R3608

Sub. Code
502301

M.Sc. DEGREE EXAMINATION, NOVEMBER – 2025

Third Semester

Bioinformatics

GENETICS AND GENETIC ENGINEERING

(CBCS – 2022 onwards)

Time : 3 Hours Maximum : 75 Marks

Part A (10 × 1 = 10)

Answer **all** questions by choosing the correct option.

1. What is the term used for different forms of a gene? (CO1, K1)

   (a) Phenotype (b) Dominance

   (c) Alleles (d) Heterozygous

2. A genetic disorder with a 50% chance of being passed from a parent to offspring is likely (CO1, K1)

   (a) Dominant inheritance

   (b) Recessive inheritance

   (c) Codominance

   (d) Epistasis

3. Which type of mutation results in the substitution of a single nucleotide in the DNA sequence? (CO2, K2)

   (a) Autosomal dominant

   (b) Autosomal recessive

   (c) X-linked recessive

   (d) Mitochondrial inheritance

4. Rh factor in blood groups is an example of (CO2, K2)
   (a) Dominant inheritance
   (b) Recessive inheritance
   (c) Codominance
   (d) Epistasis
5. Which of the following is an example of post-transcriptional modification? (CO3, K1)
   (a) DNA polymerase (b) Splicing of introns
   (c) Protein folding (d) RNA polymerase binding
6. In recombinant DNA technology, the enzyme used to join DNA fragments is (CO3, K2)
   (a) Ligase (b) Restriction enzyme
   (c) DNA polymerase (d) Reverse transcriptase
7. Which method of gene transfer involves the uptake of naked DNA by a cell? (CO4, K2)
   (a) Transformation (b) Conjugation
   (c) Transduction (d) Sexduction
8. In transduction, genes are transferred between bacteria by (CO4, K1)
   (a) Plasmids (b) Pili
   (c) Phages (d) Naked DNA
9. Which gene transfer method uses a "gene gun"? (CO5, K2)
   (a) Microinjection
   (b) Electroporation
   (c) Biolistics
   (d) Agrobacterium-mediated transfer
10. Which bacterium is commonly used for genetic transformation in plants? (CO5, K2)
   (a) Escherichia coli
   (b) Agrobacterium tumefaciens
   (c) Bacillus thuringiensis
   (d) Saccharomyces cerevisiae

Part B (5 × 5 = 25)

Answer **all** questions not more than 500 words each.

11. (a) Differentiate between phenotype and genotype with examples. (CO1, K2)

Or

(b) Briefly explain mitochondrial inheritance with an example. (CO1, K2)

12. (a) Define mutation and explain its types with examples. (CO2, K2)

Or

(b) Describe the inter-allelic interaction responsible for the comb patterns in fowls. (CO2, K2)

13. (a) Explain the regulation of translation in eukaryotic cells. (CO3, K5)

Or

(b) Describe the basic steps involved in the isolation and purification of proteins. (CO3, K5)

14. (a) Explain the process of mapping genes using interrupted mating experiments. (CO4, K3)

Or

(b) Explain the concept of fine-structure gene analysis. (CO4, K3)

15. (a) What are edible vaccines? Mention their advantages and challenges. (CO5, K3)

Or

(b) Describe the binary vector system and its advantages in plant transformation. (CO5, K3)

Part C (5 × 8 = 40)

Answer **all** questions not more than 1000 words each.

16. (a) Discuss the Law of Independent Assortment with an example and highlight the exceptions observed in genetic studies. (CO1, K2)

Or

(b) What is multifactorial inheritance? Explain its significance and provide examples. (CO1, K2)

17. (a) Discuss epistasis in detail. Explain dominant and recessive epistasis with suitable examples. (CO2, K3)

Or

(b) Describe the structure and organization of human chromosomes and mitochondrial genome. (CO2, K3)

18. (a) Explain recombinant DNA technology, highlighting its role in over expression and protein purification. (CO3, K5)

Or

(b) Explain post-transcriptional modifications of RNA and their importance in gene expression. (CO3, K4)

19. (a) Explain the Hardy-Weinberg Principle in detail. How can deviations from this principle indicate evolutionary changes? (CO4, K4)

Or

(b) Write an account of epigenetic mechanisms and their role in inheritance and gene regulation. (CO4, K3)

20. (a) What are the issues related to the biosafety of transgenic products? Provide examples of environmental risks. (CO5, K3)

Or

(b) Discuss the applications of plant genetic engineering in improving abiotic and biotic stress resistance. (CO5, K4)

R3609

Sub. Code
502302

M.Sc. DEGREE EXAMINATION, NOVEMBER – 2025

Third Semester

Bioinformatics

STRUCTURAL BIOLOGY

(CBCS – 2022 onwards)

Time : 3 Hours Maximum : 75 Marks

Part A (10 × 1 = 10)

Answer **all** the following objective questions by choosing the correct option.

