

**Fourth Semester Examination – 2008**

**CELL BIOLOGY AND GENETICS**

**Full Marks – 70**

**Time : 3 Hours**

*Answer Question No. 1 which is compulsory  
and any **five** from the rest.*

*The figures in the right-hand margin  
indicate marks.*



1. Answer the following questions :      2 × 10
- (a) What is protein turn over ? Why it plays significant role in metabolic interactions ?
- (b) The concentration of Na<sup>+</sup> inside a vertebrate cell is about 12 mM, and that in blood plasma is about 145 mM. For a typical cell with transmembrane potential of –0.07 v

(inside negative relative to outside), what is free energy change for transporting 1 mol. of Na<sup>+</sup> out of the cell into the blood at 37 °C ?

- (c) What do you mean by supplementary gene action ? Name an example for supplementary gene action.
- (d) Define *cis-trans* allelic complementation with an example.
- (e) Tall tomato plants are produced by the action of dominant allele *D*, and dwarf plants by its recessive allele *d*. Hairy stems are produced by dominant gene *H*, and hair less stems by its recessive allele *h*. A heterozygous tall hairy plant is test crossed. The F1 progeny were observed to be 118 tall, hairy: 121 dwarf hairless: 112 tall, hairless : 109 dwarf, hairy. What is the ratio of

tall : dwarf and hairy : hairless ? Are these two allelic pairs assorting independently of one another ?

- (f) What is paracentric inversion and how it differs from pericentric inversion ?
- (g) At what allelic frequency does the homozygous recessive genotypes (*aa*) become twice as frequent as the heterozygous genotype (*Aa*) in a Hardy-Weinberg population ?
- (h) What is MAPK ? How it regulates the passage of cell cycle from **G<sub>1</sub>** to **S**- phase ?
- (i) Name the precursors for purine nucleotide biosynthesis.
- (j) "Mitochondria is a cell within the cell"- Justify.
2. What is  $\beta$ -oxidation of Fatty acid and how it differs from  $\alpha$ -oxidation of fatty acids ? Briefly explains the steps involved in  $\beta$ -oxidation with

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reference to palmitic acid. Calculate the energetics of palmitic acid oxidation to CO<sub>2</sub> and H<sub>2</sub>O. 2+5+3

3. (a) Briefly explain the Salvage pathway for the anabolism of Pyrimidine nucleotides. 5
- (b) Briefly explain the DNA sequence composition of human genome. 5
4. Write down short notes on any *two* of the following : 5x2
- (a) Protein targeting to Mitochondria
- (b) Biosynthetic pathway of glutamic acid
- (c) Scatchard analysis for protein ligand interaction.
5. What is Cell cycle ? Briefly explain the various phases of cell cycle with a note on check points and CDK regulation. 2+4+4

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6. A homozygous *Brassica rapa* variety (PER) with brown seed, pubescent leaf and white rust resistant (*BB LL RR*) was crossed with another homozygous variety of *B. rapa* ( R-500) with yellow seed, normal leaf and white rust susceptible trait (*bb ll rr*). The following progeny were obtained in F<sub>2</sub> generation :

<u>Phenotype</u>	<u>Frequency</u>
Brown seed, Pubescent leaf and White rust resistant	44
Yellow seed, normal leaf and white rust susceptible	48
Brown seed, Pubescent leaf and White rust susceptible	16
Yellow seed, normal leaf and White rust resistant	19
Brown seed, normal leaf and white rust susceptible	23

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Yellow seed, Pubescent leaf and White rust resistant	28
Brown seed, normal leaf and White rust resistant	08
Yellow seed, Pubescent leaf and White rust susceptible	06

- (a) Diagram cross in the experiment using suitable method. 2
- (b) Whether these three pair of genes are linked ? Justify your answer. 2
- (c) What is the map distance and gene order between three pair of genes ? 4
- (d) Calculate the coefficient of coincidence and interference. 2

7. (a) Briefly explain the fluid mosaic model of plasma membrane and add a note on the function of intrinsic proteins. 5

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(b) What is translocation heterozygote ?  
Briefly explain its effect with reference to  
chromosomal aberration. 5

8. (a) Define Hardy-Weinberg equilibrium for a  
panmictic population and add a note on  
genetic drift. 4+2

(b) A population data is given below. Calculate  
the allele frequencies from that population  
data and predict the Hardy-Weinberg geno-  
type frequencies using allele frequencies.  
Are these frequencies are in agreement  
with the observed frequencies ? (Tabulated  
 $\chi^2$  value at degree of freedom 01 is 3.841  
at  $p = 0.05$ ). 4