**THE OPEN UNIVERSITY OF SRI LANKA**
**DEPARTMENT OF ZOOLOGY**
**BSc DEGREE PROGRAMME**
**FINAL EXAMINATION 2024 / 2025**
**COURSE TITLE: FUNDAMENTALS OF MOLECULAR BIOLOGY**
**COURSE CODE: ZYU5315**
**DURATION: TWO HOURS**

DATE: 26 November 2024 TIME: 1.30 pm – 3.30 pm

**ANSWER ANY FOUR (4) QUESTIONS.**

**DRAW FULLY LABELLED DIAGRAMS WHERE NECESSARY.**

1. Describe the process of DNA replication. Explain how the process of DNA replication ensures precise transmission of genetic information during cell division. Highlight its importance for cellular function and inheritance. [100 marks]

2. "Polymerase Chain Reaction (PCR) has become a vital tool in Molecular Biology". Justify this statement highlighting its importance. [100 marks]

3. Even though every cell of an organism contains the same genetic material, only a subset of genes is actively expressed in each cell type. Explain how this selective gene expression contributes to an organism's development, function, and adaptability. [100 marks]

4. Eukaryotes process their mRNA transcripts within the nucleus through multiple steps before their export to the cytoplasm for protein synthesis. Discuss the functions of each step. [100 marks]

5. Write short notes on the following.
   i) Exon shuffling [25 marks]
   ii) Southern blotting [25 marks]
   iii) Operons [25 marks]
   iv) Hyperchromicity [25 marks]

6. **(a)** The coding strand from a part of a human gene contains the following sequence.

5′ ATGTTGTATCCTACTAGTGGTCGC 3′

**i)** What is the base sequence of the mRNA product transcribed from this strand?

**ii)** Write the three possible reading frames of the mRNA product and the corresponding amino acid sequence of each reading frame using the genetic code provided (Figure 1).

**iii)** Which one do you think is the correct reading frame? Explain your answer.

[50 marks]

**(b)** The base sequence of the coding strand of a human gene 'X' is given below. A mutated base sequence of the same gene due to base substitutions, is also given below the normal gene sequence.

Normal base sequence of gene 'X' - 5′ ATG TCT AGC TTG GAA TAT 3′

Mutated base sequence of gene 'X' - 5′ ATG TC**A** AGC TT**C** GAA TA**A** 3′

(Mutated positions are underlined and substituted bases are in boldface)

If gene 'X' is translated by reading frame 1;

**i)** Name each type of mutation that would result due to the above three base substitutions and explain briefly the effect of each on the polypeptide chain synthesized.

Give examples of human genetic disorders that are caused by each mutation wherever necessary. [50 marks]

**Second Letter**

| 1st letter | U | | C | | A | | G | | 3rd letter |
|---|---|---|---|---|---|---|---|---|---|
| U | UUU | Phe | UCU | Ser | UAU | Tyr | UGU | Cys | U |
| | UUC | | UCC | | UAC | | UGC | | C |
| | UUA | Leu | UCA | | UAA | Stop | UGA | Stop | A |
| | UUG | | UCG | | UAG | Stop | UGG | Trp | G |
| C | CUU | Leu | CCU | Pro | CAU | His | CGU | Arg | U |
| | CUC | | CCC | | CAC | | CGC | | C |
| | CUA | | CCA | | CAA | Gln | CGA | | A |
| | CUG | | CCG | | CAG | | CGG | | G |
| A | AUU | Ile | ACU | Thr | AAU | Asn | AGU | Ser | U |
| | AUC | | ACC | | AAC | | AGC | | C |
| | AUA | | ACA | | AAA | Lys | AGA | Arg | A |
| | AUG | Met | ACG | | AAG | | AGG | | G |
| G | GUU | Val | GCU | Ala | GAU | Asp | GGU | Gly | U |
| | GUC | | GCC | | GAC | | GGC | | C |
| | GUA | | GCA | | GAA | Glu | GGA | | A |
| | GUG | | GCG | | GAG | | GGG | | G |

**Figure 1**: Genetic Code

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