

**Total number of printed pages – 7**      **B. Tech**  
**CPBT 7202**

**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

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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  $G_1$  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  $CO_2$  and  $H_2O$ . 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 : 5×2
  - (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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Contd.

- (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