

# INDIAN STATISTICAL INSTITUTE

## Recruitment for posts of Scientific Assistant A (*Specialization: Biological Sciences*)

### SECTION II

#### Syllabus for Online and Skill Tests

- **Cell Biology:** Prokaryotic & eukaryotic cells; Nucleus and nuclear components – structure & function; Cell division, cell cycle; Diversity of genomes; Transport across membrane; Cellular compartments and function, protein sorting; Mitochondria and chloroplast; Cell signaling; Germ cells; Stem cells; Cancer cells; Necrotic & Apoptotic cell death.
- **Genetics:** Information transfer in the sequence of DNA-RNA-Protein; genotype & phenotype; Pseudogenes; Cell division; Mutation; Mendelian inheritance; Deviation from Mendelian inheritance, Linkage & Sex-linked inheritance; mitochondrial genetics, Recombination; Gene expression and function; Human genetics & genetic disorders; Population genetics; Immunogenetics; Genes and Evolution. Epigenetics: DNA methylation, non-coding RNAs, chromatin remodelling, Histone modifications, Role of epigenetics in human diseases.
- **Molecular Biology:** Structure & function of DNA, RNA; Chromosomes, chromatin and function; Replication; Repair; Recombination; Transposons & retrotransposons; Transcription; RNA processing; Translation; Genetic code; Gene regulation in Prokaryotes and Eukaryotes; Genomic evolution & diversity.
- **Biochemistry:** Amino acids and proteins; Carbohydrates; Nucleotides and nucleic acids; Lipids; Vitamins; Hormones; Protein structure and functions, enzymes; Metabolism of carbohydrate, protein, lipid/fat, metabolic pathways and metabolic diseases; Biochemistry of signal transduction and hormone action.
- **Immunology:** Immune system; B cell, T cell receptors and signalling; Antigens; Innate immunity; Cytokines and chemokine; The complement system; MHC, Antigen processing & presentation; T cell/B cell development, activation & differentiation; Adaptive immune; Immunoglobulins; Antibody diversity; Antigen antibody reactions; Self-Nonself discrimination; Clonal selection; Autoimmunity; Tumour immunology.
- **Genetic Engineering and techniques:** Modern methodologies in cell/tissue culture; Chromosome techniques; PCR, qPCR; ELISA; Immunocyto/histochemical techniques; DNA, RNA & Protein isolations and purifications; Southern, Western and Northern blot; Automated DNA sequencing by Sanger's method; Radioactive and Non-radioactive probe labelling; Hybridization techniques; Protein DNA interaction; Antisense RNA; Cloning; Transformation & transfection; Next generation sequencing technologies and other molecular biology techniques.
- **Basic Statistics:** Measures of central tendency and dispersal; Correlation and Regression; Binomial, Poisson and Normal Probability distributions; Test of significance, t-test; Analysis of variance; Chi-square test; Confidence Interval.

# Sample Questions for the Online Test

*Note: For each of the questions there are four suggested answers, of which only one is correct. You will score*

*4 marks for each correctly answered question,*

*0 mark for each incorrectly answered question, and*

*1 mark for each unattempted question.*

1. It is suspected that a novel protein only interacts with the promoter region of a gene. Which of the following techniques should be used to confirm this suspicion?
  - (a) EMSA
  - (b) DNase foot-printing
  - (c) Gel mobility shift assay
  - (d) All of the choices are correct
2. During DNA replication, Okazaki fragments used to elongate
  - (a) the lagging strand towards the replication fork
  - (b) the leading strand toward the replication fork
  - (c) the lagging strand away from the replication fork
  - (d) the leading strand away from the replication fork
3. Expression of a gene can be analysed by
  - (a) Northern Blot analysis
  - (b) Southern Blot analysis
  - (c) Comparative genomics
  - (d) RNA interference
4. In a family, one parent is affected while the other parent is unaffected. If one offspring is affected and another offspring is unaffected in the family, then the disease can be
  - (a) recessive or dominant
  - (b) recessive but not dominant
  - (c) dominant but not recessive
  - (d) neither recessive nor dominant
5. Which of these projects is the best suited for next generation sequencing?
  - (a) to genotype 3 known SNPs in 50 Genomic DNA samples
  - (b) to find the expression of 5 genes in 50 tumor samples
  - (c) to find DNA methylation in 50 tumor samples
  - (d) To compare the average methylation of two cell types
6. The rate of migration of a protein in SDS-Polyacrylamide gel is not influenced by
  - (a) size of the protein
  - (b) charge in the protein
  - (c) pore size of the gel
  - (d) strength of the electric field
7. If you want to test the equality of variances of two population, each of which is distributed as normal, then you would use
  - (a) chi-square test
  - (b) t-test
  - (c) F test
  - (d) z-test
8. In a sequencing reaction, by mistake, ddATP was added in the reaction mixture instead of dATP. What would be the consequence?
  - (a) No DNA synthesis would occur
  - (b) Normal DNA synthesis would occur
  - (c) Synthesis would always stop at the position at which first A was incorporated
  - (d) Synthesis would terminate randomly regardless of the nucleotide incorporated
9. What do T-cells need to recognize so that they can respond to specific antigens?
  - (a) The antigenic epitope displayed by MHC molecules
  - (b) B cells
  - (c) Immunoglobulin
  - (d) Cytokines

10. If  $^{14}\text{C}$ -glycine is used for biosynthetic labelling, which one of the following molecules can be labelled in bacterial cells?
- (a) Purines and pyrimidines      (b) Purines and proteins  
(c) Proteins and lipids              (d) Proteins and pyrimidines
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