

Code No.

**M – 2933**

## Ph.D. ENTRANCE EXAMINATION, DECEMBER 2021

Time : 3 Hours

Max. Marks : 100

### **Instructions :**

- 1) Answer **any ten** questions each from Part **A** and **B**.
- 2) Each question carries **five** marks.
- 3) Candidates should clearly indicate the **Part, Question Number** and **Question Booklet Code** in the answer booklet.
- 4) The candidates are **permitted** to answer questions **only** from the subject that comes under the **faculty** in which he/she seeks registration as indicated in the **application** form.

Name of candidate

Register Number

Answer Booklet Code

Signature of Candidate

Signature of Invigilator

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## FACULTY OF SCIENCE

1. **Geography**
2. **Mathematics**
3. **Psychology**
4. **Physics**
5. **Home Science**
6. **Zoology**

**1. Geography**

**Part – A**

**Research Methodology**

- I. Answer any **ten** questions :
1. Differentiate between qualitative and quantitative research.
2. Write a brief note on case study method with suitable examples.
3. Discuss about any five characteristics of a good research design.
4. Explain about basic steps involved in formulation of research problems.
5. Define thesis and describe the procedure involved in thesis writing.
6. Write a detailed essay on different types of research in geography.
7. Discuss the significance of theories and models in geography.
8. Describe about major issues and challenges faced by geographers in their research work.
9. Define sampling and explain types of sampling in geographical research.
10. Distinguish between type 1 error and type 2 error.
11. Write about significance of bibliography of a thesis.
12. What is SPSS? Discuss its application.
13. Write about methods of qualitative research.
14. What do you mean by participatory approach in geographical enquires?
15. Discuss the significance of research ethics.

**(10 × 5 = 50 Marks)**

**Part – B**  
**Geography**

II. Answer any **ten** questions :

1. Discuss the concept of cycle of erosion.
2. Examine the causes of climate change.
3. Critically approach Quantitative revolution in Geography.
4. Write about the application of Remote sensing in hydrological studies.
5. Examine the spatrial pattern of poverty in India.
6. Discuss the significance of Weber's Model of location of Industries.
7. Discuss the features of CBD of cities.
8. Briefly explain the application of GIS in terrain modelling.
9. Elaborate the stages of Environmental Impact Assessment.
10. Explain the causes of regional imbalances.
11. Discuss the consequences of return migration in Kerala.
12. Write notes on techniques of field survey.
13. Explain the methods of slope analysis.
14. Discuss the advantages of GPS survey.
15. Explain in brief the recent trends in human geography.

**(10 × 5 = 50 Marks)**

## 2. Mathematics

### Part – A

#### Research Methodology

- I. Answer any **ten** questions :
1. What do you mean by research? Discuss about different types of research.
  2. What is a research problem? State the components of research problem.
  3. What is meaning of probability sampling? Discuss about simple random sampling, systematic sampling and stratified sampling.
  4. Write a note on plagiarism.
  5. Explain the importance of a research report and state the various steps to be taken in writing such a report.
  6. Write a note on usefulness of bibliography in a research report.
  7. Explain the points to be considered in the process of identifying a research problem.
  8. Discuss the format of thesis and dissertation.
  9. Define Research and explain how qualitative research differs from quantitative.
  10. What is meant by testing of hypothesis? Draw a flow chart for executing hypothesis testing procedure with a suitable example.
  11. Write different types of citation style of the following research article.
  12. How correlation is different from regression? Cite an example where correlation will be applicable and another example where regression will be applicable.
  13. Describe in detail types of literature referred in research.
  14. Explain the requisites of abstract.
  15. What is meant by citation index?

**(10 × 5 = 50 Marks)**

## Part – B

### Mathematics

II. Answer any **ten** questions :

1. Let  $G$  be a group of order  $120 = 2^3 \times 3 \times 5$ . Show that  $G$  either has a normal Sylow 5-subgroup or a (normal) subgroup of index 2.
2. Let  $G$  be a group of order  $p^3$ , where  $p$  is prime. Determine all possibilities for the number of conjugacy classes in  $G$  and their sizes.
3. Let  $a \in \mathbb{C}$  and assume that  $f : \mathbb{C} \rightarrow \mathbb{C}$  is a function which is not identically zero, which is complex-differentiable at the origin and  $f'(0) = a$ , and which satisfies

$$f(z_1 + z_2) = f(z_1)f(z_2)$$

for each  $z_1, z_2 \in \mathbb{C}$ . Prove that  $f(z) = e^{az}$  for each  $z \in \mathbb{C}$ .

4. Give an example of a region  $G \subset \mathbb{C}$  and a harmonic function  $u : G \rightarrow \mathbb{R}$  such that  $u$  is not the real part of any holomorphic function on  $G$ . You will need to justify your assertion.
5. Show that the series

$$\sum_{n=1}^{\infty} \frac{(-1)^n}{n + |x|}$$

converges for each  $x \in \mathbb{R}$  and the sum defines a Lipschitz function.

