

JAYPEE UNIVERSITY OF INFORMATION TECHNOLOGY, WAKNAGHAT

T-3 Examination- 2023

M.Sc-I Semester (BT)

COURSE CODE (CREDITS): 20MS1BT112 (3)

MAX. MARKS: 35

COURSE NAME: Cell and Molecular Biology

MAX. TIME: 2 Hour

COURSE INSTRUCTORS: Dr. Abhishek

Note: Note: (a) All questions are compulsory.

(b) Marks are indicated against each question in square brackets.

(c) The candidate is allowed to make Suitable numeric assumptions wherever required for solving problems

1. Protein synthesis is a highly regulated process that is controlled by a complex network of proteins. Many of these proteins are essential for viability and mutations are not well tolerated, often affecting the fidelity or rates of protein synthesis that can dramatically affect growth. (4+2+2+2)
 - a. Detail out all the steps involved in protein synthesis with suitable ray diagram. In eukaryotic and bacterial cells; most of the significant differences are in the mechanism of initiation. Detail out all the important difference between eukaryotic and prokaryotic initiation mechanism of poetin synthesis especially in term of initian factor.
 - b. In bacteria, the two types of tRNA specific for methionine are designated tRNAMet and tRNA^fMet. Why bacterial system require two tRNA for methionine. What are the possible disadvantages of having single tRNAMet instead of both?
 - c. Newly synthesize proteins, both prokaryotic and eukaryotic, do not attain their final biologically active conformation until they have been altered by one or more processing reactions called posttranslational modifications. Detail out the entire important posttranslational event in protein.
 - d. Some drug molecule prevents the infection of microbe by blocking protein synthesis. Explain the mechanism of action of following drug molecule
(a) Puromycin (b) Cycloheximide (c) Tetracyclines (d) Streptomycin

2. Some of the most interesting molecular events in RNA metabolism occur during this postsynthetic processing. After these processing have been completed, the mature mRNA molecules have to be translocated into the cytoplasm, where protein synthesis occurs. Post-transcriptional modifications of RNA add complexity to RNA-mediated functions by regulating how and when a primary RNA transcript is converted into a mature RNA and play an important role in a wide range of biological processes.
 - a. What are the posttranscriptional event do you think are important for the conversion of primary transcript to mature RNA. Discuss all the introns removal mechanism involves in posttranscriptional processing? [1+4]

- b. 5' capping and polyadenylation are important posttranscriptional event. The 5'-end cap is directly recognized by the eukaryotic translation initiation factor eIF-4E, which is essential for mRNA translation by the ribosome and Poly A tail is important for the export of the mature mRNAs from the nucleus to the cytoplasm also poly(A) tail promotes the translation of the mRNAs and protects them from degradation. List out all the important steps involved in 5'capping and Polyadenylation of RNA during posttranscriptional process. [2+2]
- c. Detail out the significance of siRNA and miRNA and also illustrate the role of siRNA in gene silencing (1+1+2)
3. An 84 bp segment of a circular DNA in the relaxed state would contain eight double-helical turns, or one for every 10.5 bp. If one of these turns were removed, what will be the number of base pair per turn? [2]
4. A protein engineer is studying the sub cellular localization of a different cell organelle in an animal cell homogenate. The engineer performs successive centrifugation at increasing speed. The engineer start spinning the cell homogenate at 1000 g for 10 min, collect the pellet, spin the supernatant at 20,000g for 20 min, collect the pellet, spin the supernatant at 80,000g for 1 hour, collect the pellet, spin the supernatant at 150,000 for 3 hour and collect the pellet and final supernatant. Based on above observation, detail out the organelles present in the pellet of 1000 g for 10 min, 20,000g for 20 min, 80,000g for 1 hour and 150,000g for 3h. [4]
5. Chromatography is an important biophysical technique that enables the separation, identification, and purification of the components of a mixture for qualitative and quantitative analysis. Proteins can be purified based on characteristics such as size and shape, total charge, hydrophobic groups present on the surface, and binding capacity with the stationary phase. Four separation techniques based on molecular characteristics and interaction type use mechanisms of ion exchange, surface adsorption, partition, and size exclusion. Other chromatography techniques are based on the stationary bed, including column, thin layer, and paper chromatography. Column chromatography is one of the most common methods of protein purification. Illustrate the mechanism and significance of Column chromatography, In ionexchange chromatography, gel-filtration chromatography and affinity chromatography [6]