UNIVERSITI KUALA LUMPUR
MALAYSIAN INSTITUTE OF CHEMICAL AND BIO-ENGINEERING TECHNOLOGY

FINAL EXAMINATION

OCTOBER 2025 SEMESTER

COURSE CODE	:	CBB30303
COURSE TITLE	:	BIOMOLECULAR TECHNIQUES
PROGRAMME NAME	:	BACHELOR OF CHEMICAL ENGINEERING TECHNOLOGY (BIOPROCESS) WITH HONOURS
DATE	:	31 JANUARY 2026
TIME	:	9:00AM - 12:00PM
DURATION	:	3 HOURS

INSTRUCTIONS TO CANDIDATES

1. Please read the instructions given in the question paper CAREFULLY.
2. This question paper is printed on both sides of the paper.
3. This question paper consist of ONE sections.
4. Section A consist of five questions. Answer FOUR (4) questions only.
5. Please write your answer on the answer booklet provided.
6. Please answer all questions in English only.
7. Refer to the attached Formula/ Appendies. ☐ *Tick if applicable*

THERE ARE 6 PAGES OF QUESTIONS INCLUDING THIS PAGE

SECTION A (Total: 100 marks)

Answer FOUR (4) questions.

Please use the answer booklet provided.

Question 1

In prokaryotic cells, the translation process occurs in the cytoplasm. It is facilitated by a series of molecular factors that ensure the accurate and efficient production of proteins from mRNA templates

(a) Explain the roles of initiation and elongation factors in the process of prokaryotic translation.

(6 marks)

(b) Distinguish genomic libraries with cDNA libraries

(4 marks)

(c) Analyze the DNA hybridization method by discussing its principles, techniques, and applications in genetic research

(15 marks)

Question 2

The discovery of the DNA structure by James Watson and Francis Crick in 1953 was a landmark achievement in molecular biology, profoundly shaping scientific understanding until they formulated the theory of the central dogma.

(a) Analyze how the Watson and Crick Model illustrates the structure of DNA.

(10 marks)

(b) RNA, or ribonucleic acid, plays a crucial role in the biological processes of all living organisms. Compare and contrast the different types of RNA, analyzing their specific functions in biological processes

(9 marks)

(c) Examine the distinct roles played by the core enzyme and sigma factor in the transcription process of prokaryotic organisms.

(6 marks)

Question 3

The lac operon serves as a model for understanding gene regulation in bacteria, recombinant DNA technology harnesses these principles to manipulate genes and create novel genetic combinations with applications across various scientific and industrial fields

i. Evaluate the mechanism of the lac operon in *E. coli* when they are cultured in Medium A, which contains no glucose but lactose.

(5 marks)

ii. Evaluate the mechanism of the lac operon in *E. coli* when they are cultured in Medium B, which contains no lactose but glucose only

(5 marks)

(b) Outline the detailed procedure of insulin production using recombinant DNA technology

(15 marks)

Question 4

A researcher aims to reduce the cost of PCR reagents by replacing *Taq* DNA polymerase with a DNA polymerase isolated from a mesophilic bacterium (e.g., *Escherichia coli*), which normally functions optimally at approximately 37°C. The PCR protocol involves repeated cycles of denaturation at 95°C, annealing at 55°C, and extension at 72°C.

(a) Describe the principle of the Polymerase Chain Reaction (PCR), including the purpose of thermal cycling and the roles of the key components involved in DNA amplification.

(10 marks)

(b) Evaluate the suitability of using a mesophilic DNA polymerase in place of *Taq* DNA polymerase in this PCR experiment. In your answer, discuss enzyme stability, amplification efficiency across PCR cycles, and whether sufficient quantities of the target DNA fragment can be produced.

(5 marks)

(c) Describe the role of the Ti (tumour-inducing) plasmid in genetic engineering, including its natural biological function and its application as a gene transfer vector in plant biotechnology.

(10 marks)

Question 5

A postgraduate research student is analysing PCR products amplified from three different genes with expected fragment sizes of 300 bp, 750 bp, and 2,000 bp. Following agarose gel electrophoresis using a 0.6% agarose gel, run at 120 V for 45 minutes, the student observes smeared DNA bands and poor separation between the fragments.

(a) Discuss the key factors that influence the migration of DNA during electrophoresis, including both the DNA properties and experimental conditions.

(10 marks)

(b) Analyse the experimental conditions used and determine the factors that may have contributed to poor band resolution and smearing, with specific reference to agarose concentration, applied voltage, and fragment size range.

(7 marks)

(c) Justify appropriate modifications to the electrophoresis setup that would improve separation and resolution of the 300 bp, 750 bp, and 2,000 bp DNA fragments. Your answer should link each modification to its expected effect on DNA migration.

(8 marks)

END OF EXAMINATION PAPER