6. Prove that if  $a$  and  $b$  are odd integers, then the polynomial  $f(x) = x^3 + ax + b$  has no rational roots.
7. Prove that every closed subset  $C$  of the real line is the closure of a finite or countable set.

8. Suppose that  $X$  is a compact metric space. If  $Y$  is another metric space (possibly noncompact), let  $p : X \times Y \rightarrow Y$  be the map  $p(x, y) = y$ . Show that if  $Z$  is a closed subset of  $X \times Y$  then  $p(Z)$  is closed in  $Y$ .
9. Prove that the polynomial  $x^4 + x + 2021$  is irreducible over  $\mathbb{Q}$ .
10. Let  $A$  be a nonsingular real  $n \times n$  matrix. Prove that there exists a unique orthogonal matrix  $Q$  and a unique positive definite symmetric matrix  $B$  such that  $A = QB$ .
11. Let  $S, T$  be two normal operators in the complex finite dimensional inner product space  $V$  such that  $ST = TS$ . Prove that there is a basis for  $V$  consisting of vectors that are eigenvectors of both  $S$  and  $T$ .
12. Apply the Monotone Convergence Theorem to show that

$$\lim_{n \rightarrow \infty} n \left( 1 + \frac{t}{n} \right) = t, t \geq 0$$

13. Does  $\{\sin(nx)\}$  converge in the  $L^1$  norm on  $[0, 2\pi]$ ?
14. Give an example of a sequence of functions  $\{f_n\}$  which converges to the constant zero function in  $L^1$ , but so that  $f_n(x)$  does not converge to zero at any point of  $[0, 1]$ .
15. Is there a compact, uncountable set of real numbers which contains no rational numbers? Give an example or prove no such set exists.

**(10 × 5 = 50 Marks)**

### 3. Psychology

#### Part – A

#### Research Methodology

- I. Answer any **ten** questions :
1. Requirements for a standardized test.
  2. Non-experimental research designs.
  3. One way ANOVA and post hoc tests.
  4. Interview as a research tool.
  5. Types of tests.
  6. Experimental Social Psychology.
  7. Action Research.
  8. Researcher as a social activist.
  9. Qualitative data analysis.
  10. Attitude scales.
  11. Types of observation.
  12. Case study.
  13. Review of literature.
  14. Projective technique.
  15. 16PF.

**(10 × 5 = 50 Marks)**

**Part – B**  
**Psychology**

II. Answer any **ten** questions :

1. Integrating culture in Psychology.
2. Factors affecting problem solving.
3. Ethics in Counselling.
4. Endocrine secretions during stress.
5. Blood brain barrier and thalamic region.
6. Hemispheric asymmetry.
7. Working memory.
8. Nature and characteristics of phobia.
9. Causes of Schizophrenia.
10. Human Resource Development.
11. Theories of emotion.
12. Selective Attention.
13. Selective Mutism.
14. Social identity.
15. Illusion and perception.

**(10 × 5 = 50 Marks)**



## 4. Physics

### Part – A

#### Research Methodology

I. Answer any **ten** questions :

1. Discuss the motivation and types of research.
2. Discuss the criteria of scientific research.
3. Define the terms “citation index and impact factor”.
4. Give a short account of intellectual property rights and patent law.
5. What are systematic errors and random errors? Explain.
6. What are Monte-Carlo methods? Explain.
7. What are the key features of Python?
8. Name any five physics journals along with publishers and subject area.
9. Explain linear regression analysis.
10. Describe Chi-square distribution and F distribution.
11. Explain the XRD analysis for the determination of unit cell parameters.
12. Comment on the statement. “IR and Raman analyses complement each other”.
13. Discuss briefly on the working principle of TGA and DTA.
14. Distinguish between SEM and TEM techniques.
15. Give a brief account on band gap and defect level analysis.

**(10 × 5 = 50 Marks)**

## Part – B

### Physics

II. Answer any **ten** questions :

1. What are Type I and Type II superconductors? Explain.
2. Derive the expression for the energy in an electric field.
3. Find the inverse Laplace transform of  $\frac{s}{s^2 + a^2}$ .
4. Explain the term effective mass and crystal momentum.
5. State and explain Franck-Condon principle.
6. Construct a half adder using an XOR and AND gate.
7. Explain the concepts of phase velocity and group velocity.
8. Explain with neat diagram what are Schmitt lines.
9. Outline the specialities of magic numbers in nuclei.
10. What are Pauli spin matrices? Deduce their important properties.
11. What are the limitations of Klein-Gordon equation? How they are remedied in Dirac equation.
12. Evaluate the integral  $I = \int_0^{\infty} \frac{dx}{1+x^4}$  using the residue theorem.
13. The lagrangean for simple pendulum is given by  $L = \frac{1}{2} ml^2 \dot{\theta}^2 - mgl(1 - \cos \theta)$ . Obtain the Hamilton's equations.
14. Reduce expression  $\overline{\overline{AB} + \overline{A} + AB}$  using Boolean algebraic theorems.
15. Consider a two level quantum system with energies  $\epsilon_1 = 0, \epsilon_2 = \epsilon$ . Obtain the Helmholtz free energy and the specific heat of the system.

