Code No.	M – 2937

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	

FACULTY OF SCIENCE

1. **Aquatic Biology and Fisheries**
2. **Biochemistry**
3. **Botany**
4. **Chemistry**
5. **Geology**
6. **Statistics**

FACULTY OF SCIENCE

1. Aquatic Biology and Fisheries

Part – A

Research Methodology

I. Answer any **ten** questions :

1. Parametric and Nonparametric statistics.
2. Principles in the formulation of research projects.
3. Ethics in research.
4. Steps involved in research designing.
5. Different types of research.
6. Designing a sample survey.
7. Pretesting a questionnaire.
8. Softwares used in statistical analysis.
9. Importance of case studies in research.
10. Impact factor and H-index.
11. Self plagiarism.
12. Types of scientific writing.
13. Goodness of fit.
14. Functions of IPR.
15. Process involved in patenting.

(10 × 5 = 50 Marks)

Part – B

Aquatic Biology and Fisheries

II. Answer any **ten** questions :

1. Ramsar sites of Kerala.

2. Recirculating aquaculture system.

3. Applications of restoration ecology in species conservation.

4. Discuss the role of Matsyafed.

5. Types of animal associations.

6. Impact of climate change on stock fluctuation of pelagic fish.

7. Adaptations of organisms inhabiting intertidal region.

8. Biosecurity in aquaculture.

9. Relevance of Marine Protected Areas.

10. Migratory patterns in freshwater fishes.

11. River continuum concept.

12. Environmental Impact Assessment.

13. Methods for assessment of fish stocks.

14. TED and BRD.

15. Bacterial diseases in farmed fishes.

(10 × 5 = 50 Marks)

2. Biochemistry

Part – A

Research Methodology

I. Answer any **ten** questions :

1. Note on research ethics.
2. Explain different sampling methods.
3. Differentiate deductive and inductive logics.
4. Describe the components of a scientific experiment.
5. How do you asses the importance of a research topic?
6. Note on different types of data.
7. Explain the behaviours of the following types of curves– Linear, Hyperbolic Sigmoid.
8. Explain student t- test and its importance.
9. Note on null hypothesis.
10. Explain different components of scientific methods.
11. Explain the term plagiarism and its types.
12. Differentiate the terms hypothesis, law and theory.
13. Write note on different modern Bibliography management systems.
14. How will you prepare a scientific report?
15. What you mean by bio ethics and animal ethics in scientific research?

(10 × 5 = 50 Marks)

Part – B

Biochemistry

II. Answer any **ten** questions :

1. Explain programmed cell death.

2. Details of production of Vaccines.

3. What you mean by gene bank?

4. Explain major secondary messengers of metabolism.

5. Write note on seventh class of enzymes.

6. Criteria of enzyme purity.

7. Find out the activities of the enzyme whose initial activity was 6900 lU/mg protein, and the increase in activities during the successive purification steps as 45%, 60%, 80% and 94%. of the initial activity respectively?

8. Details of photo phosphorylation.

9. Note on post transcriptional modifications in prokaryote.

10. Explain the term expression and activation of an enzyme.

11. Explain gene expression.

12. How do you perform creatine clearance test?

13. Explain Urea cycle.

14. Note on the applications Mass spectrum in modern sciences.

15. Describe the mode of infection of corona virus.

(10 × 5 = 50 Marks)

3. Botany

Part – A

Research Methodology

I. Answer any **ten** questions :

1. Write notes on Repeatability, Reproducibility and Reliability in scientific research.
2. What is the significance of graphs, diagrams and illustrations in biological research?
3. Give a note on ANOVA, different types and its applications.
4. Give a short note on chromatography; explain any two chromatographic techniques in detail.
5. Describe different types of plagiarism. What are the consequences of plagiarism? How can you avoid plagiarism?
6. What is data? What are the different methods of Data collection? Discuss in detail along with their advantages and disadvantages.
7. What are secondary storage devices? Explain any three storage devices in detail.
8. Give an account of major citation styles. What are the significances of citation styles in research publication?
9. Explain the principles of microscopy. Discuss the working of fluorescent microscope.
10. Write a note on ethics, conduct and misconduct in scientific research.
11. Give a note on botanical gardens and its importance in taxonomic studies. Name any two international and national botanical gardens.
12. What is testing of hypothesis? Explain how it is useful for illustrating a research problem.
13. What are the major software used in data analysis and visualization? Write a note on SPSS and its applications in biostatistics.
14. Explain PCR. Give an account on the applications of PCR.
15. What are the stages involved in filing a patent?

