[This question paper contains 12 printed pages.]

(13) **Your Roll No.** 2024

Sr. No. of Question Paper : 4321 **G**

Unique Paper Code : 32491501

Name of the Paper : Concepts in Genetics

Name of the Course : **B.Sc. (Hons.) Biochemistry (CBCS-LOCF)**

Semester : V

Duration : 3 Hours Maximum Marks : 75

Instructions for Candidates

1. Write your Roll No. on the top immediately on receipt of this question paper.
2. There are **8** questions.
3. Attempt **any 5** questions.
4. **All** questions carry equal marks.
5. Question no. **1** is compulsory.
6. The use of simple calculator is allowed.

P.T.O.

1. (a) Give a term that best describes the following :

(i) Phenotype of heterozygote is intermediate between the phenotypes of the two homozygotes.

(ii) An autosomal trait expressed in one gender only.

(iii) A cross between an F1 individual and one of the parental homozygous recessive genotype.

(iv) Mode of inheritance observed in LHON disease.

(v) Non-coding RNA involved in dosage compensation in mammals.

(vi) The region of homology between X and Y chromosome.

(b) Comment on the following :

(i) In the experiments conducted by Carl Correns on *Mirabilis jalapa,* the variegated branch produces progeny with three different phenotypes.

(ii) Incomplete penetrance can lead to confusing transmission patterns in pedigree analysis.

(iii) Rare male calico cats are the feline equivalent of Kleinfelter's syndrome.

(c) Discuss the application of the following in genetics :

(i) Molecular clock

(ii) LOD score

(iii) Karyotyping (6,6,3)

2. Differentiate between the following **(any five)** :

(a) Allopatric and sympatric speciation

(b) Specialized transduction and generalized transduction

(c) Maternal effect and maternal inheritance

(d) Genetic map and physical map

(e) Translocation and inversion of chromosome segments

(f) Broad sense and narrow sense heritability

(3×5)

3. (a) Aryan is colour blind. Both his parents have normal vision. His maternal grandfather is colour-blind, while both his paternal grandparents have normal colour vision. Aryan has three elder sisters Gita, Reeta, and Meeta (in the given order). All three sisters have normal colour vision. Aryan's oldest

sister, Geeta is married to a man with normal colour vision; they have two children, a 10-year-old colour-blind boy and a 6-year-old girl with normal colour vision.

(i) Using standard symbols and labels, draw a pedigree of Aryan's family.

(ii) What is the most likely mode of inheritance for colour blindness in Aryan's family? Justify your answer.

(iii) If Geeta and her husband have another child, what is the probability that the child will be a colour-blind boy?

(b) In four Hfr strains of bacteria, all derived from an original F^+ culture grown over several months, a group of hypothetical genes was studied and shown to be transferred in the order shown in the following table.

Hfr Strain	Order of Gene Transfer
1	*E R I U M B*
2	*U M B A C T*
3	*C T E R I U*
4	*R E T C A B*

(i) Assuming that *B* is the first gene along the chromosome, determine the sequence of all genes shown.

(ii) One strain creates an apparent dilemma. Which one is it? Explain why the dilemma is only apparent, not real.

(c) Explain how in a heterozygous individual, a single crossover within a pericentric inversion leads to abnormal gametes. Briefly explain how duplication may lead to the evolution of new genes.

(6,4,5)

3. (a) The following genotypes were crossed :

Aa Bb Cc dd Ee × *Aa bb Cc Dd Ee.*

What will be the proportion of the following genotypes among the progeny of this cross?

(i) *Aa Bb Cc Dd Ee*

(ii) *Aa bb Cc dd ee*

(iii) *aa bb cc dd ee*

(iv) *AA BB CC DD EE*

(b) What do you understand by trinucleotide expansion? How is it responsible for genetic anticipation? Explain with the help of a suitable example.

(c) Waxy endosperm (*wx*), shrunken endosperm *(sh)*, and yellow seedling (*v*) are encoded by three recessive genes in corn that are linked on

chromosome 5. A corn plant homozygous for all three recessive alleles is crossed with a plant homozygous for all the dominant alleles. The resulting F_1 are then crossed with a plant homozygous for the recessive alleles in a three-point testcross. The progeny of the testcross are :

Wx	*sh*	*V*	87
Wx	*Sh*	*v*	94
Wx	*Sh*	*V*	3,479
wx	*sh*	*v*	3478
Wx	*sh*	*V*	1,515
wx	*Sh*	*v*	1531
wx	*Sh*	*V*	292
Wx	*sh*	*v*	280
	Total		10,756

(i) Determine the order of these genes on the chromosome.

