5859

Ph.D. ENTRANCE EXAMINATION, OCTOBER 2013

Name of Candidate	
Register Number	
Answer Booklet Code	
Signature of Candidate	
Signature of Invigilator	

Time : 140 Minutes Max. Marks : 160

Section – B & C

(This is to test the candidate's capability of defining concepts through short answers.)

***Note** :*

1) *Answer **any twelve** questions from Section **B** and **one** question from Section **C**.*
2) *In Section **B** **each** question carries **10** marks. Section **C** carries **40** marks.*
3) *In Section **B** an answer should not exceed **100** words. In Section **C** an answer should not exceed **500** words.*
4) *Candidates should **clearly** indicate the **Section**, **Question Number** and **Question Booklet code** in the answer paper.*
5) *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.*

FACULTY OF SCIENCE

1. **Aquatic Biology and Fisheries**
2. **Physics**
3. **Demography**
4. **Botany**
5. **Geology**
6. **Geography**

FACULTY OF SCIENCE

1. Aquatic Biology and Fisheries

Section – B

1. Indigenous ornamental fishes of Kerala.
2. Karikkadi fishery of Kerala.
3. Methods of estimation of primary production in aquatic ecosystems.
4. Migration of tuna in oceanic waters.
5. Clupeid fishery of India.
6. Reservoir fishery of India.
7. Clam resources of India and trends of production.
8. Freshwater prawn resources of India.
9. Breeding of gold fish.
10. Lobster fisheries of India.
11. Classification of estuaries of India and ecological characteristics of each type.
12. Coral resources of India and probable impacts of climate change on corals.
13. Importance of trawl ban in Kerala and its impacts on fishery.
14. Induced breeding in fishes.
15. Integrated farming systems in aquaculture.
16. Problems of fish marketing in Kerala.

Section – C

1. Write theories of mud bank formation. Discuss on the resources available in mud banks.
2. How fish stock assessment is being made.
3. Conservation of marine mammals in India.

2. Physics

Section – B

1. A particle in the harmonic oscillator potential starts out in the state

   $\psi(x,0) = A[3\psi_0(x) + 4\psi_1(x)]$.

   a) Find A

   b) Construct $\psi(x,t)$ and $|\psi(x,t)|^2$.

2. State and explain Gauss's law. Find the field outside a uniformly charged solid sphere of radius R and charge q.

3. Let $\vec{E} = \hat{x}E_0 \exp\left[i(\vec{k}.\vec{r} - \omega t)\right]$ where $\vec{k} = \hat{z}(k\cos\phi + ik\sin\phi)$, $k = |\vec{k}|$ and $\hat{x}$, $\hat{y}$ and $\hat{z}$ are Cartesian unit vectors represent an electric field of a plane electromagnetic wave of frequency ω. Find the magnetic field B of the wave.

4. Five bosons are distributed in two compartments, the first having three sets and the second four. Find the thermodynamic probability for the micro state.

   a) (5, 0) and (b) (4, 2).

5. Using Cauchys residue theorem for a complex function, evaluate the integral $\frac{1}{2\pi i}\int_0^{2\pi} \frac{d\theta}{a + b\cos\theta}$, $a > b > 0$.

6. a) Obtain the condition for threshold population inversion required for laser oscillation.

   b) Briefly explain the principle of Q-switching and mode locking.

7. Explain the operation of a high pass active filter using OP-Amp.

8. What is pulse code modulation ? Why PCM is more noise resistant than other forms of pulse modulation.

9. Employing the concept of reciprocal lattice vector, derive Bragg condition for X-ray diffraction.

10. Discuss the Weiss theory of ferromagnetism. What is anti ferromagnetism ?

11. What is NMR ? Briefly describe the working of a FTNMR spectrometer with the help of a block diagram.

12. Explain (a) Hyper Raman effect. (b) Inverse Raman effect.

13. Define covariant, contravariant and mixed tensors. Show that δ_k^l is a mixed tensor of rank 2, but δ_{kl} is not a tensor.

14. a) Show that the order of a group is an integral multiple of the order of its sub group.

    b) Show that the set of all n × n matrices form a group under matrix multiplication operation.

15. Explain how LED works. What is a double hetero structure LED ? Explain.

16. a) Distinguish between step index and graded index fibers.

    b) Define numerical aperture and V-number of an optical fiber.

    c) In a step index fiber, the refractive indices of core and cladding are respectively 1.43 and 1.4. Find the numerical aperture and acceptance angle of the fiber.

Section – C

1. A. i) Find the Clebsch-Gordan coefficients associated with the coupling of spins of the electron and the proton of hydrogen atom in the ground state.

    ii) Find the transformation matrix formed by the Clebsch-Gordan coefficients. Verify that this matrix is unitary.

   B. Obtain the Fresnel's equation of oblique incidents for electromagnetic waves in matter.

2. A. i) Define Poisson and Lagrange brackets.

ii) Show that the Poisson bracket of any dynamical variable and a constant is equal to zero.

iii) Explain the equation $\frac{dA}{dt} = \frac{\partial A}{\partial t} + [A, H]$.

B. i) Show that the density of states at the Fermi energy is given by

$$N(E_F) = \frac{4(3)^{1/3}\pi^{2/3}mn^{1/3}}{h^2}.$$

ii) The electron concentration in silver is $5.85 \times 10^{28}/m^3$. Find the Fermi energy at 0 K and Fermi temperature.

3. A. i) Explain anomalous Zeeman effect. How does Zeeman splitting occur for $^2P_{3/2} - ^2S_{1/2}$ transition in a one electron system ?

ii) Describe an infrared spectrometer.

