UNIVERSITI KUALA LUMPUR
MALAYSIAN INSTITUTE OF CHEMICAL AND BIOENGINEERING TECHNOLOGY

FINAL EXAMINATION
OCTOBER 2025 SEMESTER

COURSE CODE	:	CCB 40203
COURSE NAME	:	RENEWABLE AND SUSTAINABLE ENERGY ENGINEERING
PROGRAMME NAME	:	BACHELOR OF CHEMICAL ENGINEERING WITH HONOURS
DATE	:	03 FEBRUARY 2026
TIME	:	9.00 AM – 12.00 PM
DURATION	:	3 HOURS

INSTRUCTIONS TO CANDIDATES

1. Please read CAREFULLY the instructions given in the question paper.
2. This question paper has information printed on both sides of the paper.
3. This question paper contains a total of FOUR (4) questions. Answer ALL questions.
4. Answer ALL questions in English language only.
5. Please write your answers on the answer booklet provided.

THERE ARE 4 PAGES OF QUESTIONS EXCLUDING THIS PAGE.

INSTRUCTION: Answer ALL questions (Total = 100 marks).

QUESTION 1

(a) The adoption of renewable energy technologies for power generation in Malaysia has progressed slowly. An analysis of the underlying causes has been conducted across the key dimensions of the renewable energy project development lifecycle. Identify the challenges associated with each renewable energy source.

i. Solar PV (photovoltaic)
ii. Biomass and Biogas
iii. Waste to Energy
iv. Small Hydro
v. Large Hydro

(15 marks)

(b) MyRER (Malaysia Renewable Energy Roadmap) has been formulated to support Malaysia's vision to achieve 31% Renewable Energy share in the national installed capacity mix by 2025. Furthermore, the MyRER designs a pathway to enhance decarbonization of the electricity sector through 2035. The MyRER strategic framework builds upon four technology-specific pillars:

- Solar pillar.
- Bioenergy pillar.
- Hydro pillar; and
- New solutions and resources pillar, including geothermal, wind and energy storage technologies.

These four pillars are supported by cross-technology enabling initiatives, along four areas:

(1) future-proof existing electricity regulatory and market practices.
(2) access to financing.
(3) future readiness; and
(4) increased system flexibility.

Identify the key actions for each of the four enabling initiatives area.

(10 marks)

QUESTION 2

(a) The hydrogen economy value chain, encompassing production, conversion and storage, transportation, and end-use, faces notable technical limitations despite hydrogen's superior energy density compared to gasoline. For instance, hydrogen in its gaseous state presents significant storage challenges, while its synthesis remains highly energy-intensive, thereby reducing overall efficiency. These constraints highlight the critical need for advancing emerging technologies through targeted innovation.

i. Determine **FOUR (4)** technological solutions to address the drawbacks.

(4 marks)

ii. Evaluate **FOUR (4)** hydrogen end uses or applications.

(12 marks)

(b) Hydropower, a long-established renewable energy source, has been generating low-carbon electricity for over a century. Determine **THREE (3)** main types of hydropower.

(3 marks)

(c) Integrating hydropower with other variable renewable energy (VRE) technologies can unlock significant synergies. Hydropower plants stand to gain substantial advantages when complemented by solar photovoltaic (PV) or wind power generation. Determine **SIX (6)** advantages by pairing hydropower with floating solar PV.

(6 marks)

QUESTION 3

To facilitate heat exchange among four streams with a minimum temperature difference, ΔT_{min} = 20 °C, the heat exchanger network (HEN) illustrated in **Figure 1** is proposed.