(ii) Calculate the map distances between the genes.

(iii) Determine the coefficient of coincidence and the interference among these genes.

(iv) What does the interference tell us about the effect of one crossover on another?

(4,4,7)

4. (a) With the help of suitable examples, explain the phenomenon and molecular basis which gives rise to the phenotypic ratio of 12:3:1 and 15:1.

(b) State the Hardy Weinberg law. Calculate allelic, genotypic and phenotypic frequencies in a population of 30,000 individuals in which 65 individuals are diagnosed positive for autosomal recessive disorder.

(c) Explain how Benzer used the complementation test to determine the structure of rII locus of T_4 bacteriophage. (6,4,5)

5. (a) What do you mean by complementation test? The dominant mutation *Plum* in the fruit fly causes brownish-purple eyes. Is it possible to determine by complementation test whether *Plum* is an allele of the *brown* or *purple* genes? Justify your answer.

(b) Explain the underlying mechanism during development, which leads to the differentiation of Drosophila embryo into anterior-posterior and dorsal-ventral axes.

(c) What will be the result of the following conjugation between cells with different F-factors :

(i) $F^+ \times F^-$

(ii) $F' \times F$

(iii) $Hfr \times F^-$ (4,8,3)

6. (a) Species A has $2n = 14$ and species B has $2n = 20$. Give all possible chromosome numbers that may be found in the following individuals.

(i) An autotriploid of species A

(ii) An autotetraploid of species B

(iii) An allotriploid formed from species A and species B

(b) Phenylketonuria, a metabolic disease in humans, is caused by a recessive allele, k. If two heterozygous carriers of the allele marry and plan a family of five children :

(i) What is the chance that four children will be unaffected and one affected with phenylketonuria?

(ii) What is the chance that the first child will be an unaffected girl?

(c) Explain the molecular mechanism of dosage compensation in humans and compare it with that of the fruit fly.

A normal female has an inactivated X chromosome as Barr body. However, if she does not have both X chromosomes, she exhibits a genetic disorder. Explain. (3,4,8)

7. Write short notes on the following **(any five)** :

(a) Neutral theory of evolution

(b) Quantitative Trait Loci and their identification

(c) Robertsonian Translocation

(d) Mechanisms of genetic transfer in bacteria

(e) Genetic markers

(f) Homeotic genes of Arabidopsis

(g) Somatic hybridization (3×5)

[This question paper contains 4 printed pages.]

(14) **Your Roll No.** 2024

Sr. No. of Question Paper : 4375 **G**

Unique Paper Code : 32491502

Name of the Paper : Gene Expression and Regulation (Core)

Name of the Course : **B.Sc. (Hons.) Biochemistry**

Semester : V

Duration : 3 Hours Maximum Marks : 75

Instructions for Candidates

1. Write your Roll No. on the top immediately on receipt of this question paper.
2. There are **eight** questions.
3. Attempt **any five** questions.
4. **All** questions carry equal marks.
5. Question no. **1** is compulsory.

1. (a) Explain the following :

   (i) In prokaryotes the ribosome is able to differentiate between internal and initiator methionine.

   (ii) The eukaryotic mRNAs are more stable than prokaryotic mRNAs.

P.T.O.

P.T.O.

(iii) Peptide bond formation takes place without ATP hydrolysis.

(iv) Sigma factor is not associated with the elongating RNA polymerase.

(v) Genetic code is universal and degenerate.

(b) Define the following terms :

(i) Promoter

(ii) Abortive initiation

(iii) Enhancer

(iv) Polyribosome

(v) Operon (10,5)

2. (a) Describe the activity of lac operon in each of the following cases :

(i) Both lactose and glucose are present

(ii) Glucose is present, lactose is absent

(iii) Both lactose and glucose are absent

(iv) Lactose is present, glucose is absent

(b) Describe how the enzyme poly A polymerase is different from RNA polymerase.

(c) Explain the role of transcription factors TFIID and TFIIH in transcription. (8,3,4)

3. (a) Give the mode of action of the following :

(i) Cordycepin

(ii) Actinomycin D

(iii) Rifampicin

(iv) Puromycin

(v) Cycloheximide

(b) Discuss the mechanism of alternate splicing with the help of a suitable example. (10,5)

4. (a) Describe the salient features of a prokaryotic promoter. Compare with the promoter elements of a eukaryotic promoter.