B. i) Explain a.c. Josephson effect. What is macroscopic quantum interference ?

ii) What is atomic structure factor ? Obtain an expression for atomic structure factor.

3. Demography

Section – B

1. Explain the demographic indicators of development.
2. Discuss the major sources of population data with special emphasis on vital registration system in India.
3. The year 1921 is called “the Great Divide” in the history of population growth in India – Explain.
4. Explain broad age group of population in Kerala State and compare this situation with the broad age structure of India’s population.

5. Kerala is demographically advanced State – Enunciate.
6. Explain environmental deterioration caused by rapid increase in population.
7. Is there any gender bias in literacy rate for Kerala State ?
8. Critically evaluate Malthusian theory of population.
9. Discuss the reproductive measures (rates).
10. Explain the anatomy of life table.
11. Discuss the methodology of survival rate method to measure migration indirectly.
12. Analyse the linkage between urbanization and economic development.
13. What do you understand by fertility influencing policies ?
14. Why maternal and child health programmes became integral part of Family Welfare Programme in India in 1976.
15. Explain with example “Hypothesis testing”.
16. Explain the use of Chi-square in analysis of social science data.

Section – C

1. Give a detailed account of a research proposal for monitoring and evaluation of reproductive health programmes to be initiated in Kerala State.
2. Explain the application of demographic transition theory to both developed and developing countries.
3. For comparative analysis of mortality, standardized mortality rate is a meaningful index – Discuss.

4. Botany

Section – B

1. Explain the impact of global warming on agricultural productivity.
2. C_4 plants are considered as highly productive. Discuss this statement with suitable examples.
3. Describe various types of incompatibility and the methods to overcome this.
4. Describe the basic principles of tissue culture and explain various media used for tissue culture.
5. How would you link plant breeding with the modern concepts in plant biotechnology ?
6. Write an account on the role of molecular biology in plant taxonomic studies.
7. Give a brief account of giant chromosomes.
8. Explain the natural system of classification and modern system of classification in plant taxonomy.
9. Explain the importance of statistical analysis in plant science research.
10. Define polyembryony. Write an account on the classification and types of polyembryony.
11. Explain the causes and effects of water pollution and add a note on control measures.
12. Describe the cytological and biochemical events involved in plant growth.
13. Elucidate the procedure of localization of nucleic acids and proteins in plant tissues using Histochemical staining.
14. Explain in detail about salinity stress and their impact on the physiology of plants.
15. Describe the biosynthesis of protein in eukaryotic cells.
16. Give a brief account on alternation of generation in the lower forms.

Section – C

1. Chromatography is an inevitable technique in biological science research. Describe various types of chromatography. Add notes on the principles of the equipments used and procedure of separation.
2. Certain embryological features have been traditionally and most frequently applied in solving plant taxonomic problems. Write an account on these embryological characters and with examples describe the application of these embryological characters in solving disputes in plant taxonomy.
3. Write an account on transgenic plants. Add your comments on the social issues in the introduction of GM crops in India.

5. Geology

Section – B

1. Erosion, transportation and depositional mechanisms by streams.
2. What is Darcy's law ? Explain partial differential equations governing groundwater flow.
3. Define : polymorphism, polytypism, polysomatism, solid solution and exsolution.
4. Plate tectonic regimes of igneous rock formation.
5. Define common types of finite strain ellipsoids describe progressive strain history and methods for its determination.
6. Define Goldschmidts' phase rule. Explain its application in magmatic processes.
7. Metamorphic facies.
8. Methods of stratigraphic correlation with a note on Shaw's Graphic correlation and concept of sequence stratigraphy.

9. Factors controlling the deposition and distribution of oceanic sediments.
10. Metallogeny and its relation to crustal evolution.
11. Origin, migration and entrapment of petroleum.
12. Proterozoic sedimentary basins of India.
13. Optic sign and sign of elongation.
14. Quaternary dating methods.
15. Applications of remote-sensing in geology and mineral exploration.
16. Describe briefly the various geological considerations in the construction of dams.

Section – C

1. Use of microfossils in paleoceanographic and plaeoclimatic interpretation.
2. Phase rule and its applications in petrology.
3. Discuss on the provenance of sediments. Describe the heavy mineral separation techniques and add a note on the provenance of heavy minerals.

6. Geography

Section – B

1. Quantitative revolution provided an empirical basis for geography research. Explain.
2. Discuss the distribution of major types of soil in India.
3. Examine the relevance of the concept of uniformitarianism in present day geomorphology.
4. Bring out the importance of geographical knowledge in planning tourism industry.
5. Discuss the use of GIS in natural resource assessment and management.

6. Write a note on the cropping pattern of Kerala.
7. Elaborate the concept of land evolution.
8. Give an account on Participatory Rural Appraisal.
9. Discuss the role of Remote sensing in change detection analysis.
10. Examine the impact of green revolution on the agricultural production of India.
11. What do you mean by a city region ? Discuss the indicators used for delimits the city regions.
12. Write a role on systems approach to landform analysis.
13. Explain Thornthwaite's scheme of climate classification.
14. Discuss the need for multi-disciplinary research in Geography.
15. Explain the constraints in map making.
16. Bring the salient features of plate tectonic theory.

Section – C

1. Contemporary global climatic change in man-induced phenomenon. Discuss in detail and justify the statement.
2. Examine the different approaches adopted by geographers for land use analysis and planning.
3. Explain the cropping patterns in different agricultural regions of India and analyse the geographical factors influencing it.

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