Birla Institute of Technology & Science (BITS), Pilani
Intro to Mol Bio and Immuno (PHA F215); **Second Semester 2022-23**
Mid Sem Exam – Closed Book, 14th Mar 2023; Maximum Marks: **50** (Weightage 30%)

Q1. You are studying the mechanism of DNA polymerase loading at eukaryotic DNA replication origins. Unlike the situation in bacteria, the three different eukaryotic DNA polymerases are not tightly associated with one another. Describe an assay you would use to monitor the assembly of the DNA polymerases at the origin. **[5]**

Q2. Imagine the Meselson and Stahl experiments had supported conservative replication instead of semi-conservative replication. What results would you predict to observe after two rounds of replication? Be specific regarding percent distributions of DNA incorporating ^{15}N and ^{14}N in the gradient. **[5]**

Q3. Quinolone antibiotics kill bacterial cells by blocking the activity of topoisomerase. Why does this treatment work? Explain what occurs at the molecular level. **[3]**

Q4. An adult with a history of tanning has his genome sequenced. The beginning of a protein-coding region of his DNA (template strand) reads TACCCCTATACCGTATT. If the protein sequence of a healthy adult reads Met-Gly-Ile-Cys-Ala, identify the site and type of mutation. **[5]**

Q5. What are ribosomes? What are the differences between rRNA and mRNA? Describe the relevance of both rRNA and mRNA to the biology of a cell. **[2+2+3]**

Q6. Describe how transcription in prokaryotic cells can be altered by external stimulation, such as excess lactose in the environment. **[5]**

Q7. A scientific study demonstrated that rat mothering behavior impacts the stress response in their pups. Rats that were born and grew up with attentive mothers showed low activation of stress-response genes later in life, while rats with inattentive mothers had high activation of stress-response genes in the same situation. An additional study that swapped the pups at birth (i.e., rats born to inattentive mothers grew up with attentive mothers and vice versa) showed the same positive effect of attentive mothering. How do genetics and/or epigenetics explain the results of this study? **[5]**

Q8. Some autoimmune diseases show a positive correlation with dramatically decreased expression of histone deacetylase 9 (HDAC9, an enzyme that removes acetyl groups from histones). Why would the decreased expression of HDAC9 cause immune cells to produce inflammatory genes at inappropriate times? **[5]**

Q9. Part of cortisol's role in the body involves passing through the plasma membrane to initiate signaling inside a cell. Describe how the structures of cortisol and the plasma membrane allow this to occur. **[2]**

Q10. Aquaporins are proteins embedded in the plasma membrane that allow water molecules to move between the extracellular matrix and the intracellular space. Based on its function and location, describe the key features of the protein's shape and the chemical characteristics of its amino acids. **[3]**

Q11. A cell develops a mutation in its ion channels that prevents the ions from leaving the cell. If the cell's aquaporins are still active, what will happen to the cell? **[2.5]**

Q12. Glucose from digested food enters intestinal epithelial cells by active transport. Why would intestinal cells use active transport when most body cells use facilitated diffusion? **[2.5]**

<u>Codon Table can be found on the back side of the question paper.</u>

---------- Best Wishes ----------

Codon Table

UUU, UUC: Phe UUA, UUG: Leu	UCU, UCC, UCA, UCG: Ser	UAU, UAC: Tyr UAA, UAG: Stop	UGU, UGC: Cys UGA: Stop UGG: Trp
CUU, CUC, CUA, CUG: Leu	CCU, CCC, CCA, CCG: Pro	CAU, CAC: His CAA, CAG: Gln	CGU, CGC, CGA, CGG: Arg
AUU, AUC, AUA: Ile AUG: Met	ACU, ACC, ACA, ACG: Thr	AAU, AAC: Asn AAA, AAG: Lys	AGU, AGC: Ser AGA, AGG: Arg
GUU, GUC, GUA, GUG: Val	GCU, GCC, GCA, GCG: Ala	GAU, GAC: Asp GAA, GAG: Glu	GGU, GGC, GGA, GGG: Gly