

| Name:  |   |  |     |
|--|---|--|-----|
| Enrolment No:  |   |  |     |
| <b>UNIVERSITY OF PETROLEUM AND ENERGY STUDIES</b><br><b>End Semester Examination, May 2022</b><br><b>Course: Molecular Biology</b><br><b>Program: B.Sc., Integrated (B.Sc.) - (M.Sc.)- Allied Science</b><br><b>Course Code: HSMB 1008</b> |   |  |     |
|  |   | <b>Semester: IInd</b><br><b>Time : 03 hrs.</b><br><b>Max. Marks: 100</b>           |     |
| <b>Instructions:</b>   |   |  |     |
| Q.No   | Section A<br>MCQs/Short answer questions/True &False  | (20x1.5=<br>Marks) 30  | COs |
| Q  | Statement of question<br>(each question carries 1.5 marks)  |  | CO  |
| 1.   | Watson and Crick were awarded with Nobel Prize for contribution towards elucidation of 3D structure of DNA. Who was the third scientist to share the prize with them?   | 1.5  | CO1 |
| 2.   | A short length of DNA molecule contains 120 adenine and 120 cytosine bases. The total number of nucleotide in this DNA segment is:<br><br>a) 480<br>b) 240<br>c) 120<br>d) 60   | 1.5  | CO1 |
| 3.   | The first intimation regarding the status of DNA as a genetic material was given by Avery, Macleod and McCarty on<br><br>a) E.coli<br>b) D. pneumoniae<br>c) T2 phage<br>d) Klebsiella  | 1.5  | CO1 |
| 4.   | If the GC content of the DNA molecule is 52% what are the percentage of the four bases in the DNA molecule?<br><br>a) G 32%, C 20%, T 20%, A 28%<br>b) G 20%, C 20%, T 24%, A 24%<br>c) G 26%, C 26%, T 24%, A 24%<br>d) G 25%, C 26%, T 24%, A 24% | 1.5  | CO1 |
| 5.   | Name the subunit that which is the part of core polymerase- DNA Pol III?<br><br>a) $\alpha$<br>b) $\tau'$<br>c) $\gamma$<br>d) $\beta$  | 1.5  | CO2 |

|     |   |     |     |
|-----|---|-----|-----|
| 6.  | What are stereoisomers? Give an example?  | 1.5 | CO2 |
| 7.  | State True or False:<br><br>Covalent bonds can never be polar in nature.  | 1.5 | CO1 |
| 8.  | Differentiate between integral and peripheral proteins?   | 1.5 | CO1 |
| 9.  | Ori C in prokaryotes comprise of consensus sequences:<br><br>a) three repeats of 13bp and four repeats of 9bp<br>b) thirteen repeats of 3bp and nine repeats of 4bp<br>c) three repeats of 10bp and four repeats of 7bp<br>d) ten repeats of 3bp and seven repeats of 4bp | 1.5 | CO2 |
| 10. | State True or False<br><br>Promoter sequences span from -70 to +30 bp from RNA start site in prokaryotes  | 1.5 | CO2 |
| 11. | Robert Holley is credited with the discovery of<br><br>a) mRNA<br>b) tRNA<br>c) rRNA<br>d) sRNA   | 1.5 | CO2 |
| 12. | Short strands of _____ primers are used in DNA replication<br><br>a) DNA<br>b) RNA<br>c) Histones<br>d) proteins  | 1.5 | CO2 |
| 13. | Carboxyl Terminal domain is component of:<br><br>a) DNA ligase<br>b) DNA polymerase<br>c) Endonuclease<br>d) RNA polymerase   | 1.5 | CO2 |
| 14. | State True or False:<br><br>Poly (A) tails are non-templated additions of adenosines at the 3' end of most eukaryotic messenger RNAs.   | 1.5 | CO3 |
| 15. | Which of the following is not a "termination codon"?<br><br>a) AUG<br>b) UAA<br>c) UAG<br>d) UGA  | 1.5 | CO3 |

|     |  |                       |           |
|-----|--|-----------------------|-----------|
| 16. | State two salient features of “wobble hypothesis”?   | 1.5                   | CO3       |
| 17. | In which phase of cell cycle is DNA replicated<br><br>a) G1<br>b) S<br>c) G2<br>d) G0  | 1.5                   | CO4       |
| 18. | State the role of shugoshin in mitotic cell cycle?   | 1.5                   | CO4       |
| 19. | State True or False:<br><br>There are 65 codons: 3 codons are stop codons, remaining 62 codons code for 20 essential amino acids   | 1.5                   | CO3       |
| 20. | Synthesis of cDNA from RNA is the process of:<br><br>a) DNA dependent RNA Transcription<br>b) Reverse Transcription<br>c) Replication<br>d) Translation  | 1.5                   | CO2       |
|     | <b>Section B</b>   | <b>(4x5=20 Marks)</b> | <b>CO</b> |
| Q   | Statement of question<br>(each question carries 5 marks)   |                       |           |
| 1.  | (a) What is nucleosome?<br>(b) Describe the composition of nucleosome?<br>(c) Name and describe three different stages in the event of DNA condensation from chromatin to chromosomes?   | 1+2+2                 | CO1       |
| 2.  | (a) Describe the assembly of - RNA polymerase and different transcription factors at the promoter sequence in eukaryotic transcription?<br>(b) Draw a well labelled diagram for the same.  | 3+2                   | CO2       |
| 3.  | (a) What is the role of a selectable marker in a plasmid vector? Explain with an example.<br>(b) Describe the blue-white screening technique that helps in identification of transformants from the non-transformants in cloning?<br>(c) Name the “reporter gene” and the “substrate” used for the blue-white selection of the recombinants? | 1+2+2                 | CO4       |
| 4.  | (a) Give a detailed outline of mRNAs:<br>i) Capping<br>ii) Poly-A Tailing<br>(b) Draw a step wise well labelled diagram to describe mRNA “Capping” and “tailing”   | 2+2+1                 | CO3       |

