Selection test for JRF in Agriculture & Ecology (JAEK) to be held in 2013.

Junior Research Fellowship in Agronomy and Nanobiotechnology

SYLLABUS

The candidates have to take two tests: Test **AEA** (objective type) in the forenoon session and test **AEB** (short answer type) in the afternoon session.

Syllabus (Junior Research Fellowship in Agronomy)

Standard: M.Sc. (Agriculture) in Agronomy of Indian University.

1. Agrometeorology:
   What is agrometeorology; weather forecasting; water balance model; available moisture index model; factors limiting growth, development and yield of crop as affected by light, temperature, humidity and precipitation. Growth and development in adverse environmental conditions like drought, flood.

2. Basic Agronomy:
   The inventory of potentialities in a) climate, b) soil types, c) irrigation, d) manure and fertilizers, and e) package of practices, and their utilization.

3. Crop improvement:
   Mechanism of variability and selection-seed production and distribution, seed testing and certification and storage of seeds-description and variety improvement of cereals (rice, wheat, maize), pulses (gram, pigeon pea, green gram, black gram), oilseeds (rape mustard, groundnut, linseed, sesame) and commercial crops (jute, sugarcane, potato).

4. Crop growth and nutrition:
   Growth and development in adverse conditions like acidity, salinity and alkalinity of soil. Role of nutrient elements- major and minor. Factors affecting their availability.

5. Soil fertility and water management:
   Soil fertility problems; role of organic matter, soil reaction and crop rotation in soil fertility; important manure and fertilizers including biofertilizers, their application and behaviour in different soils; soil testing methods and fertilizer recommendation; role of water in plant development and crop production; systems of irrigation and drainage; irrigation requirement of different field crops.

6. Crop husbandry:
   Advanced studies in the cultural practices of rice, wheat, maize, cotton, jute, potato, forage crops, pulses and oilseeds; economics of crop production; different cropping systems including inter and mixed cropping.

7. Field experimentation:
   Objects and trends in agronomic experiments; application, layout and analysis of data of principal experimental designs viz. Randomized block, Latin squares, factorial experiments, split-plot and confounding; computation of linear and curvilinear regressions and their uses.

Syllabus (Junior Research Fellowship in Nanobiotechnology)

Standard: M.Sc. in any branch of Biological Sciences.

1. *Plant and Animal Biology*: Origin of cells, Photosynthesis, Nitrogen metabolism, Plant hormones, Sensory photobiology, Stress physiology, Programmed cell death, Aging and senescence, Host parasite interaction, Tissue culture and transgenic plants, Transposons, Blood and circulation, Nervous system, Stress and adaptation, Endocrinology and reproduction, Excretory system, Cell signaling, Genetically modified organisms.

2. *Biochemistry and Molecular Biology*: Composition, structure and function of biomolecules, Enzymes, Membrane structure and function, Genes and chromosomes, Transcription, Translation, Recombinant DNA methods, Histochemical and Immuno-techniques.

3. *Nanotechnology*: Nano-revolution of the 20^{th} and 21^{st} century, Properties at nanoscale, Metal and semiconductor nanomaterials, Quantum dots, Wells and wires, Molecule to bulk transitions, Bucky balls and carbon nanotubes, Top-down (milling, nanolithography), Bottom-up (sol-gel processing, chemical synthesis), DLS, TEM, SEM, SPM techniques, Fluorescence microscopy and imaging, Applications in the nano medicine and nanobiotechnology.

4. *Statistical Methods in Biology*: Measures of central tendency and dispersal, Binomial, Poisson and Normal Probability distributions, Confidence Interval, Levels of significance, Regression and Correlation, t-test, Analysis of variance, Chi-square test.

Sample Questions

(Forenoon session)

AEA

(100 questions to be answered, Total marks-100, Time- 2 hours)

Sample questions for Junior Research Fellowship in Agronomy

1. An annual precipitation in semi arid tropics should be between
(a) 400-500mm (b) 500-700mm (c) 700-1000mm (d) 1000-1200mm.
2. A soil containing 80 kg available K/ha is rated
(a) Very high (b) High (c) Medium (d) Poor in P content
3. From the following select one medium duration rice cultivar
(a) Pankaj (b) Masuri (c) Jaya (d) Sabita.
4. The optimum row spacing of wheat is
(a) 22.5cm (b) 15.5cm (c) 30cm (d) 5cm.
5. Triple super phosphate is
(a) Water soluble (b) alkali soluble (c) Acid soluble (d) Citrate soluble.
6. Oil percentage of sunflower is
(a) 20-24% (b) 30-35% (c) 15-20% (d) 40-44%.
7. LER is an index to assess
(a) Light intensity (b) Intercropping advantage (c) Crop rotation advantage (d) Leaf area.
8. Which of the following disease affects young seedlings at nursery stage
(a) Fusarium wilt (b) Little leaf (c) Early blight (d) Damping off.
9. In a RBD experiment with ten sowing dates of wheat replicated thrice, the error MSS value is estimated as 24.6. Select the correct CD value.
(t at 0.05 P = 2.101)
(a) 5.32 (b) 7.57 (c) 8.51 (d) 10.02.

