BITS, PILANI- DUBAI
DUBAI INTERNATIONAL ACADEMIC CITY
SECOND SEMESTER 2009-2010
COMPREHENSIVE EXAM

COURSE NO.: BIOT C216 **25.05.10** **MAXIMUM MARKS: 40**
COURSE TITLE: Introductory Molecular Biology **DURATION: 3 Hours**
Answer to the point; Answer all questions in the given sequence

Q1. (a) Answer the following in one sentence: [5]

i) What is unique about arabinose operon in E.coli?
ii) Define allosteric proteins
iii) Define trans-splicing
iv) What is oriT?
v) What are restriction maps?

(b) State two differences and two similarities between RNA and DNA. [1]
(c) How are prokaryotic and eukaryotic ribosomes different? [2]
(d) What are Chargaff's rules? What experimental technique did Erwin Chargaff use to analyze the base composition of DNA? [2]

Q2. (a) Draw a schematic diagram of nucleosome core particle. [1]
(b) What are the different modes of alternative splicing of primary transcripts? Illustrate with an example for each type. [3]
(c) Differentiate between the two modes of initiation associated with DNA replication. [Tabular form – 2 major points only] [1]

Q3. (a) What are Okazaki fragments? [1]
(b) If this is the mRNA sequence: AUG UUA UCA AUU UAG and the peptide sequence formed is Met-Leu-Ser-Val, what anomaly is happening here? How will this anomaly be corrected? [Note: AUG – Methionine, UUA – Leucine, UCA – Serine, AUU – Isoleucine] [2]
(c) Describe excision repair by means of a diagram. [Only the diagram is needed] [1.5]
(d) What does the term "semiconservative" replication mean? [0.5]
(e) Answer the following in one or two words: [5]

i) Location and product of nuclear RNA polymerase Class I
ii) Structure where RNA splicing occurs
iii) Name (s) of the tRNA binding sites on 50S subunit of ribosome
iv) Name of the sequence between one stop codon and the next start codon in a prokaryotic mRNA molecule
v) Type of mutation which includes base addition and base deletion
vi) EMS is an abbreviation for:
vii) Name the two proteins necessary for the metabolism of lactose in E.coli
viii) Name of the sulphur containing analogue used as an inducer in place of lactose
ix) TBP is an abbreviation for:
x) Name the two types of proteins necessary for assembly of phage particles

Q4. (a) Is DNA's natural one turn per 10-11 bases supercoiling? Why / Why not? What is meant by "positive" or "negative" supercoiling? [1]

(b) Separating the tightly twisted DNA requires that the individual strands be rotated about one another. How is this achieved? [1]

(c) Give a summary of how the three classes of transcripts are regulated in E.Coli Phage T7. [2]

(d) What is Taq polymerase? [1]

(e) Differentiate between the α helix and β secondary structures. [1]

(f) Name the two types of terminators. Mention their characteristic features. [2]

Q5. (a) What are leaky mutations? [1]

(b) Write down the DNA Polymerase reactions relevant to Sanger procedure. [1]

(c) Name the two general classes of membrane proteins. Also, what does the fluid mosaic model of membrane structure signify? [1]

(d) What properties of DNA make it particularly suited for its role as the genetic material? [1]

(e) What are the steric constraints imposed by the regular helical structure of double-stranded DNA? [1]

(f) What is an enhancer sequence? [1]

(g) What are Hfr cells? What can Hfr transfer be used for? [1]

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TEST – II (OPEN BOOK)

COURSE NO.: BIOT C216 **02.05.10** **MAXIMUM MARKS: 20**
COURSE TITLE: Introductory Molecular Biology **DURATION: 50 Minutes**
Answer to the point; Answer all questions in the given sequence

Q1. (a) Why do the polymerization enzymes work in only the 5' – 3' direction? Justify with suitable illustration. [2.5]

(b) DNA: 5'-**GGT CAT ATG CCA GAT AGC CCA TAA CAT** -3' [7]
Write down – [Note: Subsections i – x carry 0.5 marks each and xi carries 2 marks]

i) mRNA formed after transcription
ii) tRNA anti-codons
iii) Peptide (protein) sequence formed after translation
iv) If a mutation occurs in the DNA –
5'-**GGT CAT ATG CCA GAT GC CCA TAA CAT** -3'
What kind of mutation is this? [Hint: Answer expected is not deletion]
v) How is the protein affected?
vi) Which repair mechanism will be used in this case?
vii) If a different mutation were to occur in the DNA –
5'-**GGT CAT ATG CCA GAT TGC CCA TAA CAT** -3'
What kind of mutation is this?
viii) If this sequence given in (vii) is exposed to UV radiation, what changes can be expected?
ix) Which enzyme is used to repair the defect that is described in (vii)?
x) What repair mechanisms are used to correct the defect described in (vii)?
xi) Show diagrammatically how the two repair mechanisms referred to in (x) will work in this particular sequence given in (vii)?

