YEAR - 2009

Syllabus and Sample Questions for JRF
in AGRICULTURE AND ECOLOGY

[Test Code: RAE]

The candidates have to take two tests: Test **RAE I** in the forenoon session and test **RAE II** in the afternoon session. Both tests will comprise of three groups (Groups A, B and C). Group A is compulsory for all the candidates, Group B for candidates having M. Sc. in Botany/Environmental Science and Group C for candidates having M. Sc. in Microbiology / Zoology / Physiology.
For both tests, Full Marks will be 100 and Time: 2 hours.

Syllabus

Syllabus

1. Structure, function and metabolism of carbohydrates, lipids, proteins, vitamins and minerals; nucleic acids; metabolic pathways; enzymes and coenzymes. Chemistry of natural products (steroids, alkaloids, flavonoids, terpenes, peptides, carbohydrates, nucleic acids and lipids). Functional biochemistry of tissues and organs.

2. Respiration and photosynthesis; protein synthesis; growth promoting plant hormones, response to stress. Principles of taxonomy as applied to the systematics of classification of plant kingdom.

3. Mendelian genetics, mitosis, meiosis, recombination; DNA structure, replication, transcription, translation; DNA footprinting; control of gene expression; polymerase chain reaction; recent trends in molecular biology.

4. Ecosystem structure, food chain and energy flow, ecosystem diversity, productivity and biogeochemical cycles, limnology; environmental pollution, sustainable development, biodiversity, global change (stratospheric ozone, global warming, loss of biodiversity).

5. Classification and morphology of microorganisms; distribution of microbes in nature; reproduction and growth of microorganisms; principles of the cultivation of microorganisms.

6. Classification of antibiotics, mode of action; side effects; resistance; resistance modifying agents. Different methods of bioassay of drugs; Bioassay guided fractionation and identification of compounds.

7. General laboratory analytical techniques and principles.

8. *Basic Statistics and Computation*: Descriptive statistics, correlation, simple regression, analysis of variance, simple probability calculations. Microsoft Excel.

Sample Questions

[Forenoon session]

RAE I

Group A

1. *Select the correct answer from the multiple choices*:

   A. Mr. Pandey is studying the effects of two innovative instructional strategies on students' achievement. He randomly selected 60 students from the 1512 students in his college to participate in the study. These 60 students are referred to most appropriately as the
      (i) research group
      (ii) target population
      (iii) sample
      (iv) accessible population

   B. If the correlation between body weight and annual income were high and positive, we could conclude that
      (i) high incomes cause people to eat more food
      (ii) high income people tend to spend a greater proportion of their income on food than low income people, on average.
      (iii) High income people tend to be heavier than low income people, on average
      (iv) High incomes cause people to gain weight.

C. Which type of charts can Excel produce?
   (i) Line graphs and pie charts only
   (ii) Only line graphs
   (iii) Bar charts, line graphs and pie charts
   (iv) Bar charts and line graphs only

D. Which of the following methods cannot be used to edit the content of a cell in Excel?
   (i) Pressing the Alt key
   (ii) Clicking the formula bar
   (iii) Pressing F2
   (iv) Double clicking the cell

2. Select the correct answer from the multiple choices:

A. Reducing sugars have
   (i) a free aldehyde group
   (ii) a free keto group
   (iii) OH group at one end
   (iv) Free aldehyde and keto group

B. In one complete turn of Krebs cycle, what is the maximum number of ATP molecules that can be produced in Krebs cycle itself?
   (i) 0
   (ii) 1
   (iii) 2
   (iv) 3

C. A genetic defect prevents guard cells from closing stomata in the leaves of a plant. This plant will most likely have excessive
   (i) CO_2 in its leaves
   (ii) O_2 in its leaves
   (iii) Nitrogen fixation
   (iv) Loss of water

D. PCR is extensively used for
   (i) DNA identification
   (ii) DNA recombination
   (iii) DNA amplification
   (iv) DNA repair

E. The two most important climatic factors affecting the distribution of world biomes are
   (i) temperature and precipitation
   (ii) altitude and temperature
   (iii) latitude and temperature
   (iv) humidity and precipitation