1. How many Bravais lattices exist in three dimensional space (CO1, K1)

   (a) 7

   (b) 12

   (c) 14

   (d) 32

2. What is the main advantage of Cryo-Electron Microscopy (Cryo-EM) over X-ray crystallography? (CO1, K2)

   (a) It provides higher resolution

   (b) It works only with metal-containing proteins

   (c) It does not require crystallization of the sample

   (d) It uses visible light

3. Which technique is most commonly used to determine the 3D structure of proteins at atomic resolution? (CO1, K2)

(a) NMR spectroscopy

(b) Mass spectroscopy

(c) X-ray crystallography

(d) UV-Vis spectroscopy

4. What type of radiation is most commonly used in small molecule X-ray crystallography? (CO1, K1)

(a) Gamma rays (b) Infrared light

(c) Cu Kα X-rays (d) Microwave radiation

5. What is the smallest repeating unit in a crystal called? (CO1, K1)

(a) Lattice (b) Unit cell

(c) Bravais cell (d) Domain

6. In small molecule crystallography, what does the R-factor indicate? (CO4, K2)

(a) The refractive index of the crystal

(b) The number of atoms in the unit cell

(c) The quality of the crystal symmetry

(d) The agreement between observed and calculated data

7. Which of the following proteins was first sequenced by Frederick Sanger? (CO4, K1)

(a) Myosin (b) Insulin

(c) Myoglobin (d) Hemoglobin

8. Which of the following techniques is often used to solve the phase problem in protein crystallography? (CO4, K1)

(a) SDS-PAGE

(b) MALDI-TOF

(c) Molecular replacement

(d) Western blotting

9. Which of the following molecules has a tetrahedral geometry? (CO4, K2)

(a) CO_2 (b) CH_4

(c) NH_3 (d) H_2O

10. What type of molecular interaction is primarily responsible for the base pairing in DNA? (CO4, K2)

(a) Ionic interactions

(b) Disulfide bonds

(c) Covalent bonds

(d) Hydrogen bonds

Part B ($5 \times 5 = 25$)

Answer **all** questions not more than 500 words each.

11. (a) What is a crystal? Describe its key characteristics. (CO1, K5)

Or

(b) What is the physical significance of Bragg's law? Derive its equation. (CO1, K6)

12. (a) Discuss the significance of planes and indices in crystallography. (CO1, K5)

Or

(b) Differentiate between point group and space group symmetry in crystals. (CO1, K5)

13. (a) How does the structure factor influence X-ray diffraction patterns? (CO1, K4)

Or

(b) Discuss the steps involved in the formation and growth of crystals. (CO4, K6)

14. (a) What is soaking? How does it differ from co-crystallization? (CO4, K4)

Or

(b) Outline the steps involved in protein folding. (CO4, K5)

15. (a) How is data validated and submitted for inclusion In the PDB? (CO4, K5)

Or

(b) Describe the concept of the Bravais lattice in crystal structures. (CO4, K5)

Part C (5 × 8 = 40)

Answer **all** questions not more than 1000 words each.

16. (a) Write an essay on the concept of the phase problem in X-ray crystallography and its solutions. (CO1, K3)

Or

(b) How are crystals classified into seven systems? Explain with parameters and illustrations. (CO1, K6)

17. (a) Elaborate on the process and importance of electron density calculation. (CO1, K4)

Or

(b) Define and explain:

(i) Unit cell

(ii) Lattice

(iii) Crystal planes

(iv) Miller indices, with suitable diagrams. (CO1, K6)

18. (a) Discuss the techniques of X-ray diffraction and its significance in material. (CO1, K4)

Or

(b) Describe the various types of crystallization methods and their applications. (CO4, K5)

19. (a) What are the procedures for collecting and reducing data in single crystal? (CO4, K5)

Or

(b) Describe the Ramachandran plot and its application in assessing protein stereochemistry. (CO4, K6)

20. (a) Differentiate between fibrous, globular, and membrane proteins with diagrams. (CO4, K6)

Or

(b) Explain the role of bonding and interactions at each level of protein structure. (CO4, K5)

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R3610	Sub. Code 502303

M.Sc. DEGREE EXAMINATION, NOVEMBER – 2025

Third Semester

Bioinformatics

PHARMACOGENOMICS

(CBCS – 2022 onwards)

Time : 3 Hours Maximum : 75 Marks

Part A (10 × 1 = 10)

Answer **all** the following objective questions by choosing the correct option.