(b) Describe how the initiation of translation takes place in eukaryotes.

(c) Write the sequence of the coding strand and non-coding strand of DNA for the following mRNA molecule :

5'AAGCUUUAACCCAUUGG3' (6,6,3)

5. Differentiate between the following :

(a) Group I and Group II self-splicing introns

(b) Class I and Class II aminoacyl-tRNA synthetases

P.T.O.

P.T.O.

(c) Activator and repressor (5,5,5)

6. (a) Discuss the process of polyadenylation and capping of mRNAs in eukaryotes.

(b) Explain the elongation phase of translation with the help of a diagram.

(c) Explain the regulation of expression of gal genes in yeast. (6,5,4)

7. (a) What are the salient features of genetic code.

(b) Describe the technique used to identify sequences on DNA that binds RNA polymerase.

(c) Explain the autoregulation of ribosomal protein synthesis. (5,5,5)

8. Write short notes on the following **(any 3)** :

(a) DNA binding domains

(b) Assembly of spliceosome

(c) Attenuation

(d) Riboswitches (5,5,5)

(15)

[This question paper contains 8 printed pages.]

Your Roll No. 2024

Sr. No. of Question Paper : 4420 **G**

Unique Paper Code : 32497901

Name of the Paper : NUTRITIONAL BIOCHEMISTRY

Name of the Course : **B.Sc. (Hons.) Biochemistry**

Semester : V (LOCF)

Duration : 3 Hours Maximum Marks : 75

Instructions for Candidates

1. Write your Roll No. on the top immediately on receipt of this question paper.
2. Attempt **five** questions in all, including Question No. **1** which is compulsory.
3. **All** questions carry equal marks.

P.T.O.

1. (a) Name the following **(Any five)** :

(i) Reference protein

(ii) A tripeptide with antioxidant activity

(iii) An incretin

(iv) Essential fatty acid

(v) An antagonist of Vitamin K

(vi) Transport protein for retinoids

(vii) Vitamin that improves iron absorption

(b) Justify the following statements **(any five)** :

(i) Fats have low respiratory quotient compared to carbohydrates

(ii) Dietary fiber can be a source of energy

(iii) Folate supplementation masks vitamin B12 deficiency

(iv) Alkalosis can affect the ionic calcium level in blood

(v) Fructose has a low glycemic index

(vi) Iron supplements can cause copper deficiency (5,10)

2. (a) Anemia is known to be a multifactorial disease. Discuss the various nutritional factors contributing to the development of anemia.

(b) Explain the biochemical basis for the following **(any five)** :

(i) Vitamin E serves as an antioxidant

(ii) Vitamin C facilitates wound healing.

P.T.O.

(iii) Repeated blood transfusions can cause hemosiderosis

(iv) Acute bone rigidity in Fluoride Toxicity

(v) Selenium deficiency precipitates Vitamin E deficiency.

(vi) Eating raw eggs can cause Biotin deficiency (5,10)

3. Compare and contrast the following :

(i) Omega 3 and omega 6 PUFA

(ii) Wet and dry beriberi

(iii) Processed and Preserved foods

(iv) BV and NPU

(v) Chylomicrons and VLDL (3×5)

4. (a) How do antibiotics and anti-malarial drugs induce nutritional deficiency?

(b) Explain the following :

(i) NEAT

(ii) GLUT5

(iii) Mutual Supplementation

(iv) Bioelectric impedence

(v) Specific dynamic action

(vi) Lysine-Arginine antagonism (6,9)

5. Give the cause and biochemical basis and nutritional management if any, for the following symptoms/ diseases :

(i) Glossitis

(ii) Night blindness

(iii) Pellagra

(iv) Goitre

(v) Keshans disease (3×5=15)

6. (a) Discuss the mucosal block and iron regulation at the level of translation with suitable diagrams.

(b) Rachitic rosary, bow legs, and stunted stature are some of the symptoms of Vitamin D deficiency. Give the biochemical basis for these symptoms. Why are these symptoms seen only in children? What happens if adults have vitamin D deficiency?