(c) i) Why is the genetic code a triplet code?
ii) How are the codons: UAA, UAG and UGA able to function as termination codons?
iii) If a promoter has a poor recognition signal, does transcription stop?
iv) Why does the nucleus contain an enormous number of different RNA molecules of varying sizes?
v) When is the lacI gene product produced? [in the lac operon] [2.5]

Q2. (a) What are the similarities and differences between the lactose, galactose and arabinose operon models in E.coli? [Tabular form] [2]
(b) What effect does glucose have on the expression of the lac operon? Explain briefly in your own words. [2]
(c) What could be the significance of the following sequence – TACTACCGCGTAGTA? Also, write down the name for such a sequence. [2]
(d) If a tRNA responds to CGC, what are the possible anti-codons? What does the recognition region do in a tRNA molecule? [2]

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TEST – I (CLOSED BOOK)

COURSE NO.: BIOT C216 **21.03.10** **MAXIMUM MARKS: 25**
COURSE TITLE: Introductory Molecular Biology **DURATION: 50 Minutes**
Answer to the point; Answer all questions in the given sequence

Q1. (a) Blender Experiment: What was the result obtained when the phage population was labeled with ^{32}P instead of ^{32}S? What did this result prove? [2]

(b) What are cruciform structures? Where do they typically occur and what purpose do they serve? [2]

(c) List the 4 major types of noncovalent interactions in the order of decreasing strength. [1]

Q2. (a) Describe the structure of a nucleoid. [2]

(b) DNA Replication: Describe the characteristic features of the two major types of initiation processes. [2]

(c) Draw the basic structure of i) an α-amino acid ii) a dinucleotide [1]

Q3. (a) The following is the gel pattern obtained from a DNA sequencing reaction: [2]

G Track A Track C Track T Track

Determine the template sequence. [Marks will be allotted for step-wise solution]

(b) Illustrate the 3'→ 5' and 5'→ 3' exonuclease activity. [3]

(c) List the interactions that determine the tertiary structure of a protein molecule. [2]

Q4. (a) Write any 4 major characteristic features of the pattern noticed in DNA sequence-specific protein binding. [2]

(b) Describe the transformation experiments [in the form of equations] and state the conclusion. [4]

(c) Differentiate between the two major theories of enzyme binding. [1.5]

(d) What are the two types of β structure? [0.5]

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QUIZ-2 [13.04.10] **A**

COURSE NO.: BIOT C216 MAXIMUM MARKS: ~~16~~ 07 DURATION: 20 min.
TITLE: Introductory Molecular Biology NOTE: Each question / subunit carries 0.5 mark

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NAME: _____ **ID NO.** _____

Q1. Define Core Enzyme:

Q2. The posttranscriptional modification process is more commonly known as _____.

Q3. Eukaryotic nuclear RNA Polymerase I is found in the _____.

Q4. State the major function of
(a) EF-Tu: _____

(b) EF-G: _____

Q5. Precursor fragments are otherwise known as _____.

Q6. A helicase / primase complex is known as a _____.

Q7. RNP is an abbreviation for _____

Q8. The reading frame is unambiguously defined upon completion of the _____

Q9. Write down the -35 consensus sequence: _____

Q10. The section of nontranslated RNA before the coding regions is called a _____

Q11. Define: Shine-Dalgarno sequence:

Q12. In accordance with the Wobble phenomenon, base U can pair with _____.

Q13. Multiple codons corresponding to a single amino acid usually differ only by the third base. Thus, the code is said to be _____.

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QUIZ-1 [02.03.10] **A**

COURSE NO.: BIOT C216 MAXIMUM MARKS: 16 DURATION: 20 min.
TITLE: Introductory Molecular Biology NOTE: Each question carries 1 mark

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NAME: _____ **ID NO.** _____

Q1. What is a dideoxyribonucleotide?

Q2. Free rotation in a peptide bond occurs between the _____

Q3. Enzymes are specific to the _____ and the _____

Q4. Elastin and spectrin are examples of _____

Q5. The characteristic functional feature of pancreatic DNase I is _____

Q6. _____ modify the superhelicity of DNA.

Q7. Name two nucleic acid isolation and characterization methods.

Q8. The membrane filters used for hybridization is made up of _____

Q9. A nucleosome consists of:

Q10. How many sites on an IgG molecule can bind antigen? _____

Q11. What is isoelectric focusing?

Q12. A multimeric protein is _____

Q13. Base composition of DNA in a particular organism =

Q14. A transmembrane protein is _____

Q15. Nucleoside is _____

Q16. The four-stranded helix is typically found in _____