Code No.	G – 1910

Ph.D. ENTRANCE EXAMINATION, MAY 2019

Time : 3 Hours | Max. Marks : 100

Instructions **:**

1) *Answer **any ten** questions from Part/Section **A** and **B**.*
2) ***All** questions carry **equal** marks.*
3) *Candidates should clearly indicate the **Part/Section, 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

FACULTY OF SCIENCE

1. **Zoology**
2. **Mathematics**
3. **Physics**
4. **Geology**
5. **Demography**

FACULTY OF SCIENCE

1. Zoology

Part – A

Research Methodology

Answer **any 10** questions. All questions carry equal marks. **(10 × 5 = 50 Marks)**

1. Give an account on methods of data collection in research. Add a note on questionnaire.
2. What is a variable? Give an account on the types of variable.
3. Define research problem. Describe types of research design.
4. What is sampling? Write the methods of sampling.
5. Write a note on manuscript preparation, publication process and proof reading.
6. How are graphical representations, illustrations and photographic images helpful in research papers?
7. Explain measures of central tendency and its importance in research. Add a note on standard deviation.
8. Explain null hypothesis, alternate hypothesis and types of error in research.
9. What are the sources of literature? Discuss the importance of literature review in research.
10. What is validity of research findings? Write a few approaches for controlling the sources of artifact and bias.
11. Give an account on the fundamental ethical principles.
12. Write a short essay on Bibliography and its related softwares.
13. What is patency? Write the pros and cons of patency in research.
14. Describe the steps to write a good research proposal.
15. Write the applications of Chi-square test and ANOVA.

Part – B

Zoology

Answer **any 10** questions. All questions carry equal marks. **(10 × 5 = 50 Marks)**

1. What is speciation? Give an account on the modes of speciation.

2. Explain the pathway of how ATPs formation occurs through chemiosmosis.

3. Write a short essay on application of molecular cloning.

4. Explain how do the animals respond to environmental changes.

5. How are genomic and proteomic databases helpful in research?

6. Give an account on methods of gene therapy and its potential applications.

7. Explain the hormonal control of molting and development in insects.

8. Discuss the sources of genetic variation highlighting the types of mutations.

9. What is an ecological community? How does the evolutionary events influence the community structure?

10. Give an account on the principle of innate immune system with an example.

11. Write a short essay on human genome organization.

12. Write a short essay on ciliary and flagellar movements in protozoa.

13. Describe the structure and classification of proteins.

14. Give an account on the respiratory system of aves.

15. Write the evolutionary and functional anatomical features of fish to be used as a research model.

2. Mathematics

Part – A

Answer **any 10** questions. All questions carry equal marks. **(10 × 5 = 50 Marks)**

1. Give any three objectives of research.
2. What do you mean by literature survey?
3. Give one examples to illustrate how to you define a research problem.
4. What are the Criteria of good research?
5. What is meant by research design?
6. Explain the procedure for organizing the contents of the thesis.
7. Write short note on preparation of abstract of a research paper.
8. Explain the organization of a scientific paper.
9. What are the majorities of the problems encountered by researchers in India?
10. How will you cite the references in a research paper?
11. How to select a good title for the thesis.
12. Write the ethics in scientific publishing.
13. How is internet useful for researchers?
14. Explain the use of computer in report writing.
15. Name any two mathematical journals along with its specialization, publishers and country.

Part – B

Mathematics

Answer **any 10** questions. All questions carry equal marks. **(10 × 5 = 50 Marks)**

1. For what value of m, the vector $(m, 3, 1)$ is a linear combination of the vectors $(3, 2, 1)$ and $(2, 1, 0)$?
2. If the characteristic polynomial of a 3×3 matrix A is $\lambda^3 + 3\lambda^2 - 4\lambda + 3$ find the trace and determinant of the matrix A.
3. What will be the basis and dimension of the subspace $V = \{a_0 + a_1 x + a_2 x^2 + a_3 x^3, x \in R\}$ of R^3.
4. Find the minimal Polynomial of the matrix $\begin{pmatrix} 1 & 0 & 0 & 0 \\ 1 & 1 & 0 & 0 \\ 0 & 0 & 2 & 0 \\ 0 & 0 & 0 & 2 \end{pmatrix}$.
5. What is harmonic conjugate of $u(x, y) = \frac{1}{2}\log(x^2 + y^2)$ if u is the real part of some complex analytic function.
6. What is the image of the circle, $|z - 2| = 2$ under the mobius transformation $w = \frac{z}{1+z}$.
7. Find the number of positive integers ≤ 1000 and relatively prime to 1000.
8. Prove that a homomorphism f of a group G into a group G' is an isomorphism if $Ker\ f = \{e\}$.
9. Show that a group of order 45 is abelian.
10. Factorize $x^2 + x + 5$ in $F[x]$, where F is the field of integers mod 11.
11. Is it true that every metric space is Hausdroff? Justify.
12. Check whether the function $f(x) = \left\{\frac{1}{x^{2/3}}, 0 < x \geq 1\right.$ and $f(x) = 0$ at $x = 0$ is lebesgue Integrable on $[0, 1]$.
13. Prove that every Cauchy sequence is bounded.
14. G is a simple graph with 15 edges and its complement contains 18 edges. How many Vertices does G have?
15. Using induction prove that $n^4 + 2n^3 + n^2$ is divisible by 4.

