Name : .....

Roll No. : .....

Invigilator's Signature : .....

CS/B.TECH (BT)/SEM-5/BT-504/2009-10

2009

GENETICS AND BIOSTATISTICS

Time Allotted : 3 Hours Full Marks : 70

The figures in the margin indicate full marks.

Candidates are required to give their answers in their own words as far as practicable.

GROUP – A

1. Choose the correct alternatives for any *ten* of the following : 10 × 1 = 10

i) The basic monomers used in DNA replication are

a) glucose b) deoxyribonucleotides

c) ribonucleotides d) amino acids.

ii) When a bacteriophage, in its lytic phase, carries some of the bacteriums, partially digested chromosome with it to another host cell, the process is called

a) transformation

b) generalized transduction

c) specialized transduction

d) conjugation.

iii) In the formation of base pairs in *E. coli* DNA replication, on the average one mistake occurs for every

a) 100 pairs

b) 1,000 pairs

c) 1,000,000 pairs

d) 1,000,000,000 pairs.

iv) D-loop model of replication is found in

a) prokaryotes b) eukaryote in nucleus

c) mitochondria d) none of these.

v) The fertility factor, or *F*-factor that plays a role in conjugation is a

a) lytic phage b) plasmid

c) viroid d) lysogenic phage.

vi) The short single stranded pieces of DNA produced by discontinuous replication of double stranded DNA are called

a) Intron b) Primer

c) Kleow fragment d) Okazaki fragment.

vii) Removal of damaged DNA by light dependent enzyme is called

a) base excision repair

b) mismatch repair

c) photo-reactivation repair

d) SOS repair.

viii) The physiologically receptive state in which a bacterial cell is able to be transformed is called

a) sensitized b) activated

c) lysogenic d) competence.

ix) Which of the following is not a method for gene transfer in bacteria ?

a) Transformation

b) Translocation

c) Conjugation with Hfr transfer

d) Transduction.

x) Normal distribution is a probability distribution based on

a) Poisson equation b) Gosset equation

c) Gaussian equation d) Binomial theorem.

xi) Among all known phages reproducing vegetatively, the only one that neither kills nor lyses the bacterial cells is

a) Phage M13 b) Phage T4

c) Phage T7 d) Phage λ.

GROUP – B

(Short Answer Type Questions)

Answer any *three* questions. 3 × 5 = 15

2. Describe with labelled diagram and only write the conclusion of Meselson and Stahl experiment.

3. What are the proteins and other factors that are involved in initiation of DNA replication at *E. coli* origin of replication ? (Use diagram and table)

4. An Hfr strain carrying the phototropic markers a^+, b^+, c^+ is mixed with an F^- strain carrying the auxotrophic alleles *a, b, c*. Conjugation was interrupted at 5 min intervals and plated on media that revealed the presence of recombinants.

Time (min)	***Recombinants detected***
5	$a\ b^+\ c$
10	$a\ b^+\ c^+$
15	$a^+\ b^+\ c^+$

What is the order of the markers in Hfr strain ? Explain the order and draw a genetic map of a^+, b^+, c^+ markers in time units.

5. Write short notes on any *one* of the following :

   i) Lytic cycles of T4 phage

   ii) Mechanism of bacterial conjugation

   iii) Replication of M13 phage

   iv) Mechanism of bacterial transformation.

6. What is complementation ? Explain with an example. 1 + 4

GROUP – C

(Long Answer Type Questions)

Answer any *three* of the following. 3 × 15 = 45

7. a) What is molecular definition of mutation ?

   b) Describe the Luria-Delbruck fluctuation test with diagram. Write the conclusion with explanation.

   c) Write the different ways by which spontaneous mutation occurs.

   d) Write the different chemical and physical agents for induced mutagenesis.

   e) Describe the mechanism of mutation by alkylating agents. 1 + 5 + 2 + 3 + 4

8. a) What are the differences between transformation, conjugation and transduction ?

   b) Describe the life cycles of bacteriophage lambda (λ) with a diagram.

   c) Write three names of inhibitors of translation and their mode of action. 3 + 8 + 4

9. a) Describe the genetic map of *F* plasmid with diagram.

   b) Describe with diagram the transfer of *F* plasmid DNA from *F* donor cell to an F^- recipient cell.

   c) Describe (with diagram only) the transfer of gal + gene from a gal + donor bacteria to a gal – recipient bacteria through specialized transduction by λ phage. 5 + 5 + 5

10. a) Describe the mechanism of UV light induced mutation in DNA wih a diagram.

    b) Describe repair mechanism of UV light induced mutation in DNA with a diagram.

    c) Describe the base excision repair and nucleotide excision repair with diagram. 4 + 4 + 7

11. a) The following genes are linked on chromosome 3 of *Drosophila melanogaster* :

    Black body (*b*), cinnabar eyes (*cn*), vestigial wings (*vg*).

    A trihybrid cross between a heterozygous female and a homozygous recessive male produced the following 1000 progeny :

Wild type – 39	Black, cinnabar — 1
Black — 416	Black, cinnabar, vestigial — 48
Cinnabar — 42	Black, vestigial — 50
Cinnabar, vestigial — 402	Vestigial — 2

    i) Which are the *n.c.o.* and *d.c.o.* classes ?

    ii) Which is the middle gene in the sequence ?

    iii) Find out the map distances between the 3 loci and prepare a linkage map.

    iv) What is coefficient of coincidence ?

    b) What do you mean by Bombay phenotype ?

    c) Explain briefly Haplodiploidy, Pseudodiploidy.

(4 × 2) + 3 + 4

12. a) Assuming that half of the population are consumers of rice so that the chance of an individual being rice consumer $\frac{1}{2}$ and assuming that 100 investigations each take 10 individuals to see whether they are rice consumers, how many investigations would you expect to report that three people or less were consumers ?

b) Suppose that the chance of an individual coal-miner being killed in a mine accident during a year is (1/1400). Use the Poisson distribution to calculate the probability that in the mine employing 350 miners, there will be at least one fatal accident in a year.

(Use $e^{-0\cdot25} = 0\cdot78$).

c) One bag contains five white and four black balls. Another bag contains seven white and nine black balls. A ball is transferred from the first to the second and then a ball is drawn from the second. Find the probability that the ball is white. 5 + 5 + 5