BITS PILANI, DUBAI CAMPUS
SECOND SEMESTER 2013-2014
Compre exam Date: 01.06.2014

CourseTitle: Genetics **Course NO: BIOT F243**
Maximum Marks: 40 **Duration: 3 hours**

Answer all the questions in the given sequence. Draw Diagrams wherever necessary

Q1a. Elizabeth is married to John, and they have four children. Elizabeth has a straight nose (recessive) and is able to roll her tongue (dominant). John is also able to roll his tongue, but he has a convex (Roman) nose (dominant). Of their four children, Ellen is just like her father, and Dan is just like his mother. The other children—Anne, who has a convex nose, and Peter, who has a straight nose—are unable to roll their tongues. Please answer the following questions about this family. [1+1+1+1=4]

i. What are the genotypes of Elizabeth and John?
ii. Elizabeth's father was a straight-nosed roller, while her mother was a convex-nosed non-roller. What can you figure out about their genotypes?
iii. John's father was a straight-nosed roller, while his mother was a convex-nosed roller. What can you determine about their genotypes?
iv. Diagram the three described generations of this family in accepted pedigree form, including the phenotypes for these two traits.

b. Explain the mechanism of chromosome remodeling. What are the two classes of proteins involved in chromosome remodeling [3]

c. Explain the Dideoxy method of DNA sequencing. [3]

Q2a. Explain the establishment of non Mendelian inheritance in moth. [3]

b. In *E.coli*, the three loci *ala, lac* and *bio* are within 1-2 minute map distance apart. To determine the exact order and relative distance, the prototroph (ala^+ lac^+ bio^+) was infected with a transducing phage P1. The lysate was used to infect the auxotroph (ala^- lac^- bio^-). The lac^+ classes of transductants were selected to produce the following data: [1+1+2=4]

ala^-	ala^+	ala^-	ala^+
lac^+	lac^+	lac^+	lac^+
bio^-	bio^-	bio^+	bio^+
122	75	3	300

i. Mention the technique used to screen the different classes of transductants.
ii. What is the gene order and why?
iii. What are the relative cotransduction frequencies between the genes?

c. What is the rho dependent termination? Explain any one control mechanism of protein synthesis where these terminators are used. [3]

Q3a. Explain the terms: [3]

i. Intergenic suppression ii. Cistrons iii. Conservative replication
iv. Primosome v. Autoradiography vi. AP sites

b. A genetics engineer was attempting to cross a tiger and a cheetah. She predicted a phenotypic outcome of the traits she was observing to be in the following ratio 4 stripes only: 3 spots only: 9 both stripes and spots. When the cross was performed and she counted the individuals she found 50 with stripes only, 41 with spots only and 85 with both. According to the Chi-square test, did she get the predicted outcome? (Given: value of $\chi 2$ for the degrees of freedom: [4]

D.F.	Value
1	3.841
2	5.991
3	7.815

c. Explain how the V-J joining develops junctional diversity? [3]

Q4a. In a population of peppered moths, 25% of the population shows the recessive phenotype of white. [0.5+0.5+0.5+1.5 = 3]

i) Which of the variables does 25% represent?

ii) Given this information, what is the frequency of recessive alleles in the population (q)?

iii) What is the value of p? How do you know?

iv) If this population had 1000 moths. How many moths would be Homozygous dominant? Heterozygous? Homozygous recessive?

b. You insert a plasmid (amo+) into a test tube of bacterial cells (amo-), where the amo gene encodes for resistance to the antibiotic Amoxicillin. However, in order to express amoxicillin resistance, the repressor that controls the amo gene must be inactivated. It can only be inactivated by the presence of the sugar arabinose. [3]

i. What type of operon is this?

ii. Describe the amount of bacterial growth you expect on the following media:

Plate 1: LB with non-transformed bacteria

Plate 2: LB + Amoxicillin and non-transformed bacteria

Plate 3: LB + Amoxicillin and Transformed bacteria

Plate 4: LB + Amoxicillin + Arabinose and Transformed bacteria

c. Suggest a method(s) to obtain a piece of ds DNA containing the gene of interest for further cloning. [2]

d. Explain the sequence of events that occur during the initiation of prokaryotic translation. [2]

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Test – 2 (Open Book)

BIOT F243: GENETICS

Date: 13.04.14(Su5) **Time 50 minutes** **Max Marks: 20**(Weightage 20%)

Answer all the questions. Marks are mentioned against each question.

1. A kidney-bean-shaped eye is produced by a recessive gene *k* on the third chromosome of *Drosophilia*. Orange eye color, called "cardinal," is produced by the recessive gene *cd* on the same chromosome. Between these two loci is a third locus with a recessive allele *e* that produces ebony body color. Homozygous "kidney," cardinal females are mated to homozygous ebony males. The trihybrid F_1 females are then testcrossed to produce the F_2. Among 4000 F_2 progeny are the following:

1761	kidney, cardinal	97	kidney
1773	ebony	89	ebony, cardinal
128	kidney, ebony	6	kidney, ebony, cardinal
138	cardinal	8	wild type

(*a*) Determine the linkage relationships in the parents and F_1 trihybrids. [2]

(*b*) Estimate the map distances. [4]

2. Assume, dark hair colour is dominant over light and curly hair texture has incomplete dominance over straight. A dihybrid heterozygous for curly and straight hair is wavy hair. Both the traits sort independently.