(10 × 5 = 50 Marks)

Part – B

Botany

II. Answer any **ten** questions :

1. Describe protoplast isolation, culture and fusion. What are the applications of this technology?

2. Describe different methods that can be used for gene transfer in plants. Give its merits and demerits.

3. Describe different types of bioreactors with its applications. How will you design an ideal bioreactor?

4. Describe the molecular basis of DNA damage and the repair mechanisms.

5. Explain phylogenetic tree. What are the different methods used to construct phylogenetic trees. Give its merits and limitations.

6. What is somatic embryogenesis? What are the processes involved in the encapsulation of the somatic embryos?

7. Write an account of C3, C4 and CAM plants in relation to physiological and ecological considerations.

8. What are secondary metabolites? Give a brief description about current approaches towards production of secondary plant metabolites.

9. Discuss the defense mechanism against plant pathogens in plants.

10. Give an account of economic importance of Algae.

11. Differentiate biotic and abiotic stress and explain its effects on morphological, anatomical and biochemical changes in plants.

12. Describe the synthetic characters of plant communities.

13. Give a note on the classification of carbohydrates with salient features of each category.

14. Write a note on protein structures.

15. Explain different strategies to be adopted for the conservation of costal ecosystem.

(10 × 5 = 50 Marks)

4. Chemistry

Part – A

Research Methodology

I. Answer any **ten** questions :

1. Explain primary, secondary and tertiary sources of literature.
2. Briefly discuss the fire safety measures to be used in a chemistry laboratory.
3. Discuss the idea of data mining in research.
4. Explain the major differences between basic and applied research.
5. What are the different types of errors possible in an experiment?
6. What is the need for a research proposal?
7. What are the significances of journal impact factor and citation index?
8. What are the characteristics of a good research report?
9. Explain the splitting of signals observed in ^{1}H NMR spectroscopy.
10. Discuss the purification methods used for materials used for an experiment.
11. Is reproducing a paragraph from your own published work considered plagiarism? Why?
12. How will mass spectroscopy help you to find the structure of a compound?
13. Write a note on solid phase peptide synthesis.
14. How will you plan an experiment based on principles of green chemistry?
15. Predict the approximate chemical shift values and multiplicity of all protons in the following three compounds: methyl vinyl ketone; 4-nitroanisole; l-naphthol.

(10 × 5 = 50 Marks)

Part – B

Chemistry

II. Answer any **ten** questions :

1. Calculate the magnetic moment for Pr^{3+}, Dy^{3+}, Gd^{3+}, and La^{3+}.

2. Compare the spectral properties of *d* block elements and *f* block elements with suitable examples.

3. Draw the thermogram of $CaC_2O_4.H_2O(s)$ and explain.

4. Write a short note on :

   (a) indicators used to detect end point in redox titrations, and

   (b) metallochromic indicators.

5. Use the particle in one dimensional box to describe quantum mechanical tunneling.

6. Give the Group multiplication table for ammonia.

7. Briefly discuss HF self consistent field method.

8. Define partition function. How it is related to enthalpy?

9. (a) When a sample of 4-heptanone was irradiated for 60 minutes with 313 nm radiation with a power output of 100 W under conditions of 50% of light absorption, it was found that 101.2 mmol of C_2H_4 was formed. What is the quantum yield for the formation of ethane? (3)

   (b) Calculate the maximum wavelength of radiation that will bring about dissociation of a diatomic molecule having a dissociation energy of 390.4 kJ/mol? (2)

10. (a) How many α particles and β-particles are emitted in the decay of ^{238}U to ^{206}Pb? (2)

(b) Calculate the time necessary to reduce the activity ^{131}I to 1% of its initial value. (Half-life of ^{131}I is 8.02 days)

