



UTHM

Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

**FINAL EXAMINATION
SEMESTER II
SESSION 2021/2022**

COURSE NAME : PIPING AND INSTRUMENTATION
DIAGRAM

COURSE CODE : BNL 30903

PROGRAMME CODE : BNL

EXAMINATION DATE : JULY 2022

DURATION : 2 HOURS 30 MINUTES

INSTRUCTION

1. ANSWER ALL QUESTIONS
2. THIS FINAL EXAMINATION IS CONDUCTED VIA **CLOSED BOOK**
3. STUDENTS ARE **PROHIBITED** TO CONSULT THEIR OWN MATERIAL OR ANY EXTERNAL RESOURCES DURING THE EXAMINATION CONDUCTED VIA CLOSED BOOK

THIS QUESTION PAPER CONSISTS OF SEVEN (7) PAGES

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- Q1** (a) Valve is a device that regulate or control the flow of fluids. Analyze the position of the valve and justify your answer for the following situations
- (i) A valve controlling the flow of a Benzene into a storage tank. (2 marks)
- (ii) A valve controlling the flow of coolant entering an engine. (2 marks)
- (b) The block flow diagram (BFD) gives a clear overview of a production. Explain **FOUR (4)** general format and conventions used in preparing block flow process diagrams. (6 marks)
- (c) Based on **Figure Q1 (c)**, explain the process in your own words. (6 marks)
- (d) A mixture containing 40% benzene (B) and 60% toluene (T) by mass in fed to a distillation column. An overhead steam of 90 wt% benzene is produced, and 10 wt% benzene fed to the column leaves in the bottom stream. The feed rate is 2400 kg/h. Determine the overhead flow rate and the mass flow rates of benzene and toluene in the bottom stream. (9 marks)
- Q2** (a) Cavitation is a common problem for centrifugal pumps. Explain how to formulate a plan to prevent that cavitation. Gives **FOUR (4)** suggestions. (6 marks)
- (b) The arrangement of pump is crucial to ensure the pumps are able to transport the fluid throughout the system. Pumps can be arranged and connected in serial or parallel. Explain both arrangements and its functions. (6 marks)
- (c) Based on **Figure Q2 (c)**, complete the diagram with Level Control and signal line connections. (4 marks)
- (d) A pump-turbine system shown in **Figure Q2 (d)** draw the water from the upper reservoir in the daytime to produce power for a city. At night, it pumps water from lower reservoir to restore the situation. For a design flow rate of 9000 m³/hr in either direction, the total frictional head loss is 20 m. Assume the turbine and pump have an efficiency of 80% and 90% respectively. Density of water = 998 kg/m³. Estimate the electrical power output by the turbine in Kilowatts (kW). (9 marks)

- Q3** (a) **Figure Q3 (a)** shows an activity of adjusting the tap water temperature to 35 °C.
- (i) Analyze the situation and identify the temperature control loop. (6 marks)
 - (ii) Illustrate the control loop using standard symbols. (7 marks)
- (b) Based on **Figure 3 (b)**, PIC-01 controls the pressure of the separator for liquid vapor hydrocarbons, by mean of a split range controller with the output signal split and sent to two pressure control valves PV-A and PV-B.
- (i) Discuss **FOUR (4)** basic elements in Distributed Control System on your own words. (6 marks)
 - (ii) Explain the valve condition when the pressure increased beyond the set point. (6 marks)
- Q4** (a) As a young engineer, you are required to take part in development of plant layout. Based on **Figure Q4 (a)**;
- (i) Describe **SIX (6)** general requirements to position the equipment. (9 marks)
 - (ii) Construct a possible equipment arrangement for the Feed and Reactor sub system. (8 marks)
- (b) **Figure Q4 (b)** is a process flow diagram of production of Benzene via Hydroalkylation of Toulene. Stream 6 provide feed to the reactor at 600°C. Construct a HAZOP for this stream using guideword of No and More of. Provide **TWO (2)** answers for each guideword. Refer **Table Q4 (b)** to construct your answer. (8 marks)

-END OF QUESTIONS-

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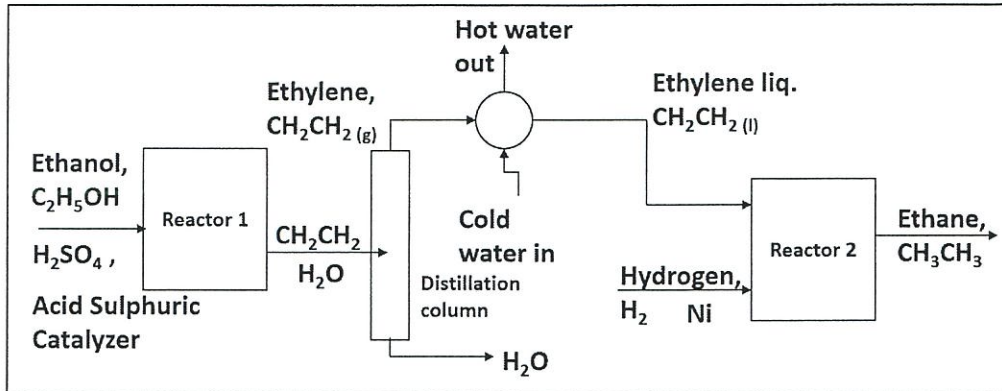