(c) Discuss the significance of these modifications in a RNA molecule.

**Section C**

**(2x15=30 Marks)**

Q Statement of question (Case studies)  
(each question carries 15 marks)

CO

1. Like synthetic lipid bilayers, cell membranes allow small nonpolar molecules to permeate by diffusion. Cell membranes, however, also have to allow the passage of various polar molecules, such as ions, sugars, amino acids, nucleotides, water, and many cell metabolites that cross synthetic lipid bilayers only very slowly. Special **membrane transport proteins transfer** such solutes across cell membranes. These proteins occur in many forms and in all types of biological membranes.

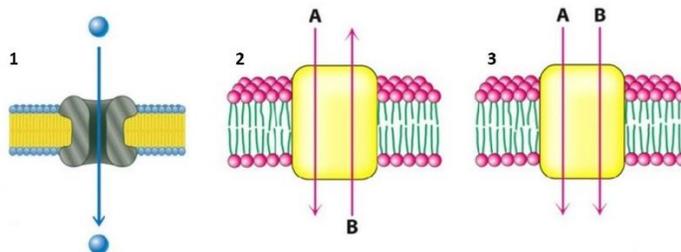
15  
  
(3+4+3+1+1+3)

CO1

- What are the two major classes in which the membrane transport protein fall? Give an example for each
- Based on mechanisms for transporting ions and small molecules across cell membranes, fill the underlying table with (+) or (-)

| Property   | Transport mechanism |                       |                  |              |
|--|---------------------|-----------------------|------------------|--------------|
|  | Passive Diffusion   | Facilitated Diffusion | Active transport | Co-transport |
| Requires specific proteins                                       |                     |                       |                  |              |
| Solute is transported against its gradient                       |                     |                       |                  |              |
| Coupled to ATP hydrolysis  |                     |                       |                  |              |
| Driven by movement of co-transported ion down its conc. gradient |                     |                       |                  |              |

c) This schematic diagram shows three different transporters.



- Name the transporters 1, 2, and 3?
- State the kind of diffusion across transporter 1, if the solute is moving down the concentration gradient?
- State the kind of transport across transporters 2 and 3, if solute A is moving down the concentration gradient while solute B is moving against its concentration gradient

|    |   |                           |     |
|----|---|---------------------------|-----|
|    | iv) Briefly explain the mechanism of solute transport in coupled transporters ( represented by 2&3)   |                           |     |
| 2. | <p>A gene of interest (G1) is to be amplified using polymerase chain reaction. The primers were designed for the amplification of G1 and the size of PCR product was chosen to be 500bp. The T<sub>m</sub> of the primer-pair is 55° C and the GC content is 52%.</p> <p>a) Discuss what would happen if:</p> <ol style="list-style-type: none"> <li>i. The annealing temp of the reaction was set at 72° C</li> <li>ii. The extension temperature was set at 45° C</li> </ol> <p>b) What is the significance of “Denaturation” step in PCR?</p> <p>c) What is the role of dNTPs in the PCR reaction mixture?</p> <p>d) Name the organism from which Taq polymerase was extracted.</p> <p>e) Who discovered PCR?</p> <p>f) Differentiate between Reverse Transcriptase PCR and Real Time PCR</p> <p>g) Name one method for genome sequencing.</p> | 15<br><br>(4+2+2+2+2+2+1) | CO4 |
|    | <b>Section D</b>  | <b>(2x10=20 Marks)</b>    |     |
| Q  | Statement of question<br>(each question carries 10 marks)   |                           | CO  |
| 1. | <p>(a) Describe different stages of mitotic cell cycle. Draw a well labelled diagram for each stage.</p> <p>(b) Discuss the role of cohesin in metaphase stage? Compare cohesin with condensin?</p> <p>(c) Briefly describe the three crucial mitotic checkpoints.</p>  | 5+2+3                     | CO4 |
| 2. | <p>a) Explain the “Fluid mosaic model” for the lipid bilayer membrane structure. Draw a well labelled diagram for the same.</p> <p>b) Differentiate between “integral” and “peripheral” proteins? What is the basis for their classification?</p> <p>c) Explain the mechanism of membrane fusion during neurotransmitter release at the synapse. Draw a well labelled diagram for the same?</p>   | 4+2+4                     | CO1 |