important requirements for using the Z-test? Use the Z-test for the following data. A school wants to compare the average test scores of male and female students:

Male: $n_1 = 50$, Mean, $\overline{X}_1 = 78$; Standard Deviation, $\sigma_1 = 10$;

Female: $n_2 = 50$, Mean, $\overline{X}_2 = 74$; Standard Deviation, $\sigma_2 = 9$. Show that we fail to reject the null hypothesis at the 1% significance level. (6)

3. (a) What are the key features of a good research problem? (5)

(b) Consider the function: $f(\theta) = (\theta - 4)^2$. . Use the gradient descent method to minimise this function starting from an initial value of $\theta_o = 0$.. Using a learning rate of $\beta = 0.1$, perform two iterations to obtain the updated values of θ using the rule: $5\theta_{n+1} = \theta_n - \beta \cdot \nabla f(\theta_n)$ after computing the gradient $\nabla f(\theta)$. Discuss one advantage and disadvantage of this method. (7)

(c) What is the difference between linear and multilinear regression? Explain with the help of a mathematical expression and when are these used? (6)

4. (a) A scientist is looking for a journal for the publication of their work. Below are three journals with various parameters. Based on this data, discuss five factors which will help to decide their choice to be a non-predatory journal. Which journal is likely to be a predatory journal in this list? (6)

Journal	Peer Review Time	Indexing	APC (Dollars)	Impact Factor	Editorial Board Information
X	3 Weeks	Indexed in reputed database	2000	Not Calculated	Available
Y	3 Days	Not Indexed	1500	Not Calculated	Not Available
Z	4 Weeks	Indexed in reputed database	2500	5.2	Available

(b) What is the NASA/IPAC Extragalactic database (NED)? Explain the purpose and input fields of the Coordinate Calculator in this database. (5)

(c) Explain three ways in which errors can be communicated for a published article. Describe their differences. (7)

5. (a) Discuss any four features of scientific conduct. Specify two reasons why it is needed. (6)

(b) Explain the difference between redundant and duplicate publications. What is meant by salami slicing and why should it be discouraged? (5)

(c) Mention five different types of work which can be copyrighted. Explain the concept of "fair use" in copyright law with the help of an example. (7)

6. (a) What is a trademark? Mention three different types of trademarks. What is a symbol for a registered and unregistered trademark? (6)

(b) What is a control parameter in any experiment? Why is it needed? Explain it with the help of any physics experiment. What are the objectives of background setting of an experiment? (7)

(c) What is the peer-review process? Differentiate between single-blind and double-blind peer review. (5)