

Name : .....  
Roll No. : .....  
Invigilator's Signature : .....

**CS/B.Tech/BT(O)/SEM-5/BT-504/2012-13**

**2012**

**GENETICS & 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.*

*Graph sheet will be supplied by the institution.*

**GROUP - A**

**( Multiple Choice Type Questions )**

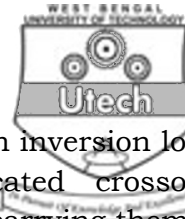
1. Choose the correct alternatives for any *ten* of the following :

10 × 1 = 10

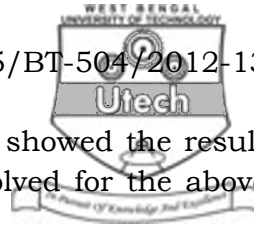
- i) Genes between related organism exhibits high variation.  
The variations would maximally occur in
- |              |                          |
|--------------|--------------------------|
| a) exons     | b) intron                |
| c) promoters | d) polyadenylation site. |
- ii) In a herd of cattle there are 4 cows, 3 bulls and 1 calf.  
What is probability of correct parents of calf if a pair is  
randomly drawn from herd ?
- |          |            |
|----------|------------|
| a) 1 / 7 | b) 2 / 7   |
| c) 2 / 5 | d) 1 / 12. |

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[ Turn over



- iii) When does crossing over occur within an inversion loop, which leads to deleted and duplicated crossover chromosomes and inviability of zygotes carrying them ?
- a) No crossing over in the inversion loop
  - b) Crossing over leads to formation of all acentric chromosomes
  - c) Segregation of chromosome is not normal
  - d) None of these.
- iv) The random fluctuation in gene frequencies is known as
- a) gene pool
  - b) sex linkage
  - c) genetic drift
  - d) migration.
- v) In normal differentiated somatic cells, telomerase
- a) actively adds material to the ends of chromosomes with each cell division
  - b) is not expressed and telomere tips erode with each division
  - c) removes telomeres tips with each division
  - d) is overexpressed and cells undergo apoptosis.
- vi) Partial diploid bacterial strain is used for
- a) gene mapping
  - b) complementation testing
  - c) both (a) and (b)
  - d) none of these.
- vii) Transduction has been used extensively for genome mapping for bacteria. Which of the following processes is useful for gene mapping ?
- a) Generalized transduction
  - b) Specialized transduction
  - c) Site specific recombination
  - d) None of these.
- viii) Individual with Turner's syndrome contains ..... number(s) of barr body.
- a) 1
  - b) 2
  - c) 3
  - d) none of these.



- ix) In *Neurospora crassa* tetrad analysis showed the result + : m :: 6 : 2. The phenomenon involved for the above result would be
- a) branch migration                      b) strand exchange  
c) Holiday junction                      d) DNA replication.
- x) Type of mutation which is most suitable for study of regulation of cell like DNA replication is
- a) suppressor mutation    b) conditional mutation  
c) both (a) and (b)                      d) none of these.
- xi) The distance between genes *A* and *B* is 10 cm. If a genotype *Ab/aB* is selfed, the percentage of progeny with *aabb* will be
- a) 10%    b) 25%  
c) 0.25%                                      d) none of these.
- xii) The gene which exhibits multiple effects is known to be
- a) complementary                      b) pleiotropic  
c) pseudogenes                          d) none of these.

**GROUP - B**

**( Short Answer Type Questions )**

Answer any *three* of the following                      3 × 5 = 15

2. a) What is complementation testing ?
- b) Six mutations (1 - 6) are known to belong to three cistrons. From the results of the complementation tests, determine which mutants are in the same cistron.

	1	2	3	4	5	6	
1	0	+	+				1
2		0		+	+		2
3			0	+	0		3
4				0		+	4
5					0	+	5
6						0	6



3. Mention three special types of chromosome along with their location.
4. Describe genic balance theory of sex determination.
5. Write short notes on any *two* :
  - i) Lyon hypothesis
  - ii) Genomic imprinting
  - iii) Free martin.
6. Describe the maternal inheritance pattern in garden snail.

**GROUP - C**

**( Long Answer Type Questions )**

Answer any *three* of the following.  $3 \times 15 = 45$

7. a) Which do you think would be easier to identify, the effects of plasma genes or the effects of chromosomal genes ? Explain.
- b) 'Inversion causes suppression of crossing over.' Justify the given statement.
- c) Discuss why recombination is not always reciprocal at the site of crossing over.
- d) Describe gynandromorphy in garden snail.  $4 + 4 + 4 + 3$
8. a) An Hfr strain carrying the phototrophic markers  $a^+, b^+, c^+$  and  $d^+$  is mixed with an  $F^-$  strain carrying the auxotrophic alleles  $a, b, c$  and  $d$ . Conjugation was interrupted at every 5 minute intervals and plated on medium that revealed the presence of recombinants.