1. Single Nucleotide Polymorphisms (SNPs) are (CO1, K2)

   (a) Large deletions in DNA sequences

   (b) A type of RNA sequence variation

   (c) Variations in a single nucleotide in a genome

   (d) Mutations only found in coding regions

2. What is epigenomics? (CO1, K2)

   (a) The study of mutations in DNA sequences

   (b) The study of heritable changes in gene expression without changing the DNA sequence

   (c) The study of RNA processing

   (d) The study of chromosomal abnormalities

3. Comparative genomics helps in understanding the evolutionary relationships between species by: (CO2, K2)

(a) Studying protein folding patterns

(b) Analyzing similarities and differences in their genomic sequences

(c) Observing physical traits of organisms

(d) Mapping metabolic pathways

4. Which of the following techniques is commonly used in functional genomics to study gene expression? (CO2, K2)

(a) Polymerase Chain Reaction (PCR)

(b) Microarrays

(c) X-ray Crystallography

(d) Gel Electrophoresis

5. Which of the following terms refers to the genetic variation affecting an individual's drug metabolism? (CO3, K2)

(a) Genotyping

(b) Polymorphism

(c) Epigenetics

(d) Pharmacokinetics

6. Pharmacogenomics primarily focuses on: (CO3, K2)

(a) Environmental factors affecting drug metabolism

(b) Genetic variation and its influence on drug response

(c) Drug-drug interactions in treatment

(d) The development of new pharmaceuticals

7. What is the main advantage of using next-generation sequencing (NGS) in pharmacogenomics? (CO4, K4)

(a) It is a low-cost technique

(b) It allows for the sequencing of entire genomes and identification of variants associated with drug responses

(c) It only sequences exonic regions

(d) It is only used for protein analysis

8. Which technology is used to study gene expression and detect which genes are active in response to a drug treatment? (CO4, K4)

(a) RNA sequencing (RNA-Seq)

(b) Chromosome conformation capture (3C)

(c) Immunoblotting

(d) DNA microarrays

9. Which of the following is the primary goal of pharmacogenomics in cancer treatment? (CO5, K5)

(a) To identify cancer-causing mutations

(b) To predict the optimal drug dosage for a specific patient based on their genetic profile

(c) To develop new cancer drugs without considering genetic factors

(d) To identify environmental factors contributing to cancer

10. Copy number alterations (CNAs) refer to: (CO5, K5)

(a) Variations in the number of copies of specific genes or genomic regions

(b) Point mutations within a single nucleotide

(c) The process by which genes are deleted during transcription

(d) Changes in the methylation status of genes

Part B (5 × 5 = 25)

Answer **all** questions not more than 500 words each.

11. (a) Describe the basic steps involved in the genome sequencing process. (CO1, K2)

Or

(b) What are the key advantages of Next-Generation Sequencing (NGS) over Sanger sequencing? (CO1, K4)

12. (a) Explain the concept of synteny with an example. (CO2, K4)

Or

(b) What is the significance of functional annotation of genes in functional genomics? (CO2, K4)

13. (a) List three examples of genes commonly studied in pharmacogenomics. (CO3, K2)

Or

(b) What role does the cytochrome P450 family play in pharmacogenomics? (CO3, K2)

14. (a) Elaborate on gene expression databases and its role in pharmacogenomics with examples. (CO4, K4)

Or

(b) Describe how NGS is used to identify genetic variants affecting drug metabolism. (CO4, K4)

15. (a) What is the Cancer Genome Atlas (TCGA), and how is it useful in cancer research? (CO5, K5)

Or

(b) How does the Catalogue of Somatic Mutations in Cancer (COSMIC) contribute to cancergenomics? (CO5, K5)

Part C (5 × 8 = 40)

Answer **all** questions not more than 1000 words each.

16. (a) Explain how metagenomic sequencing is used to study microbial communities. (CO1, K2)

Or

(b) How can genomic databases assist in identifying disease-associated genes? Provide examples. (CO1, K4)

17. (a) How can comparative genomics aid in the discovery of new drug targets? (CO2, K4)

Or

(b) Discuss the role of functional genomics in understanding human diseases. (CO2, K4)

18. (a) How do genetic variants influence the pharmacokinetics and pharmacodynamics of drugs? Explain with relevant examples. (CO3, K2)

Or

(b) What are the challenges in implementing pharmacogenomics in clinical practice? (CO3, K2)

19. (a) What are the ethical concerns associated with the use of pharmacogenomic data in clinical practice? (CO4, K4)

Or

(b) How do microarrays help in identifying drug-metabolizing enzyme variants in pharmacogenomics? (CO4, K4)

20. (a) How can genetic testing improve personalized treatment strategies for cancer patients? (CO5, K5)

Or

(b) Why is BRCA1/2 testing important in ovarian and breast cancer treatment? (CO5, K5)

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R3611

Sub. Code
502508

M.Sc. DEGREE EXAMINATION, NOVEMBER – 2025

Third Semester

Bioinformatics

Elective : PROGRAMMING IN C AND C++

(CBCS – 2022 onwards)

Time : 3 Hours Maximum : 75 Marks

Part A (10 × 1 = 10)

Answer **all** the questions by choosing the correct option.