3. Physics

Part – A

Answer **any 10** questions. **(10 × 5 = 50 Marks)**

1. What is Chi-square test? Explain its significance in statistical analysis of any research problem.
2. Discuss on the various criteria of research.
3. Explain different Sources of errors.
4. Explain central limit theorem with a specific example.
5. Explain the method of least square linear fitting with an example.
6. Distinguish between Precision and Accuracy.
7. Explain the need of multidisciplinary and interdisciplinary research.
8. Explain the primary and secondary methods of data collection.
9. What are the features of a research design?
10. In Searle's experiment to find Young's modulus, the diameter of wire is measured as $d = 0.050$ cm, length of wire is $l = 125$ cm, and when a weight $m = 20.0$ kg is put, extension in wire was found to be 0.100 cm. Find the maximum permissible error in Young's modulus (Y). Use $Y = \dfrac{mgl}{\left(\dfrac{\pi}{4}\right)d^2x}$.
11. Define hypothesis and state the characteristics of a good hypothesis.
12. State the significance of review of literature and its Sources.
13. Discuss the Probability and non-probability sampling techniques.
14. Differentiate between correlation and regression.
15. The current passing through a device is 5.32 A and the potential difference across it is 235.46 V. Find the power to the appropriate number of significant figures.

Part – B

Physics

Answer **any 10** questions. **(10 × 5 = 50 Marks)**

1. Solve the harmonic oscillator problem using Hamilton-Jacobi equation.

2. Discuss the Kronig-Penney model for the motion of an electron in a periodic potential.

3. What are Pauli's spin matrices? What are its properties?

4. Explain the rotational fine structure of electronic vibrational transitions.

5. Explain the principle behind ESR spectroscopy.

6. Discuss the Yukawa theory of deuteron.

7. Show that in cubic system, the closest packing is for f.c.c. lattice.

8. Discuss the basic postulates of quantum mechanics.

9. Show that the Poisson brackets are invariant under the set of canonical co-ordinates in which they are expressed.

10. Derive Laplace and Poisson's equation in electrodynamics. How do they differ?

11. State and explain Poynting's theorem.

12. Derive equipartition theorem.

13. Find the inverse Laplace transform of $\frac{s}{s^2 + a^2}$.

14. Distinguish between high-pass and low-pass filters.

15. Derive Cauchy's integral formula.

4. Geology

Part – A

Research Methodology

Write short notes on **any 10** of the following. **(10 × 5 = 50 Marks)**

1. Defining a research problem in Geology.
2. Representative sampling for geological studies.
3. Web-resources and caution for the spurious information on the web.
4. Statistical methods for testing the data quality.
5. Observations and interpretations in geological studies.
6. Importance of field-work in geological research.
7. Presentation and communication of the geological data.
8. Essentials of a scientific report.
9. Use of the GIS (Geographic Information System) softwares.
10. Error analysis.
11. Types of data and variables in geological research.
12. Importance of quantification in geological research.
13. Designing an experiment.
14. Laboratory methods for geological research.
15. Collaboration in science research.

Part – B

Geology

Write short notes on **any 10** of the following. **(10 × 5 = 50 Marks)**

1. Magmatism at an intra-oceanic subduction zone.
2. Classification of calcic-amphiboles.
3. Cretaceous-Tertiary boundary.
4. Formation of hydrothermal ore-deposits.
5. Different types of remote-sensing data.
6. Landslide hazard in Kerala.
7. Supercontinent cycle.
8. Paleoclimate studies using foraminifera.
9. Quality parameters for groundwater.
10. Point-group symmetry.
11. Change in concentration of incompatible elements in the melt during batch-melting.
12. Granulite facies metamorphism of basaltic rocks.
13. Shear sense indicators.
14. Sedimentary structures and textures.
15. Parameters affecting chemical weathering.

5. Demography

Part – A

Research Methodology

Answer **any 5** questions. All questions carry equal marks.

1. What is Research Design? Explain with examples.

2. Elaborate different types of sampling methods with illustrations.

3. Discuss in brief the classification and tabulation of data.

4. How do you differentiate between qualitative and quantitative research methods?

5. What is Focus Group Discussion? Discuss.

6. Explain Chi-square test and its advantages and limitations.

7. Differentiate between In-depth interviews and key informant interviews with examples.

8. How can one assess the reliability and validity of measurements?

9. Discuss the bi-variate and uni-variate analysis with suitable examples.

10. What is research ethics? What measures need to be taken to ensure ethical protocols are followed while undertaking field based data collection?

11. Define the following?

    (a) Participant observation

    (b) Content analysis

    (c) Non-sampling error.

Part – B

Demography

Answer **any 5** questions. All questions carry equal marks.

1. What are the important demographic data sources in India? Elaborate.

2. What is age-sex pyramid? Explain.

3. Is Demographic Transition Theory relevant for India? Discuss.

4. What are the linkages between population growth and economic development?

5. Discuss various measures of fertility with examples.

6. Discuss India's national population policy-2000.

7. What are the factors contributing rural to urban migration in India? Elaborate.

8. How age at marriage influence the fertility patterns? Discuss in Indian context.

9. How the theory of Change and response useful to explain fertility changes?

10. How socio-cultural factors influence demographic behaviour in India? Illustrate with suitable examples.

11. Define the following?

    (a) Stable population

    (b) Balancing Equation

    (c) Total Fertility Rate (TFR).

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