11. (a) Calculate the mean ionic activity of a 0.001 molal $BaCl_2$ in aqueous solution at 25ºC using D-H limiting law. The A value is 0.509? (3)

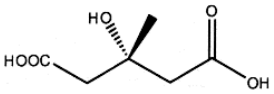
(b) Determine the equilibrium constant of the reaction $Zn + Cd^{2+} \rightarrow Zn^{2+} + Cd$ at 25ºC. The standard electrode potentials of Zn and Cd are –0.767 V and –0.403V respectively? (2)

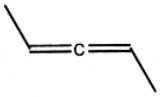
12. (a) The free electron density of aluminium is 18.10×1028 m^{-3}. Calculate its Fermi energy at 0 K. Planck's constant and mass of free electron are 6.626×10^{-34} Js and 9.1×10^{-31} kg. (3)

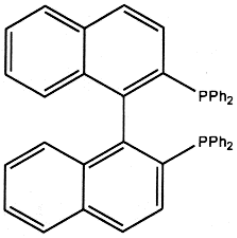
(b) Find the probability of an electron occupying an energy level 0.02 eV above the Fermi level at 200 K and 400 K in a material. (2)

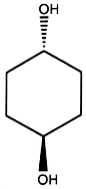
13. Illustrate Wittig reaction with suitable examples. Explain the reason behind stereoselective formation of E and Z alkenes from stabilized and unstabilized ylides.

14. Which among the following molecules are chiral? Justify your answers.

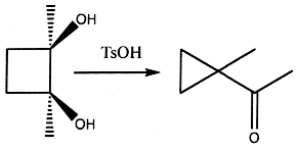
(a) 

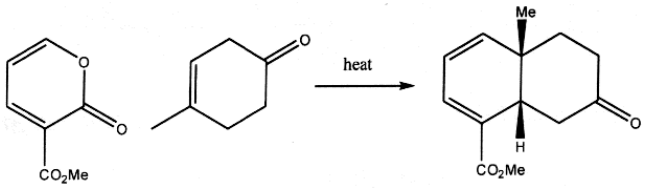
(b) 

(c) 

(d) 

15. Suggest mechanisms for these reactions.

(a) 

(b) 

(10 × 5 = 50 Marks)

5. Geology

Part – A

Research Methodology

I. Answer any **ten** questions :

1. Field procedures in geological mapping.
2. Statistical representation of data.
3. Role of literature survey in scientific research.
4. Accuracy and precision.
5. Bibliography and references.
6. Writing of reports and research papers in Geology.
7. Computer applications in geological research.
8. Digital Library.
9. Types of data collection.
10. Difference between citation and citation index.
11. Thin section analysis.
12. Types of Web browsers.
13. Topographic maps.
14. Ethical issues in geological research.
15. Methods used in sampling of fossils.

(10 × 5 = 50 Marks)

Part – B

Geology

II. Answer any **ten** questions :

1. Geochemical classification of elements.
2. Concept of Plate Tectonics.
3. Principles of stratigraphic correlation.
4. Diagenesis as a sedimentary process.
5. Advantages of remote sensing over conventional geological survey.
6. Rocks as construction material.
7. Importance of fossils in paleoclimatic studies.
8. Classification of igneous rocks.
9. Types of metamorphism.
10. Chemical weathering.
11. Soils of Kerala.
12. Types of Landslides.
13. Role of geologist in environmental studies.
14. Vertical distribution of groundwater.
15. Components of a GIS.

(10 × 5 = 50 Marks)

6. Statistics

Part – A

Research Methodology

I. Answer any **ten** questions :

1. What is meant by research? What are the important characteristics of research?

2. Distinguish between fundamental and applied research? Give examples from statistical contexts.

3. What are the guiding principles for selecting a research problem?

4. What is meant by synopsis? What are the importance parts of a synopsis?

5. Explain review of literature. What are its objectives? Which are the important sources?

6. What is a hypothesis? Explain how you will formulate a hypothesis as part of a research problem.

7. Explain the meaning of research design. Give a typical design format for a research proposal.

8. Discuss on the important types of sampling designs and their uses.

9. Explain case study method in research giving an illustrative example. Discuss on SPSS and R.

10. Discuss on patent and copy right. What are the important differences between these? Discuss on the rules in India.

11. Explain intellectual property rights. What are the important laws pertaining to protect it?

12. What are the important steps for publication of a research paper in a journal?

13. Distinguish between ISSN and ISBN. Bring out the importance of journal publications in research. What are open access journals?