1. _____ operator has the highest precedence in C? (CO1, K1)

   (a) * (b) +

   (c) () (d) &&

2. What is the output of the following code? (CO4, K2)

   int i = 0, if(i) printf("True"); else printf("False");

   (a) True (b) False

   (c) 0 (d) Error

3. Which of the following is the correct way to initialize a 2D array? (CO4, K2)

   (a) int arr[2][3] = {1, 2, 3, 4, 5, 6};

   (b) int arr[2][3] = {{1, 2, 3}, {4, 5, 6}};

   (c) int arr[2][3] = {1, 2, 3, 4, 5};

   (d) int arr[2][3]={{1, 2}, {3, 4}, {5, 6}};

4. If int $x = 10$; int *p = &x; what does *p return? (CO3, K3)

(a) Address of x

(b) Value of x

(c) Pointer p

(d) Undefined

5. What is the return value of the strlen() function in C? (CO3, K2)

(a) The total memory used by the string

(b) The length of the string excluding the null character

(c) The length of the string including the null character

(d) The ASCII value of the first character in the string

6. _____ argument in the initgraph() function used to initialize the graphics mode in C. (CO2, K1)

(a) Graphics driver

(b) Window size

(c) Graphics mode

(d) Color mode

7. The purpose of a destructor in to _____. (CO1, K2)

(a) initialize the object

(b) allocate memory for the object

(c) release resources when an object goes out of scope

(d) copy one object to another

8. The concept in C++ allows restricting access to the internal state of an object is _____. (CO1, K2)

(a) Polymorphism

(b) Inheritance

(c) Encapsulation

(d) Abstraction

9. Which of the following is the correct way to pass arguments by reference in C++? (CO2, K2)

(a) function(variable);

(b) function(&variable);

(c) function(* variable);

(d) function(variable&);

10. _____ method is used to pass an array to a function in C++. (CO1, K2)

(a) function(arr);

(b) function(arr[]);

(c) function(&arr);

(d) function(arr[5]);

Part B (5 × 5 = 25)

Answer **all** questions not more than 500 words each.

11. (a) Discuss operators in C with their hierarchy and an example application. (CO4, K2)

Or

(b) How do scanf() and printf() work in C? Provide an example. (CO2, K2)

12. (a) Write a C program to demonstrate auto, static, and extern storage classes. (CO2, K6)

Or

(b) Explain the use of preprocessor directives and explain how is it used? (CO1, K2)

13. (a) Define a structure and a union in C. How do they differ in terms of memory allocation? (CO3, K4)

Or

(b) Explain graphics module in C and the function initgraph() for initializing graphics mode. (CO2, K3)

14. (a) Explain the role of Access Specifiers in C++ and state the different types of access specifiers? (CO5, K4)

Or

(b) Explain the concept of Data Hiding in C++. (CO1, K2)

15. (a) What is recursion? Write a C++ program that uses recursion to calculate factorial of a number. (CO5, K6)

Or

(b) Explain the difference between Call by Value and Call by Reference in C++. (CO1, K4)

Part C (5 × 8 = 40)

Answer **all** questions not more than 1000 words each.

16. (a) Explain the basic structure of a C program with an example. (CO3, K2)

Or

(b) Write a C program to implement billing system to calculates the total price of items based on user input for the quantity and price per item. If the total cost exceeds $500, apply a discount of 10% (CO5, K5)

17. (a) Write a C program that dynamically allocates memory for both a 1D and a 2D array. (CO4, K6)

Or

(b) Write a C program that proves the use of pointer notations to access and modify the elements of 1D array. (CO4, K6)

18. (a) Explain the difference between structures and unions. Discuss the memory allocation mechanisms of both structures and unions. (CO2, K6)

Or

(b) Explain the use of file handling functions in C such as fopen, fprintf, fscanf and fclose. (CO2, K6)

19. (a) (i) Create a base class Person with the data members name and age, and a derived class. Student that inherits from Person and has an additional data member Roll_No.

(ii) Implement constructor in both classes and create a function to display the details. (CO2, K5)

Or

(b) Explain the concept of Encapsulation in C++ with an example. (CO1, K2)

20. (a) Write a C++ program that uses recursion to compute the nth Fibonacci number. (CO2, K5)

Or

(b) Explain the concept of exception handling in C++. How does C++ handle runtime errors use exceptions? (CO2, K6)

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