



NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY
FACULTY OF APPLIED SCIENCES

BACHELOR OF APPLIED SCIENCES HONOURS DEGREE

SUPPLEMENTARY EXAMINATIONS – AUGUST 2014

CHEMICAL ENGINEERING PLANT DESIGN - SCH 4108

TIME: THREE (3) HOURS

Instructions to Candidates:

1. Answer all questions in Section A and any three questions in Section B.
 2. Show all your steps clearly in any calculation.
 3. Start the answers for each question on a new page.
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SECTION A

1 (a) Explain the following terms:

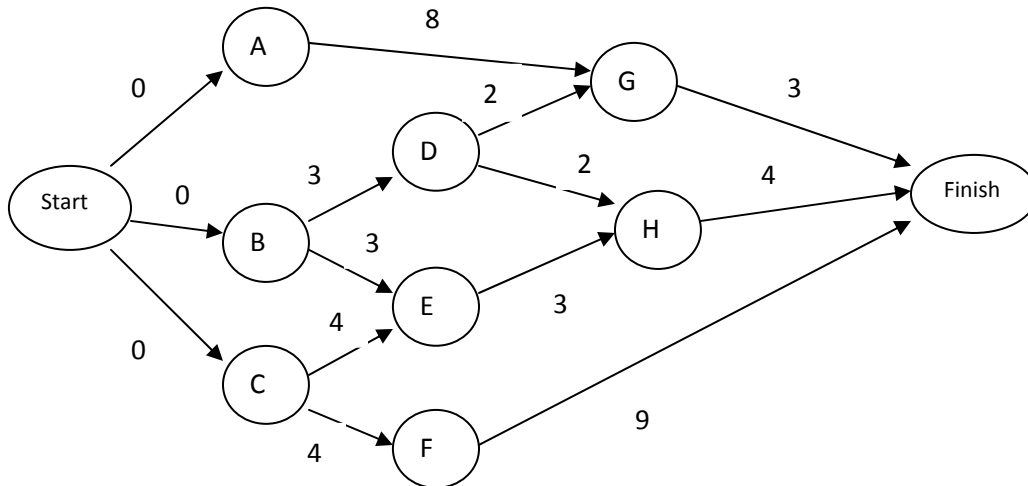
- (i) Plant design
- (ii) Design objective [4]

(b) With aid of a diagram, outline the anatomy of a chemical manufacturing process [13]

(c) List any three methods of storing a product in a process. [3]

2 (a) What other method can be used instead of the Critical Path Method for achieving the same results. [2]

(b) A project consists of the following activity network in which the vertices represent activities and the numbers next to the arcs represent time in days.



Assuming that an unlimited number of workers is available,

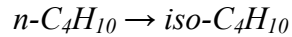
- (i) Find a critical path in this activity network
 - (ii) Tabulate the latest starting time for each activity
 - (iii) What is the minimum finish time for this project [16]
- (c) List any two projects where critical path method can be applied. [2]

SECTION B

- 3 (a)** List any four information that can be extracted from an MSDS about a certain material. [4]
- (b)** Discuss any two methods for analyzing hazards in industry. [8]
- (c)** Explain any three factors that affect the choice for plant location [8]
- 4 (a)** Describe and explain the three types of design [7]
- (b)** List and explain the two types of design reports. [5]
- (c)** Rephrase the following common statements found in design reports to a proper language.
- (i) We designed the absorption tower on the basis of . . .
 - (ii) A complete list of the results are given in the Appendix.
 - (iii) The data is analysed using [8]

5 (a) Explain the term degrees of freedom [3]

(b) In estimating the composition of the liquid and vapor phases when n-butane isomerizes at 311 K (100°F), it is by procedure to first determine the number of degrees of freedom for the system. Assume that the reaction occurs in the vapor phase.



Determine the number of degrees of freedom [5]

(b) A hold tank is installed in an aqueous effluent-treatment process to smoothen out fluctuations in concentration in the effluent stream. The effluent feed (density 1 000kg/m³) to the tank normally contains no more than 100 ppm of acetone. The maximum allowable concentration of acetone in the effluent discharge is set at 200 ppm. The surge tank working capacity is 500 m³ and it can be considered to be perfectly mixed. The effluent flow is 45,000 kg/h. If the acetone concentration in the feed suddenly rises to 1000 ppm, due to a spill in the process plant, and stays at that level for half an hour. Calculate the concentration (in ppm) in the effluent discharge?

[12]

6 (a) Discuss any two factors that affect the investment and production costs. [6]

(b) Explain the difference between fixed and working capital [6]

(c) The purchased cost of a 50-gal glass-lined, jacketed reactor (without drive) was \$8350 in 1991. Estimate the purchased cost of a similar 380-gal glass-lined, jacketed reactor (without drive) in 1996. Use the annual average Marshall and Swift equipment-cost index (all industry) to update the purchase cost of the reactor.

Marshall and Swift equipment-cost index (all industry)
1991 – 908
1996 – 1230

Equipment vs Capacity exponent = 0.53 [8]

END OF PAPER!!!!