14. What is meant by plagiarism in research? What are the important measures taken by UGC and MHRD to curb this?

15. What are the important sources and agencies for research funding for statistics in India? Also list any three standard research journals in statistics published from India.

(10 $\times$ 5 = 50 Marks)

Part – B

Statistics

II. Answer any **ten** questions :

1. Explain the orthogonal reduction of a quadratic form $X'AX$ and discuss the nature of definiteness in terms of the eigen roots of A.

2. Let $\{A_n\}$ be a sequence of sets. Then define the limit inferior and limit superior of the sequence. If $\{A_n\}$ is a non-decreasing sequence of events show that $\lim_{n\to\infty} P(A_n) = P\left(\bigcup_{n=1}^{\infty} A_n\right)$.

3. Consider two random variables X and Y jointly distributed with pdf

$$f(x,y) = \begin{cases} \frac{1+xy}{4}; & |x|<1, |y|<1 \\ 0; & \text{elsewhere} \end{cases}$$

Show that X and Y are not independent but X^2 and Y^2 are independent.

4. Define log normal distribution. Find its r^{th} moment about zero. Explain how the parameters are estimated.

5. Let $x_1, x_2, \ldots, x_{100}$ be i.i.d. random variables with mean 75 and variance 225. Using Chebychev's inequality calculate the probability that the sample mean will not differ from the population mean by more than 6. Compare this with the same probability using Central Limit Theorem.

6. State Cramer-Rao inequality. If $X \sim B(n,p)$, show that $\frac{x}{n}$ is the UMVUE of p. Also verify that its variance attains the Cramer-Rao lower bound.

7. Define maximum likelihood estimator and sufficient statistic for a parameter θ. Let T be a sufficient statistic. Show that the m.l.e. if it exists is a function of T. Give an illustrative example. Is it consistent?

8. State Bayes' formula for finding the posterior distribution. Derive the Bayes' estimator of θ for a binomial population $B(n,\theta)$ assuming that the prior distribution in Beta (p,q), under squared error loss function (SELF).

9. State Neyman-Pearson fundamental semma for finding the most powerful test. let X be an observation in the interval (0, 1). Find the most powerful size α test for testing $H_0 : x \sim f(x) = \begin{cases} 4x; & 0 < x < \frac{1}{2} \\ 4-4x; & \frac{1}{2} \le x < 1 \end{cases}$ against $H_1 : x \sim f(x) = 1$ if $0 < x < 1$. Also find the power of your test.

10. Derive the likelihood ratio test for testing $H_0 : \mu = \mu_0$ against $H_1 : \mu \neq \mu_0$ based on a random sample of size *n* from $N(\mu, \sigma^2)$ where both μ and σ^2 are unknown. Show that it is a UMPU test. Extend to the *p*-variate case.

11. Explain stratified sampling. How does it differ from systematic sampling? Obtain the estimates for the population mean under both sampling schemes and compare their variances.

12. Explain missing plot technique in the case of an RBD when one of the observations is missing. Estimate the missing observation and its standard error. How will you carry out the analysis of variance?

13. Derive the hazard rate function if life times follow the Weibull distribution. Also obtain conditions under which we get IFR, DFR, CFR cases. Also show that constant failure rate is a characteristic property of exponential distribution.

14. Describe the postulates of a birth-death process and obtain the Kolmogrov differential equations. Using these derive the stationary equilibrium distribution of an $M/M/1/K$ queue.

15. Discuss on Box-Jenkins models in time series analysis. Explain how a model can be fitted to a given time series data.

($10 \times 5 = 50$ Marks)

ROUGH WORK

ROUGH WORK

ROUGH WORK