



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

FINAL EXAMINATION
OCTOBER 2025 SEMESTER

COURSE CODE : CPB20403
COURSE TITLE : PLANT UTILITIES & MAINTENANCE
PROGRAMME NAME : BACHELOR OF CHEMICAL ENGINEERING TECHNOLOGY
(PROCESS) WITH HONOURS
DATE : 30 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 TWO sections.
4. Answer ALL questions for Section A.
5. Section B consist of four questions. Answer THREE (3) questions only.
6. Please write your answer on the answer booklet provided.
7. Please answer all questions in English only.
8. Please answer MCQ/EMQ questions using OMR sheet. ☐ *Tick if applicable*
9. Refer to the attached Formula/ Appendies. ☐ *Tick if applicable*

SECTION A (Total: 40 marks)

Answer ALL questions.

Please use the answer booklet provided.

Question 1

A cooling tower is an important piece of equipment used in many industrial plants to remove excess heat from process water. It operates mainly based on the principle of evaporation, where heat is transferred from warm water to moving air.

- (a) Explain the working concept of a cooling tower in an industrial system.
(4 marks)
- (b) Classify the types of cooling towers used in industry.
(6 marks)
- (c) Differentiate between a forced draft cooling tower and an induced draft cooling tower.
(8 marks)
- (d) Identify two main components of a cooling tower.
(2 marks)

Question 2

Plant utilities and maintenance involve providing essential support services and carrying out activities to keep plant equipment and systems running efficiently.

- (a) Identify five scopes of plant utilities.
(5 marks)
- (b) Identify three objectives of plant utilities maintenance.
(3 marks)
- (c) Explain two types of water systems used in a plant and their purposes.
(4 marks)
- (d) Explain four uses of a nitrogen system in industry.
(4 marks)
- (e) Describe unplanned maintenance in a chemical plant.
(4 marks)

SECTION B (Total: 60 marks)

Answer THREE (3) questions only.

Please use the answer booklet provided.

Question 1

Machines experience different failure rates during their lifecycle: infancy, normal operating life, and wear-out periods. Failures can result from early defects or from aging and wear. The early life of a machine is especially important for its long-term reliability.

- (a) Analyze the causes of failures in each period of a machine's lifecycle.
(6 marks)

- (b) Maintenance strategies are essential for ensuring machine reliability and controlling costs, and they vary in purpose, methods, and cost implications.
 - i. Analyze the purpose of preventive maintenance. Provide an example.
(4 marks)
 - ii. Analyze the purpose of predictive maintenance. Provide an example.
(4 marks)
 - iii. Analyze the purpose of corrective maintenance. Provide an example.
(4 marks)

- (c) Outline the benefits of a preventive maintenance program.
(2 marks)

Question 2

Plant shutdowns and turnarounds (TA) are key maintenance events that stop operations briefly to check and fix equipment. They ensure the plant stays safe, reliable, and efficient by coordinating teams across disciplines under tight schedules and strict safety rules.

- (a) Analyse three operational or management differences between a normal plant shutdown and a turnaround.

(6 marks)

- (b) During a turnaround, maintenance work is classified as major tasks and minor tasks.

- i. Analyse one problem that may occur if a **major** task is poorly planned or controlled.

(3 marks)

- ii. Analyse one problem that may occur if **minor** tasks are poorly managed.

(3 marks)

- (c) A turnaround consists of four phases.

- i. Outline two turnaround phases.

(2 marks)

- ii. Examine the key activities carried out during each phase.

(6 marks)

Question 3

Compressors require regular maintenance to preserve high efficiency. Properly structured maintenance schedules are essential to minimize unplanned downtime and maintain safe operations.

- (a) Using the information below

Checklist A – _____

Inspect the coupling for wear or misalignment

Check the shaft seals for leaks or damage

Examine air line filters for cleanliness and blockages

Verify that all mountings are secure and properly tightened

Checklist B – _____

Inspect motor bearings for proper operation and noise

Check system oil levels and quality; replace if necessary

Checklist C – _____

Review compressor use and sequencing for correct operation

Conduct an overall visual inspection for signs of wear or damage

Assess for any air or fluid leakage

Check dryers for proper function and moisture removal

Inspect compressor ventilation and lubrication systems

Ensure condensate drains are functioning correctly

Monitor operating temperature for normal ranges

Checklist D – _____

Inspect pressure relief valves for proper operation

Check belt tension and condition

Examine intake filter pads for cleanliness

Verify the function of air-consuming devices

Inspect drain traps and ensure they are operating correctly

- i. Determine the frequency for checklist A, B, C and D.

(4 marks)

- ii. Categorise a maintenance checklist table based on its maintenance frequency with explanations.

(12 marks)

- (b) Determine the appropriate type of lubricant fluid for each of the following applications.
- i. Anti friction & rolling element bearing (1 marks)
 - ii. Aircraft turbine oil (1 marks)
- (c) Analyze one key property of a lubricant and its effect on machinery performance. (2 marks)
-

Question 4

Commissioning of the plant is concluded with a series of tests to demonstrate the operability and efficiency of the various systems. Stores inventory management also plays a crucial part in plant efficiency.

- (a) Examine plant commissioning and its key components. (4 marks)
- (b) Outline four major phases of plant commissioning in a project. (4 marks)
- (c) Outline the three key components with example of a successful plant commissioning process. (6 marks)
- (d) Outline six conditions that contribute to increased maintenance stores inventories. (6 marks)

END OF EXAMINATION PAPER