(c) Give the importance of the following assessments :

(i) HbAlc

(ii) CRP

(iii) Xanthurenic acid in urine

(iv) MMA (6,5,4)

7. Write short notes on the following :

(a) Nitrogen Balance

(b) Anthropometry

(c) Oxidative stress

(d) Functions of Zinc (4,4,4,3)

8. Discuss the relationship between the following :

(a) Trans fats and atherogenesis

(b) Lipotropic factors and fatty liver

(c) Vitamin B6 requirement and dietary protein

(d) Vitamin K and bone health

(e) Veganism and Vitamin B12 deficiency

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[This question paper contains 8 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 4421 **G**

Unique Paper Code : 32497906

Name of the Paper : Advanced Cell Biology (DSE)

Name of the Course : **B.Sc. (Hons.) Biochemistry**

Semester : V

Duration : 3 Hours Maximum Marks : 75

Instructions for Candidates

1. Write your Roll No. on the top immediately on receipt of this question paper.
2. There are **8** questions.
3. Attempt **any 5** questions.
4. **All** questions carry equal marks.
5. Question no. **1** is compulsory.

P.T.O.

1. (a) Explain the following statements **(Any FIVE)** :

(i) Inactivation of "BRCA1" protein may lead to tumor formation.

(ii) Taxol and colchicine are toxic for dividing cells despite their opposite effects on microtubule assembly.

(iii) Ran GTP concentration is lower in cytosol than in nucleus.

(iv) Pre-sequences of mitochondrial proteins are positively charged whereas the transit peptides of chloroplast proteins are not.

(v) Cancer patients undergoing chemotherapy often need bone marrow transplantation.

(vi) Mutated cyclin A can cause DNA reduplication during S-phase.

(b) Name the following :

(i) Technique used for the separation of subcellular organelles

(ii) Protein that helps in nucleation of G-actin

(iii) Protein that initiates the UFP response in yeast

(c) Discuss the contribution of following scientists :

(i) Günter Blobel

(ii) Yoshio Masui and Clement Markert

(10,3,2)

2. (a) Write the mechanism of action of the following drugs :

(i) Cytochalasin

(ii) Herceptin

(iii) Phalloidin

(iv) Tamoxifen

(b) Explain the process of N-linked glycosylation of a secretory glycoprotein. How does N- linked glycosylation help in quality control function of ER?

(c) Comment on the following :

(i) Concept of Oncogene addiction helps in selection of molecular targets for cancer therapy.

(ii) Concentration of GTP controls growth and shrinkage of Microtubules. (4,6,5)

3. (a) Explain, with help of diagram, the molecular mechanism that leads to cancer when Rb protein and p53 protein are mutated.

(b) Elaborate on the four major mechanisms of regulation of CDK activity during the cell cycle.

(c) Compare the structure and function of Myosin, kinesin and dynein motor proteins. (5,4,6)

4. (a) What are stem cells? What are the advantages of embryonic stem cells as compared to adult stem cells for therapeutic applications?

(b) Illustrate the structural features of SRP. Explain the co-translational translocation of secretory proteins into the lumen of ER.

(c) What is the mode of action of imatinib? How do tumors develop resistance to this drug? (5,6,4)

5. (a) How does APC/c promote the separation of sister chromatids at anaphase. Explain with the help of a diagram.

(b) Explain the structure of the sarcomere of a skeletal muscle myofibril. Describe the sliding filament theory of muscle contraction.

(c) Predict the effects of the following mutations on the ability of the cell to undergo apoptosis:

(i) Mutation in Bad such that it cannot phosphorylate protein kinase B.

(ii) Mutation in Bax such that it cannot form dimers.

(iii) Mutation in adaptor proteins such that it cannot form dimers.

(iv) Overexpression of Bcl-2. (5,6,4)

6. (a) Illustrate the steps involved in the progression of a genetically altered cell into a tumor cell.

(b) What is the molecular basis of the following diseases?

(i) I-cell disease

(ii) Zellweger disease

(iii) Gaucher's Disease

(c) How do ATR and ATM proteins regulate the DNA damage checkpoint of the cell cycle? (5,6,4)

7. (a) Differentiate between the following **(ANY TWO)** :

(i) COP I and COP II coated vesicles

(ii) Actin Bundles and Actin Networks

(iii) Apoptosis and necrosis

(b) With the help of a diagram, explain the role of "*BiP*" in post-translational translocation of secretory protein into ER lumen.

(c) Explain the role of CDK2/cyclin-A complex in ensuring that the DNA is replicated only once per cell cycle in the S-phase. (6,4,5)

8. Write short note on the following :

(a) Role of Caspases in Apoptosis

(b) SCNT in therapeutic cloning

(c) Applications of ultracentrifuge

(d) Structural and function of MTOC (4,4,3,4)