



**Ph.D. ENTRANCE EXAMINATION, MAY 2018**

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

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**FACULTY OF APPLIED SCIENCE**

**1. Environmental Sciences**

**2. Computational Biology and Bioinformatics**

**3. Biotechnology**

**4. Optoelectronics**





FACULTY OF APPLIED SCIENCE

1. ENVIRONMENTAL SCIENCES

**PART – A**

I. Answer **any ten** of the following :

**(10×5=50 Marks)**

- 1) How do you compare two variables in SPSS ?
- 2) Write a short note on nominal data.
- 3) Write about the tools available in data analysis.
- 4) Write a short note on two way Anova.
- 5) Describe the principal component analysis.
- 6) Write about the types of sampling.
- 7) Write a short note on independent variables.
- 8) Why do studies with good internal validity often have poor external validity ?
- 9) Describe the essential elements that are required for informed consent with human participants.
- 10) Describe the instrumental analysis of measuring carbon monoxide.
- 11) State and derive Beer's law from basic principles. Discuss the limitations of it.
- 12) Explain in detail the working principle of Gas Chromatography.
- 13) Describe the working principle of NO<sub>2</sub> analyzer.
- 14) Distinguish between pH electrode and ion selective electrodes.
- 15) Explain the instrumentation and applications of Scanning Electron Microscope (SEM).

**PART – B**

II. Answer **any ten** of the following :

**(10×5=50 Marks)**

- 1) Explain the various phases of environmental impact assessment.
- 2) Discuss the advantages of wetlands.
- 3) Discuss the consequences of overdrawing surface and ground water.
- 4) Explain the methods of harnessing tidal power.
- 5) Explain the process of domestic wastewater treatment.
- 6) Describe the in-situ conservation of biodiversity.
- 7) What are the causes of soil erosion and deforestation ?
- 8) Explain various disaster management measures during cyclone and floods.
- 9) Write a note on solar energy.
- 10) Explain the causes, effects and control measures of air pollution.
- 11) What are the effects of modern agriculture ?
- 12) Write the effects of extracting and using mineral resources.
- 13) Mention the objective and features of Air Act, 1981.
- 14) Explain the hydrological cycle in detail.
- 15) How is acid rain formed ? Explain its impact on environment.



2. COMPUTATIONAL BIOLOGY AND BIOINFORMATICS

**PART – A**  
**Research Methodology**

Answer **any ten** questions :

**(10×5=50 Marks)**

1. What are the criteria that need to be followed by good scientific research ? Illustrate problems encountered by researchers in India.
2. What do you mean by sample design ? Differentiate between stratified and quota sampling.
3. What is case study method ? Mention the important characteristics of case study method.
4. What is rank correlation ? Explain significance of Karl Pearson's coefficient of correlation.
5. Explain the different steps involved in a research process.
6. What is ANOVA ? Explain the basic principle of ANOVA.
7. Write notes on :
  - a) Quantitative and Qualitative research.
  - b) Conceptual and Empirical research.
8. Differentiate between technical and scientific reports.
9. What is IPR ? What are the different forms of IPRs ?
10. Write notes on :
  - a) Plagiarism
  - b) Paraphrasing.



11. What are the ethical issues in research ? What is the importance of ethical committee in research ?
12. What is a patent ? Elaborate inventions that are not patentable in India.
13. What is hypothesis ? Explain the various steps in hypothesis testing.
14. Write a note on different statistical packages used in research.
15. Explain the format of a scientific paper.

## PART – B

### Computational Biology and Bioinformatics

Answer **any ten** questions :

**(10×5=50 Marks)**

1. Write notes on :
  - a) BLAST and FASTA sequence alignment tool
  - b) E-value and Bit score.
2. What are tertiary protein structures ? Write a note on different tertiary structure prediction methods.
3. What does INSDC stands for ? Discuss the role of INSDC in bioinformatics research.
4. Write a note on *De-novo* drug design.
5. Explain the meaning of the symbols in the given PROSITE pattern, [RK]-x-M-x(4)-{ED} and show how it matches the following sequence DVLPLDVC SLKHVRYMFQALIIYWI KAMNQQTTLDT.
6. Compare the methods : Neighbor-Joining and Maximum Likelihood.



7. Explain the following :
  - a) With reference to data mining, explain the knowledge discovery in databases.
  - b) Explain K-means clustering algorithm. Illustrate the algorithm with an example.
8. What is meant by scoring matrices ? Explain PAM and BLOSUM matrices.
9. What is Next Generation Sequencing ? Briefly explain different Next Generation Sequencing Methods.
10. Write notes on :
  - a) Virtual screening
  - b) Pharmacophores
11. Write a Perl/Python program to detect the ORFs and identify the total number of ORFs in a given DNA sequence.
12. Write down the best global alignment for the sequences GAATTCAGTTA and GGATCGA using Dynamic programming algorithm. (Match = 1, Mismatch = 0, Gap penalty = 0)
13. Distinguish between pharmacogenomics and pharmacogenetics. Can pharmacogenomics be used to develop new drugs ? Explain.
14. What is a force field ? Write its application in molecular dynamic studies.
15. Explain the basic features of SVM. Differentiate the merits and demerits of HMM and its application in bioinformatics.



