



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

FINAL EXAMINATION
OCTOBER 2025 SEMESTER

COURSE CODE : CBB31104
COURSE TITLE : BIOPROCESS DEVELOPMENT AND EQUIPMENT
PROGRAMME NAME : BACHELOR OF CHEMICAL ENGINEERING TECHNOLOGY
(BIOPROCESS) WITH HONOURS
DATE : 26 JANUARY 2026
TIME : 2:00PM - 5:00PM
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 4 PAGES OF QUESTIONS INCLUDING THIS PAGE

SECTION A (Total: 100 marks)

Answer FOUR (4) questions.

Please use the answer booklet provided.

Question 1

A bioprocess facility is transitioning a recombinant product from pilot plant trials to full-scale manufacturing.

- (a) Analyze the critical role of teamwork between chemists and bioprocess engineers during the bioprocess scale-up phase.

(10 marks)

- (b) Discuss the organizational synergy required between the legislative department and the technical team to ensure a "smooth running" manufacturing process.

(15 marks)

Question 2

Fermentation process development involves the selection of a culture, designing and optimizing media, and analyzing and optimizing conditions.

- (a) The medium and reaction conditions are adjusted to enable the best performance of the catalyst. Discuss the criteria for the selection of medium conditions.

(5 marks)

- (b) The production of recombinant cyclodextrin glycosyltransferase (CGTase) has been optimized using engineered microbial hosts in both pilot and industrial-scale submerged fermentation. As a production engineer, design the complete production of CGTase from *Escherichia coli* in fermentation plants and pilot plants including upstream and downstream processing.

(20 marks)

Question 3

Scaling up of bioreactors in industrial scale requires careful consideration of various factors to ensure the successful transition from laboratory-scale to larger production volumes.

- (a) Discuss the challenges and strategies associated with scaling up bioproduct in bioreactors.

(10 marks)

- (b) Besides scaling up bioproduct in bioreactors, scaling up in downstream processing requires careful consideration. Explain the scaling up and design of filtration system.

(15 marks)

Question 4

Utility requirements in bioprocessing are essential for sterilization, operation, and maintaining optimal conditions to ensure efficient and contamination-free bioprocess operations.

- (a) A number of means are available for sterilization, but not all sterilization is suitable for large scale installation. Select the most suitable sterilization method for culture media and justify your selection.

(10 marks)

- (b) Pharmaceutical water systems are designed to deliver an acceptable quality of water in a consistent and reproducible manner to the point of use. Discuss the acceptable quality and the microbial attributes of pharmaceutical water.

(15 marks)

Question 5

The success of a fermentation depends upon the existence of defined monitoring environment for biomass and product formation. Monitoring equipment should be capable of being linked to a suitable control system as well as producing information indicating fermentation progress.

- (a) In monitoring equipment, it is also important to consider the need for a sensor and its associated control system to interface with a computer. Explain the types of sensors.

(10 marks)

- (b) Explain how regular maintenance and accurate calibration of sensors, controllers, and other control loop components contribute to reliable performance and process efficiency in bioreactors.

(15 marks)

END OF EXAMINATION PAPER

