Instructions

There are two (2) sections for this exam. Answer each section in a separate answer book.

Section 1 has three (3) questions. Answer all questions
  Question 1 is worth 20 marks
  Question 2 is worth 25 marks
  Question 3 is worth 15 marks

Section 2 has two (2) questions. Answer all questions
  Question 4 is worth 30 marks
  Question 5 is worth 30 marks

Use your time wisely in relation to the marks
Use diagrams where possible
If you are running out of time, point form is OK

Total marks: 120
Total time allocated: 120 minutes
SECTION I

Use a separate answer book for this section.

Answer all three (3) questions.

Total Marks Allocated for this Section is 60

**Question 1. Answer any ten (10) from the following questions in one or two sentences**

(2 marks each, 20 marks total)

1. What is the difference between an obligate and facultative anaerobe?
2. What is the nucleoid?
3. DNA replication is bi-directional and semi-conservative, what does this mean?
4. What is an allosteric enzyme?
5. What is feedback inhibition?
6. What role does NADH play in energy production?
7. What types of molecules does a chemoautotroph use as an energy source? As a carbon source?
8. What are two types of post-translational modifications proteins may undergo?
9. What is global control and provide an example?
10. What structures are associated with motility in bacteria?
11. What are Okazaki fragments?
12. How do positive and negative allosteric effectors differ?
13. What is the difference between charged and uncharged tRNA molecules?
14. What do topoisomerase enzymes do?
15. What is the difference in cell wall phospholipid structure of *Bacteria* and *Archaea*?

**Question 2. Answer any five (5) of the following questions in one paragraph**

(5 marks each, 25 marks total)
1. Using suitable diagrams, compare the general structure of Gram-positive and Gram-negative bacterial cell walls.

2. Compare Rho-dependent and Rho-independent transcription termination processes

3. What is the structure of a typical \textit{E. coli} promoter?

4. What is the structure of the RNA polymerase core enzyme? The holoenzyme?

5. What types of interactions and chemical bonds maintain protein structure?

6. What subunits make up the ribosome? What is each subunit composed of?

7. Provide an overview of the general metabolic regulation strategies available to a bacterial cell.

8. Compare substrate level phosphorylation, oxidative phosphorylation and photophosphorylation.

\textbf{Question 3. Write an essay on any one (1) of the following questions} \\
\hspace{1cm} (15 marks each, 15 marks total)

1. Using suitable diagrams, explain the process by which flagella movement responds to chemical gradients by chemotaxis.

2. What is the general structure of a tRNA molecule and indicate how this structure relates to the molecules function.

3. Describe in detail the structure and the mechanism of regulation used for either the Lac or Trp operon.

4. Using a suitable diagram, describe the metabolic pathways and processes required for bacterial energy production by aerobic respiration and fermentation. Why is fermentation a less efficient process?
SECTION 2

Use a separate answer book for this section. Answer both questions.

Total Marks Allocated for this Section is 60

**Question 4. Answer all five (5) questions.** (6 marks each, 30 marks total)

1. **The question deals with components of the lac operon of *E. coli.***

   Which of the following is not part of the lac operon of *E. coli?** (Write the correct answer against the question in your answer book)
   
   A. genes for inducible enzymes of lactose metabolism
   B. genes for the repressor, a regulatory protein
   C. gene for RNA polymerase
   D. a promoter, the RNA polymerase binding site
   E. the operator, the repressor binding site

2. **This question deals with the effect of high concentrations of glucose on lac operon expression**

   Bacteria utilize glucose first, even if other sugars are present, through a mechanism called: (Write the correct answer against the question in your answer book)
   
   A. operon repression.
   B. enzyme repression.
   C. catabolite repression
   D. gene regulation.
   E. glucose utilization

3. **This question is on nucleic acids and complementary bases**

   For the DNA strand 5'-TACGATCATAT-3' the correct complementary DNA strand is: (Write the correct answer against the question in your answer book)
   
   A 3'-TACGATCATAT-5'
   B 3'-ATGCTAGTATA-5'
   C 3'-AUGCUAGUAUA-5'
   D 3'-GCATATACGCG-5'
   E 3'-TATACTACGAT-5'

4. **This question deals with amino acid translation from mRNA**

   A messenger acid is 336 nucleotides long, including the initiator and termination codons. The number of amino acids in the protein translated from this mRNA is: (Write the correct answer against the question in your answer book)
5. This question deals with mRNA and protein coding

Under conditions where methionine must be the first amino acid, what protein would be coded for by the following mRNA? (Circle the correct answer)

5'-CCUAUAUGCGCCAUAUAAGUGACACACA-3'

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A. pro his met arg his tyr lys cys his thr
B. met arg his tyr lys cys his thr
C. met arg his tyr lys
D. met pro his met arg his tyr lys cys his thr
E. arg his ser glu tyr tyr arg leu tyr ser

Question 5. Write briefly on any two (2) of the following questions

(15 marks each, 30 marks total)

1. (a) Define an operon. (b) Draw the structure of the E. coli Lac operon and describe the role of each of the component in gene regulation.

2. Transformation, transduction and conjugation are mechanisms for gene exchange in bacteria. (a) Describe how these processes differ from each other. (b) Discuss how the recipient cell protects against foreign DNA
3. Describe the type of damage to DNA induced by UV irradiation. Describe how such damage can be repaired.