**(10 × 5 = 50 Marks)**

## 5. Home Science

### Part – A

#### Research Methodology

- I. Answer any **ten** questions :
1. State the importance and advantages of breast feeding.
  2. Give an account of basic issues in Child Development.
  3. Enumerate the various types of learning.
  4. Highlight on the existing scenario of early childhood education in India.
  5. Bring out the basic perception and need of developmentally appropriate practices.
  6. Elaborate on the functions and types of nutrients in the body.
  7. Give an account of methods of cooking and state its significance, advantages and limitations.
  8. Prepare a RDA diet plan for a pregnant women.
  9. Write notes on
    - (a) Work simplification
    - (b) Mundell's classes of changes.
  10. Explain the contemporary trends in housing.
  11. Elucidate the elements and principles of garment designing.
  12. State the principles and steps for extension program planning.
  13. Define Entrepreneurship. Point out its significance at the present scenario.
  14. Enumerate the parts of research report in detail.
  15. What are the ethical concerns to be taken into consideration in research?

**(10 × 5 = 50 Marks)**

**Part – B**  
**Home Science**

I. Answer any **ten** questions :

1. Explain on the types of graphs and tables used in research.
2. Describe the human developmental stages and its significance.
3. Make a note of mental health issues faced by adolescents during the COVID 19 pandemic.
4. Classify differently abled children and make a note on their characteristics and causes.
5. Point out the need and significance of life skill education and counselling in schools.
6. Indicate the food preservation techniques used. Also define and classify food preservatives.
7. State the characteristics, feeding patterns and complications faced by LBW and premature babies.
8. Elaborate on the significance, role and effect of advertisements on consumers.
9. Enumerate on the methods of fabric construction.
10. Define and classify dyes.
11. Point out the significance and barriers of communication.
12. What do you mean by Women Empowerment? State the current status of Women in India.
13. Define and classify research with relevant examples. State its significance and objectives.
14. Point out the different forms of scientific writing.
15. Prepare a weekly plan on any relevant topic for grade 1 students.

**(10 × 5 = 50 Marks)**

## 6. Zoology

### Part – A

#### Research Methodology

- I. Answer any **ten** questions :
  1. Comment on the meaning, objectives and significance of research.
  2. Write notes on the types of research.
  3. Discuss the importance of literature survey in research.
  4. Write notes on the online databases available for life science research.
  5. Discuss the important concepts related to research design.
  6. Describe the characteristics and format of a research report.
  7. Discuss the significance of intellectual property rights (IPR) in research.
  8. Write notes on the following :
    - (a) Plagiarism
    - (b) Copyright
  9. Discuss methods of data collection.
  10. Write notes on geographical indication.
  11. What do you mean by impact factor of a journal? What are the factors that affect the impact factor of a journal?
  12. Discuss legal and ethical guidelines applicable to research in India.
  13. Write notes on the following :
    - (a) Ethics in research
    - (b) Patents.
  14. Write briefly on the following :
    - (a) ANOVA
    - (b) Student 't' test
    - (c) Regression analysis
    - (d) Standard deviation
  15. Describe the features of a good experimental design.

**(10 × 5 = 50 Marks)**

## Part – B

### Zoology

II. Answer any **ten** questions :

1. Comment on the unique physico-chemical properties of water and its biological importance.
2. Why biodiversity is considered as most important natural wealth of a nation? Discuss the major threats to biodiversity and possible conservation measures.
3. Discuss the major pathways of glucose utilization.
4. Comment on the nutritional diversity among prokaryotes. How does the physiological diversity among prokaryotes could be exploited in bioremediation strategies?
5. Write an essay on various types of RNA's and their function.
6. Describe theory of natural selection.
7. Write notes on Human Genome Project and its utility to humanity.
8. Discuss high energy bonds and energy rich compounds in muscle.
9. Compare the osmoregulatory mechanisms of a fresh water fish and a marine fish.
10. Write an essay on gene mapping methods.
11. Discuss the importance of hypophyseal hormones.
12. What do you mean by global warming and climate change? With the help of few examples discuss the major threats to biodiversity due to climate change.
13. Comment on the different types of natural disasters. What are the strategies for a natural disaster management?
14. What is meant by gene therapy? Describe the principle behind CRISPR Cas 9 mediated gene editing.
15. Write about the applications of nano biotechnology in biology and medicine.

**(10 × 5 = 50 Marks)**

## ROUGH WORK

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