A man with homozygous dark, curly hair marries a woman with light, straight hair. Their daughter Pam marries a man Sam, who has light, curly hair. What are the genotypes and phenotypes of Sam and Pam's children? [2+3=5]

3. A point mutation occurred in the alcohol dehydrogenase gene in E.coli. What are the consequences of a second point mutation in the same gene? [2]

4. In a sesame plant, one pod condition is dominant to 3-pod condition and normal leaf is dominant to wrinkled leaf. Assume these traits sort independently. Determine the genotypes of the two parents for all the possible matings producing the following off-springs: [1x5=5]

a. 316 one pod normal, 96 one pod wrinkled
b. 323 three pod normal, 106 three pod wrinkled
c. 150 one pod normal, 147 one pod wrinkled, 51 three pod normal, 48 three pod wrinkled
d. 401 one pod normal
e. 223 one pod normal, 72 one pod wrinkled,76 three pod normal, 27 three pod wrinkled

5. A culture of *E.coli* was accidentally exposed to UV light. As a result thymine dimers were formed in the *E.coli* DNA. The culture was throughout incubated in dark. However, no mutants could be recovered from the culture. With the knowledge of genetics, explain what has happened to the culture and why mutants were not recovered from the culture. Also explain the mechanism involved. 2]

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SECOND SEMESTER 2013-2014

Test – 1 (Closed Book)

BIOT F243: GENETICS

Date: 9.03.14 (Su5) **Time 50 minutes** **Max Marks: 25** (Weightage 25%)

Answer all the questions. Draw supporting diagrams wherever necessary.

Q1a. Explain the steps involved in the initiation of prokaryotic translation. [3]

b. What is the Chargaff's rule? Are there any violations seen to this rule? [2]

c. What is the key role of the enzymes topoisomerase IV, DNA ligase, DNA polymerase I and helicase. [2]

d. Schematically explain the Hershey and Chase experiment. [3]

e. Write a short note on eukaryotic RNA polymerase II and its subunits. [3]

Q2a. Write a short note on the Watson and Crick's model. [2.5]

b. Explain the process of termination of translation in prokaryotes. [2]

c. Give significance of sigma factor and rho protein [2]

d. Give the examples of any two unusual bases in tRNA [1]

e. The replication of DNA on the lagging strand is discontinuous. Justify. [3]

f. What is the Shine- Delgarno hypothesis? [1.5]

**********ALL THE BEST**********

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Quiz – 2

BIOT F243: GENETICS

Date: 11.05.14(Su4) **Time 20 minutes** **Max Marks: 7** (Weightage 7%)

1. What is meant by superinfection? [0.5]

2. What is meant by specialized transduction? [1]

3. BamHI and PstI are both restriction endonucleases. What is the difference between the two? [0.5]

4. Name any two animal vectors used in recombinant DNA technology. [1]

5. What are linkers? Give their significance. [1]

6. What do you mean by Reporter genes? Give an example of a reporter gene. [1]

7. What is a partial digest ? [1]

8. What are dideoxy nucleotides? [1]

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SECOND SEMESTER 2013-2014

Quiz – 1 (Closed Book)

BIOT F243: GENETICS

Date: 30.03.14 (Su5)	**Time 50 minutes**	**Max Marks: 8** (Weightage 8%)
Name:		**ID No.**

1. Give the significance of the fluctuation test. [1]

2. Define mutation rate. [1]

3. Give the effect of 8-oxoguanidine on nucleotides in a DNA stand. [1]

4. What are the consequences of a frame shift mutations. [1]

5. Explain with an example the phenomenon of conditional lethality? [2]

6. What is the significance of the enzyme uracil-DNA glycosylate? [1]

7. What is the role of Ku protein in DNA repair? [1]

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SECOND SEMESTER 2013-2014

Quiz – 1 (Closed Book) ANSWERKEY

BIOT F243: GENETICS

Date: 30.03.14 (Su5) **Time 50 minutes** **Max Marks: 8** (Weightage 8%)

1. Give the significance of the fluctuation test. [1]
It helps us in differentiating between physiological induction and random mutation.

2. Define mutation rate. [1]
It is the number of mutations that arise per cell division in bacteria and single celled organisms or the number of mutations that arise per gamete in higher organisms.

3. Give the effect of 8-oxoguanidine on nucleotides in a DNA stand. [1]
8-oxoguaninepairs with adenine in the DNA strand. A GC base pair is converted to a TA base pair. This transversion is commonly found in cancers.

4. What are the consequences of a frame shift mutations. [1]
It causes 2 problems;

a. All codons from the mutation point ie frame shift, will be different and thus yield a useless protein.
b. Stop-signal information will be misread. Or pre-matured termination of protein synthesis could occur.
c.

5. Explain with an example the phenomenon of conditional lethality? [2]
Mutation that is lethal under one set of circumstances but not under another set.
Eg; nutritional requirement mutants, temperature sensitive mutants.

6. What is the significance of the enzyme uracil-DNA glycosylate? [1]
Uracil-DNA glycosylase, recognizes uracil within DNA and **cleaves** it out at the **glycosidic bond**. The resulting site is an **AP** site.

7. What is the role of Ku protein in DNA repair? [1]
Ku protein is a heterodimer of Ku70 and Ku80, which binds to broken chromosomal ends in non homologous DNA joining. It uses a protein kinase (PKcs) and XRCC4 protein. The complex directs the annealing of the broken ends by DNA ligase IV.