F. Oxidative phosphorylation occurs in
   (i) Nucleus of a cell
   (ii) Cytoplasm of the eukayotic cell
   (iii) Endoplasmic reticulum of the cell
   (iv) Inner mitochondrial membrane

G. Interferons are
   (i) Glycoproteins
   (ii) Simple amino acids
   (iii) Monosaccharides
   (iv) Fibrous proteins

H. Bacteria utilizing radiant energy to prepare food are
   (i) Chemosynthetic bacteria
   (ii) Heterotrophic bacteria
   (iii) Photosynthetic bacteria
   (iv) Free-living bacteria

I. Blood vessel A has thick wall, narrow lumen and no valves, while blood vessel B has thin wall, wide lumen and has valves. Here A and B are
   (i) A is artery and B is vein
   (ii) A is vein and B is artery
   (iii) A is vein and B is capillary
   (iv) A is capillary and B is artery

3. Fill in the blanks:
   (a) The other name of glycolysis is ……
   (b) Two or more interacting populations are called …….
   (i) Nitrogen is returned to the atmosphere by the action of …….
   (ii) Natural lipids are readily soluble in ……..
   (iii) Insulin is a protein of …… amino acids

(iv) The basic monomers used in DNA replication are ……..

(v) The pH of 0.01 N HCl is …….

4. Distinguish between the following:
   (a) Littoral zone, limnetic zone and profoundal zone
   (b) Satellite DNA and Plasmid
   (c) Apoenzyme and Cofactors
   (d) Flora and Vegetation
   (e) HPLC and HPTLC
   (f) pH and pOH
   (g) Molar solution and Molal Solution

Group - B

Answer briefly

5. Describe briefly the various categories of biotic components of an ecosystem.

6. How does water serve as an excellent transport medium inside living organisms?

7. Explain how the value of biodiversity may be both an economic and biological determination.

Group - C

Answer briefly

8. Why DNA is not hydrolyzed by dilute alkali whereas RNA is? What is transdeamination?

9. What are essential amino acids? Why are they so called? Name two non-standard amino acids.

10. How do you separate two proteins A and B with same molecular weight? Is there any difference between amide and peptide linkages?

Sample Questions

[Afternoon session]

RAE II

Group A

1 *Select the correct answer from the multiple choices*:

(a) Last year a small statistical consulting company paid monthly each of its five statistical clerks Rs. 2,200, two statistical analysts Rs. 5,000 each and the senior statistician Rs. 27,000. The number of employees earning less than the mean monthly salary is

(i) 4
(ii) 5
(iii) 6
(iv) 7

(b) In an experiment to determine if antibiotics increase the final dressed weight of cattle, the following were measured on each animal in the study.
sex, weight gain, grade of meat
where, *grade of meat* is recorded as A, B, or C. The scale of measurement of these variables is:

(a) Nominal, interval, nominal
(b) Nominal, ratio, nominal
(c) Nominal, ratio, ordinal
(d) Ordinal, ratio, ordinal

Group B

2. *Read the paragraph and answer the questions given below*

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 social benefit of reclaiming the filed.

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

Answer briefly each of the following questions

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

4. Describe the causes and consequences of air pollution.

5. What is Polymerase Chain Reaction? Can any DNA polymerase be used in PCR?

6. Draw the growth curve of an annual plant and explain the important phases.

Group C

7. Paper electrophoresis at pH 6.0 was carried out on a mixture of glycine, alanine, glutamic acid, lysine, arginine and serine.
   (a) Which compound(s) moved fastest toward the anode?
   (b) Which moved fastest toward the cathode?
   (c) Which remained at or near the origin?
   (d) Which amino acids are polar and which are nonpolar?

Answer briefly each of the following questions

8. What are natural compounds? What techniques are generally used for the separation of a mixture of natural compounds?
9. What do you mean by denaturation and renaturation of DNA? How will you distinguish three DNA molecules of same length having 60%, 40% and 20% GC content using UV spectroscopy?
10. Write short notes on:
    (a) Antibiotic resistance
    (b) Thin layer chromatography
    (c) Pathogenic bacteria