3. BIOTECHNOLOGY
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**PART – A**  
**Research Methodology**

Answer **any ten** questions and **each** question carries **equal** marks : **(10×5=50 Marks)**

1. Define research problem and explain in detail on steps involved in the biological science research problems.
2. What is the beer-Lambert law ? Describe in detail the principle of spectroscopy.
3. Give an account on the principle of chromatography and discuss the working mechanism of HPLC technique for bioactive compound separation.
4. What is SDS-PAGE ? Write note on its working principles and its applications in protein separation.
5. What is manuscript writing and how to write a manuscript for publication using one way ANOVA test ?
6. As per Mendal's theory the proportion of tomato, in the four groups A, B, C, D should be 9 : 3 : 3 : 1. In an experiment among 1600 tomatos, the number in the four groups were 896, 304, 295 and 105. Does the experimental result support the Mendal's law ? Apply  $\chi^2$  test.
7. The heights in inches of 30 boys are as follows : 68, 69, 66, 70, 67, 69, 68, 64, 66, 64, 70, 72, 71, 69, 69, 64, 67, 63, 70, 71, 63, 68, 67, 65, 69, 65, 67, 66, 69, 67. Prepare a frequency distribution table showing mean, median and mode.
8. What is linear regression analysis ? Give a suitable example to support your answer.
9. Write note on :
  - a) Research objectives
  - b) Review of literature
  - c) Bibliography
  - d) Data analysis.





10. Write an essay on laboratory bio-safety management system in type III animal cell culture research lab.
11. Give an account on bioinformatics tools applications in molecular biology research (a) BLASTN (b) BLASTP.
12. Explain the applications of bioinformatics tool in drug designing and discovery using protein chemistry.
13. Write note on :
  - a) Correlation co-efficient analysis
  - b) Research monograph.
14. Explain the various stages in the development of drugs and specify the significance of each stage.
15. Describe in detail on pharmacogenomics and discuss its applications in clinical research analysis.

**PART – B**  
**Biotechnology**

Answer **any ten** questions and **each** question carries **equal** marks : **(10×5=50 Marks)**

1. Explain the various applications of SEM.TEM and AFM in nanotechnology.
2. How to identify the particular copy of DNA from chromosome using radio labelled DNA probe via Southern blot hybridization analysis.
3. Give an account on cDNA library and explain the steps involved in the construction of the same.
4. Discuss on production of insect resistant plants (Bt cotton) via agrobacterium mediated genetic transformation.
5. Define PCR and its principle. How to analysis the gene expression by qPCR analysis under abiotic stress conditions ?
6. Explain the design of a typical fermentor and illustrate the important points of media designing for fermentation process using microbes in production of antibiotics with suitable example.



7. Discuss about bioreactors and explain various aspects involved in manufacture of alcoholic beverages.
8. Explain about DNA markers and discuss on PCR based molecular markers development.
9. Give an account on the importance of PCR based methods in the detection viral pathogen diagnosis.
10. Write an essay on production of industrially important enzymes using microorganisms.
11. What is bioremediation ? Explain the steps involved in remediation of oil spillage using oil degrading microbe.
12. Give an account on process of B-cell activation, maturation and differentiation during immune response.
13. What is DNA repair and explain SOS response during repair mechanism.
14. Short note on
  - a) Transcription
  - b) Translation
  - c) Apoptosis
  - d) Restriction enzymes.
15. What is food preservation ? Why is food packaging crucial for safety and quality control ? Explain briefly by highlighting the functions and types of packaging to ensure food safety.



4. OPTOELECTRONICS

Answer **any ten** questions from Part – A and Part – B. **Each** question carries **5** marks. **(50 Marks)**

**PART – A**  
**Research Methodology**

1. Explain your views on scientific influence in human life.
2. Discuss a scientific article that inspired you.
3. Explain the cautions to be taken while choosing a topic for research.
4. Explain the need of patents in scientific research.
5. Explain various scientific information resources. Discuss how they are useful for research ?
6. What are the necessary steps essential to make a good scientific presentation ?
7. Discuss error analysis in scientific research.
8. Explain two major scientific contributions from Indian Scientists.
9. Explain the need of literature survey and discuss the role of review articles in choosing a research problem.
10. Explain the use of multimedia in a good scientific presentation.
11. Discuss how to write a scientific article in an international peer reviewed journal.
12. Comment on the recent Indian Space Missions of ISRO.
13. Point out the ethics to be adopted in doing research.
14. List out the parameters for assessing the quality of a research study.
15. Prepare a synopsis of the content of a research proposal.



**PART – B**  
**Optoelectronics**

**(50 Marks)**

16. Distinguish between Fresnel and Fraunhofer diffraction with examples.
  17. Write down Maxwell's equations and explain the terms involved.
  18. What is Fourier transform and explain its significance in optics.
  19. Arrange the electromagnetic spectrum in the increasing order of frequency and write down the spectroscopy associated with each region.
  20. Explain the concept of band gap. Distinguish between n and p type semiconductors.
  21. Explain how lasing action takes place in a three level laser.
  22. Explain the difference between a photograph and a hologram.
  23. Distinguish between partial and temporal coherence.
  24. Discuss the basic principle of an optical amplifier with an example.
  25. Discuss the medical applications of lasers.
  26. Explain the second harmonic generation and write down the phase matching condition.
  27. Distinguish between telescope and microscopy.
  28. Distinguish between step index fiber and graded index fiber.
  29. Explain the basic principle of LED. Which types of compounds are generally used in LED materials ?
  30. Explain the terms coherence length and coherence time.
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