10. A soil shows 27% of water at field capacity (ignoring wilting coefficient). Indicate the amount of irrigation water needed to raise 60% available soil moisture in one hectare of land.

(a) 2.0lakh gallns (b) 1.6lakh gallns (c) 1.0lakh gallns (d) 0.5lakh gallns.

11. Alluvial soil according to soil taxonomical classification can be called as

(a) Entisol (b) Vertisol (c) Ultisol (d) Oxisol.

12. IW/CPE ratio in wheat under alluvial soil condition is

(a) 0.92 (b) 0.88 (c) 0.78 (0.67.

13. Which should be lime requirement of a sandy loam lateritic soil with pH 5.4?

(a) 5.3 q/ha (b) 10.5 q/ha (c) 14.2 q/ha (d) 16.8 q/ha.

14. In a 120 days rice variety initiation of panicle primordia is noticed after

(a) 40 (b) 50 (c) 60 (d) 70 (Days after transplanting)

15. In an intercropped plot mixture of ij and ji crop yielded 3867 and 1254 kg/ha respectively whereas as sole crops ii and jj yielded 4775 and 4321 kg/ha. LER calculated is

(a) 1.10 (b) 1.34 (c) 1.00 (d) 1.24.

Sample questions for Junior Research Fellowship in Nanobiotechnology

Select the correct answer from the multiple choice:

1. All of the following have been proposed as a type of protocell except

a. coacervates

b. microspheres

c. endosymbionts

2. In C3 plants, photosynthetic carbon fixation occurs in

a. bundle sheath cells

b. mesophyll cells

c. upper epidermal cells

3. Which of the following prosthetic group is present in nitrate reductase
a. FAD
b. heme
c. all of the above
4. Auxin increases the _____ of cell walls
a. plasticity
b. porocity
c. rigidity
5. The action potential of a neuron
a. is initiated by efflux of Na^+
b. is terminated by efflux of K^+
c. declines in amplitude as it moves along the axon
6. The most abundant protein in human blood is
a. hemoglobin
b. albumin
c. transferrin
7. In prokaryotes, the lagging primers are removed by
a. DNA ligase
b. DNA polymerase I
c. DNA polymerase III
8. The three DNA sequences, which define a chromosome, include all of the following except
a. centromere
b. enhancer
c. telomere
d. origin of DNA replication
9. Nanoparticles are special mainly because of their
a. surface area
b. surface charge
c. enormous size : volume ratio
10. Silica nanoparticles can be synthesized through
a. attrition
b. sol-gel synthesis
c. chemical vapor deposition

Sample Questions

[Afternoon session]

AEB

(20 questions to be answered, Total marks-100, Time- 2 hours)

[To be answered in separate answer script, not in the question paper]

Sample questions for Junior Research Fellowship in Agronomy

1. Define agro-climate. Write the salient features of different agro-climatic zones of India and state the distribution of crops and cropping sequences in these zones.
2. What is uniformity trial? Why this is important in field experiments?
3. Define cropping pattern as compared to cropping system. Differentiate between :

a. Multiple cropping and monoculture;
b. Sole cropping and intercropping;
c. Relay cropping and sequential cropping
d. Critically discuss the biological basis of intercropping advantages.

4. Write the important stategies to be undertaken in rainfed farming technologies of sub-humid areas with elaboration of crop choice on up and low land situations.
5. What are important trace elements influencing crop productivity? Write in short the deficiency symptoms of boron and molybdenum and suggest possible corrective measure.

Sample questions for Junior Research Fellowship in Nanobiotechnology

1. Write a short note on the theory of cell evolution.
2. Outline the basic principle of light activation of Calvin cycle.
3. Describe Ramachandran plot and its implications in biology.

4. Write a short note with one example on double antibody sandwich method for identification of a pathogen.
5. Compare between biopesticides and BT-technology.
6. Describe the role of ion channels in cardiac physiology.
7. Write a short note on the pain mediated neuronal response in human.
8. In a population of shrimp, the sex ratio is assumed to be male : female :: 0.5 : 0.5. How many male shrimp should turn up in a random sample of 80 so as to reject the hypothesis? (Note: χ^2=3.84 for df=1, α=0.05)
9. What is a nano-encapsulation complex?
10. Write a short note on the principle of dynamic light scattering technique.