Time (min)	Recombinants detected
5	$ab^+cd$
10	$a^+b^+cd$
15	$a + b + cd^+$
20	$a^+b^+c^+d^+$

What is the order of the markers in the Hfr strain ? Explain the order and draw a genetic map of the four markers in time units.



- b) Among a population of 400 individuals, 230 were Rh<sup>+</sup> and 170 were Rh<sup>-</sup>. Assuming that the trait (Rh<sup>+</sup>) is controlled by a dominant gene *D*, calculate the allele frequency of *D* and *d*. How many of the Rh<sup>+</sup> individuals would be expected to be heterozygous ?
- c) Diagrammatically represent Meselson and Stahl experiment. 5 + 5 + 5
9. a) In tomato the mutant genes *o* (oblate = flattened fruit), *p* (peach = hairy fruit) and *s* (compound inflorescence = many flowers in a cluster) were found to be in chromosome 2. From the following data, (i) assign the three gene sequence, (ii) determine genotypes of the parents, (iii) determine distance between the genes, (iv) determine coefficient of coincidence, (v) determine percentage interference.

Phenotypes of test cross	Number of progenies
+++	73
++s	348
+p+	2
+ps	96
o++	110
o+s	2
op+	306
ops	63



- b) For a human blood, there are two alleles (called S and s) and three distinct phenotypes that can be identified by means of the appropriate reagents. The following data was taken from people in Britain. Among the 1000 people sampled, the following genotype frequencies were observed :

SS = 99, Ss = 418 and ss = 483.

Calculate the frequency of S and s in this population and carry out a  $\chi^2$  test. Is there any reason to reject the hypothesis of Hardy-Weinberg proportions in this population ?

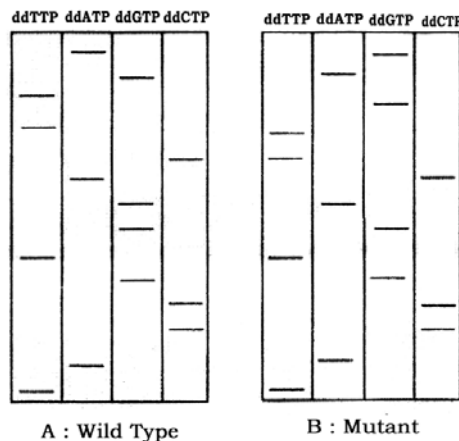
- c) Define molecular basis of mutation. Explain frameshift mutation by illustration.  
 d) Draw genetic map of M13 or T4 bacteriophage.

7 + 4 + 4

10. a) Write short notes on any *three* of the following :

- i) Abortive transductant
- ii) Alkalyting agent
- iii) Properties of Transposon
- iv) Lysogenic cycle of bacteriophage
- v) Position effect.

- b) Figures A and B respectively represent the dideoxy sequencing gels obtained for partial sequences from 5'-ends of a bacterial gene and its mutant (with a point mutation). What type of mutation has occurred in the sequenced gene ? Illustrate.



- c) What is Hardy-Weinberg Law ? Prove  $p + q = 1$ . 6 + 5 + 4

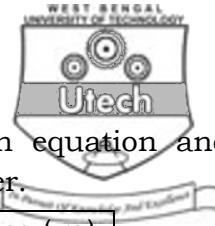


11. a) Protein content (%) of leaves of 10 potted plants of *Nigella sativa* was assessed before and after gamma irradiations and the following results have been obtained :

No. of plants	Before exposure to gamma rays	After exposure to gamma rays
1	21	17
2	22	16
3	23	18
4	20	13
5	19	18
6	20	16
7	24	17
8	15	11
9	24	20
10	25	16

Find out whether gamma irradiation has any effect on leaf protein contents of the studied species by *T*-test analysis.

- b) Assuming that the human sex ratio at birth is 1 : 1, consider two separate families, *A* and *B*, each having three children.
- What is the probability that all of the children in family *A* will be girls and that all children in family *B* will be boys ?
  - What is the probability that one or the other of the families will have only boys and the remaining family will have girls ?



c) From the data find out the regression equation and draw a regression line on the graph paper.

No. of Branches ( $x$ )	No. of capsules ( $y$ )
2	4
5	10
8	15
10	20
15	25
20	30

5 + 5 + 5

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