Figure Q1 (c)

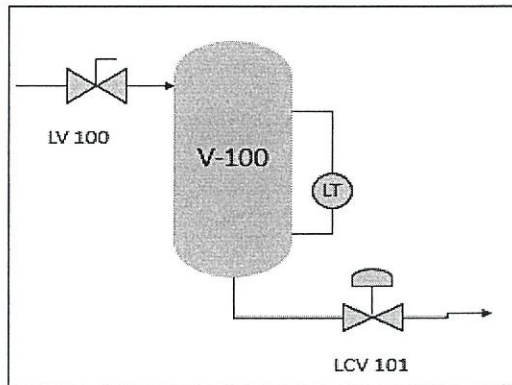


Figure Q2 (c)

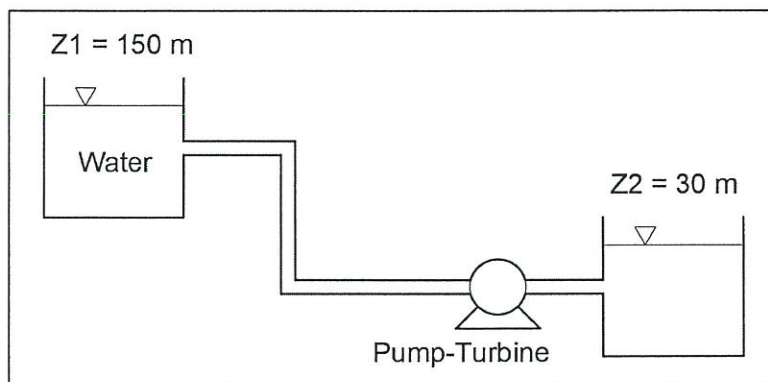


Figure Q2 (d)

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Figure Q3 (a)

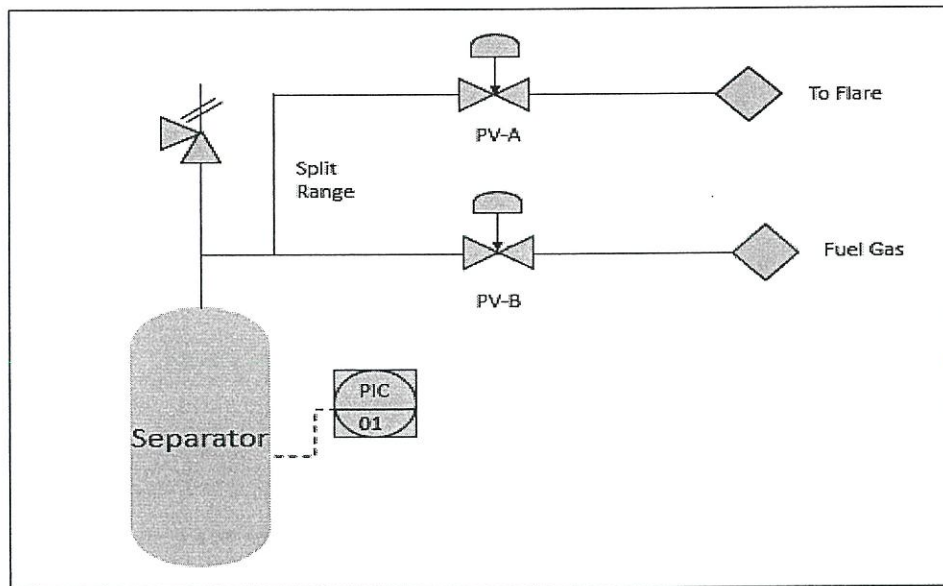


Figure Q3 (b)

