2008

Syllabus and Sample Questions for JRF

AGRICULTURAL AND ECOLOGICAL RESEARCH UNIT

[Test Code: RAE]

The candidates have to take two tests: Test **RAEI** (objective type) in the forenoon session and test **RAEII** (critical appreciation, short answer/ numerical problems and objective type) in the afternoon session.
For both tests, Full Marks will be 100 and Time: 2 hours.

Syllabus

Physiology & Biochemistry: Respiration and photosynthesis; protein synthesis; growth promoting plant hormones, response to stress; structure, function and metabolism of carbohydrates, lipids, proteins, vitamins & minerals; metabolic pathways; enzymes and coenzymes. Principles of taxonomy as applied to the systemmatics & classification of plant kingdom.

Genetics & Evolution: Mendellian genetics, mitosis, meiosis, recombination; DNA structure, replication, transcription, translation; DNA footprinting; control of gene expression; polymerase chain reaction; recent trends in molecular biology.

Ecology & Environment- Ecosystem structure, food chain and energy flow, ecosystem diversity, productivity and biogeochemical cycles, limnology; environmental pollution, sustainable development, economic importance of microbes, plants and animals, biodiversity, global change (stratospheric ozone, global warming, loss of biodiversity)

Laboratory analysis – Principles and methods.

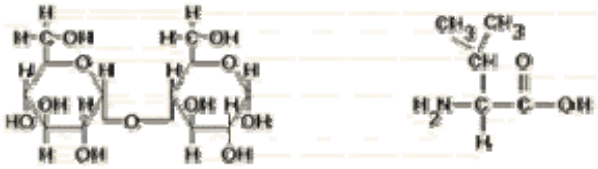
Basic Statistics & Computation – Descriptive statistics, correlation, simple regression, analysis of variance, simple probability calculations, Microsoft Excel.

Sample Questions
[Forenoon session]
RAEI

Select the correct answer from the multiple choice:

1. Enzymes:
   (a) are composed primarily of polypeptides, which are polymers of amino acids
   (b) can bind prosthetic groups such as metal ions that participate in enzyme reactions
   (c) bind their substrates at active sites
   (d) all statements are true

2. The structure on the left is a _____, and the structure on the right is a(n)_____.



   (a) lipid, polypeptide
   (b) carbohydrate, lipid
   (c) carbohydrate, amino acid
   (d) nucleotide, amino acid

3. The overall source of energy for photosynthesis is:

   (a) energy of electron transport in the thylakoid membrane
   (b) energy released when water is oxidized and oxygen is produced
   (c) energy from the hydrolysis of ATP
   (d) light energy from the sun

4. Photophosphorylation in chloroplast requires movement of:
   (a) electrons across the membrane
   (b) ions across the membrane
   (c) protons across the membrane
   (d) electrons and protons across the membrane

5. One of the following enzymes is involved in translation step in protein biosynthesis:

(a) aminoacyl-tRNA synthetase
(b) RNA polymerase
(c) ribozyme
(d) reverse transcriptase

6. Intron is a region of the chromosomal DNA:

(a) which is a part of a gene that is transcribed but is removed during maturation of the transcript
(b) which is a part of a gene that is transcribed but persists in the mature mRNA
(c) that is located between two adjacent genes
(d) that is located at the centromere

7. Population of plants within a species adapted genetically to a particular habitat but able to cross freely with other plants of the same species is called:

(a) ecophene
(b) ecad
(c) ecotype
(d) ecotone

8. Eutrophication results in:

(a) increase in NO_2
(b) increase in CO_2
(c) decrease in NO_2
(d) increase in CO_2 and NO_2

9. The correct statistical method to employ when you want to compare average measurements from two samples is

(a) Correlation
(b) Regression
(c) Analysis of variance
(d) Pie chart

10. What does Microsoft Excel refer to when it asks you to select your Bin Range?

(a) The difference between the maximum and minimum value in a dataset
(b) The range of cells that you will use as x-axis categories for a frequency histogram
(c) The range of cells you wish to use to display a graph
(d) The range of cells that you will use as y-axis categories for a frequency histogram

Sample Questions

[Afternoon session]

RAEII

[To be answered in separate answer script, not in the Question Paper]

Group A

Read the paragraph and answer the questions that follow:

1. The city of Kolkata has a large field located along the River Ganges. The field is a former industrial site where contamination by hazardous chemicals impedes redevelopment. The municipality is considering two options for reclaiming the field. The first option is to excavate and remove the contaminated soil, and the second is to decontaminate the site using vegetation.

(a) Assume that the municipality chooses the first option. Describe TWO problems that result from removing the contaminated soil from the field.

(b) Assume the municipality chooses the second option. Explain how vegetation could be used to decontaminate the soil. Discuss ONE advantage and ONE disadvantage of using this reclamation method.

(c) Describe and explain one environmental benefit and one societal benefit of reclaiming the field.

(d) Identify and describe one method currently used to reduce the production of hazardous waste.

Group B

Answer briefly/solve each of the following questions.

2. How do guard cells help in stomatal regulation during the day and during the night?

3. Discuss the individual steps involved in the oxidation of pyruvic acid through Kreb's cycle.

4. Explain using figures the basic principles of Polymerase Chain Reaction?

5. Inspite of the continued utilization of nitrogen by forest vegetation, the forest soil does not usually become depleted of its nitrogen content. How is this possible?

6. Describe ecological succession using ONE example.

7. (a) Write down a sentence or two explaining the difference between:

(i) Populations and samples
(ii) Correlation and regression

(b) The heights of 10 randomly selected plants, to the nearest tenth of a centimeter, are given below:

4.0	8.5	7.4	5.6	5.7
7.0	9.3	5.2	6.8	6.1

Calculate the sample mean and sample variance showing all your calculations.

8. (a) What does *correlation coefficient* measure?

(b) Give the formula and calculate correlation coefficient between the following two variables and interpret the results:

X	**Y**
2	4
3	1
5	0
7	2

Group C

9. *Distinguish between the following*:

(a) Apoenzyme and coenzyme
(b) Nitrification and ammonification
(c) Reductive amination & transamination
(d) Community and ecosystem
(e) Biological oxygen demand and chemical oxygen demand

10. *Answer the following in a word or two:*

(a) Which amino acid is referred to as the branched chain amino acid?
(b) Where in the chloroplast do the light reactions of photosynthesis occur?
(c) Who demonstrated that DNA replicates in a semi conservative manner?
(d) What is the maximum number of organisms that can survive in an area called?
(e) Which algae are used in recent times for soil fertility improvement?