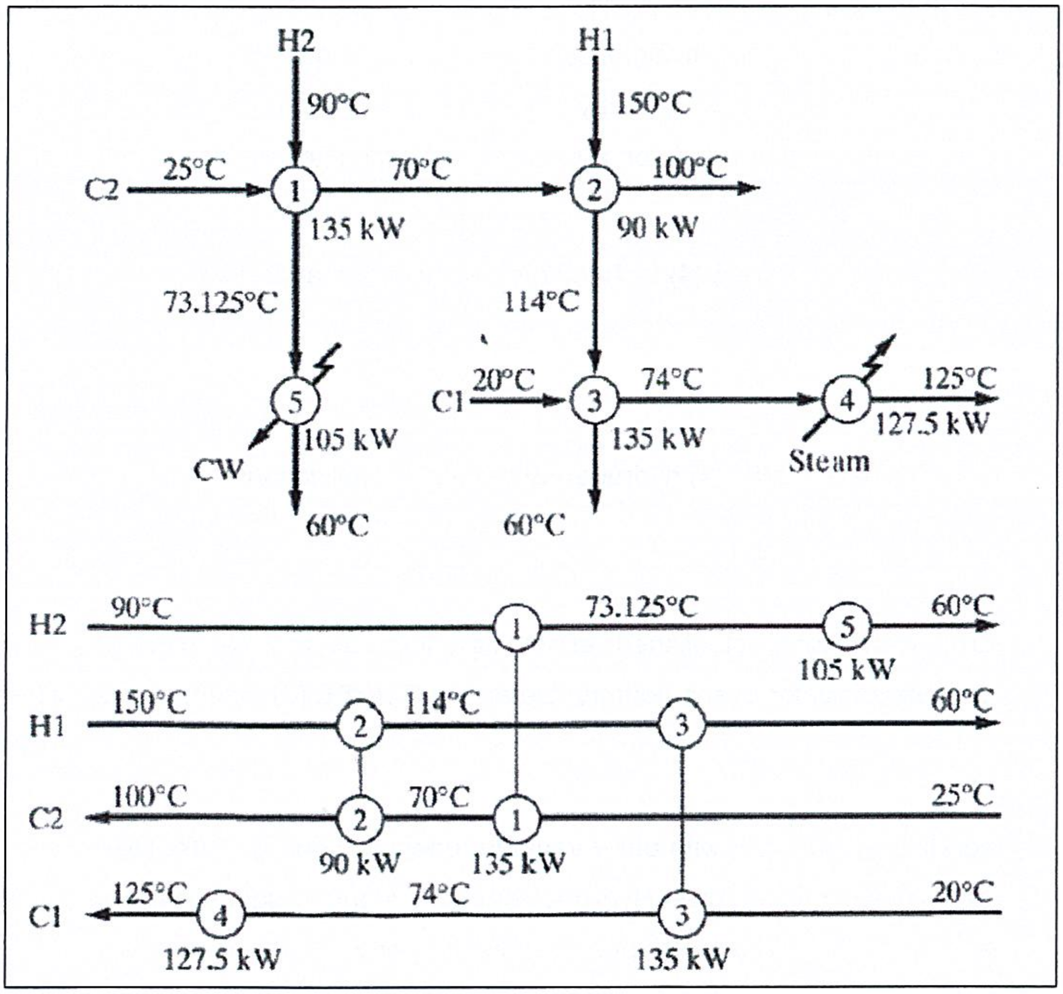

Figure 1: Flowsheet and HEN of the process

(a) Prove that the proposed heat exchanger network (HEN) illustrated in **Figure 1** does not meet the minimum utility requirements.

(10 marks)

(b) Outline a HEN design with minimum utility requirements.

(10 marks)

(c) Based on the HEN in (b), construct a new process flowsheet to show the position of interior and auxiliary heat exchangers. Show the heat duties and temperatures for each heat exchanger.

(5 marks)

QUESTION 4

Table 1 shows stream data for a chemical process plant.

Table 1: Stream data

Stream	T_s (°C)	T_t (°C)	C (kW/°C)	Q (kW)
H1	590	400	2.376	
H2	471	200	1.577	
H3	533	150	1.320	
C1	200	400	1.600	
C2	100	430	1.600	
C3	300	400	4.128	
C4	150	280	2.624	

(a) Based on the given information in **Table 1**, compute the energy, Q for all streams provided.

(7 marks)

(b) Construct a grid diagram to design a Heat Exchanger Network (HEN) at the threshold approach temperature difference, $\Delta T_{min} = \Delta T_{thres} = 50$ °C, to meet its Maximum Energy Recovery (MER) targets of $Q_{H,min} = 217.5$ kW and $Q_{C,min} = 0$ kW, as well as its $N_{HX,min}$ target of seven heat exchangers.

(18 marks)

END OF EXAMINATION PAPER