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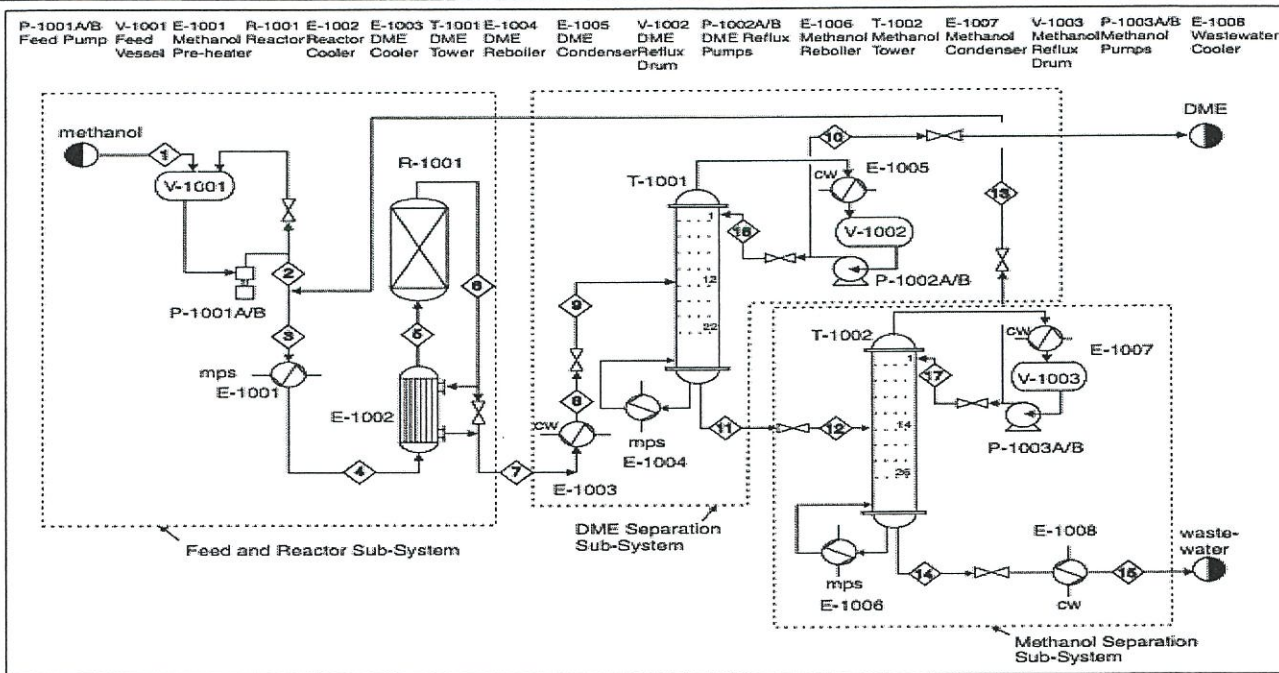


Figure Q4 (a)

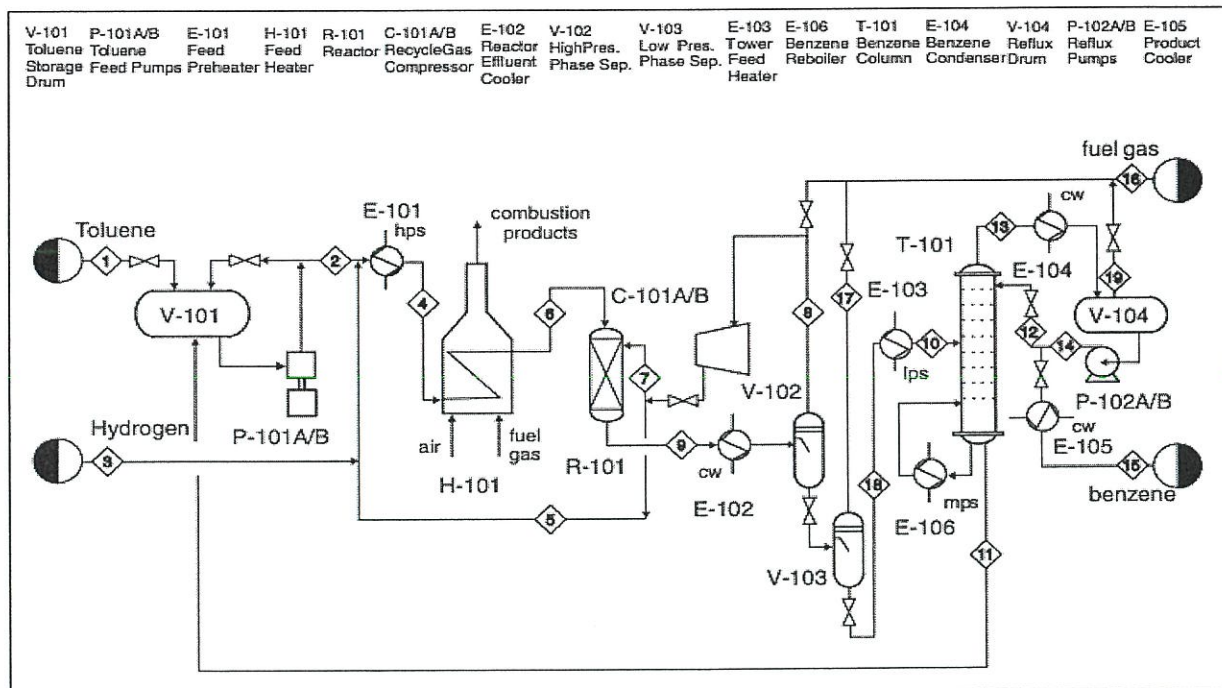


Figure Q4 (b)

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Table Q4 (b)

Guide Word	Deviation	Cause	Consequences	Action
No				
No				
More of				
More				

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