L-4/T-2/CHE

Date: 12/01/2021

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-4/T-2 B.Sc. Engineering Examinations 2018-2019

Sub: CHE 407 (Process Design II)

Full Marks: 120

Time: 2 Hours

USE SEPARATE SCRIPTS FOR EACH SECTION

SECTION-A

Marks in this Section: 60

There are THREE questions in this Section. Answer any TWO. ALL QUESTIONS CARRY EQUAL MARKS

Q.1 (a) Explain why and where "Standards" are used during process design. How does maximization of standardization help in reducing the cost of process design? (10)

(b) "In Bangladesh the existing chemical process plants were built by using codes and standards of different countries" – Give specific examples of the problems created by such a practice in our process industries. (10)

(c) Differentiate between "Engineering Specification" and "Technical Specification". Who prepares the "Engineering Specifications"? What special measures are taken while ordering a vendor to fabricate a "proprietary equipment"? (10)

Q.2 (a) Distinguish between the procurement activities of a "Process Plant Project" and an "Operating Plant". Which do you think is more difficult? Give reasons for your answer. (10)

(b) "One of the important responsibilities of the design engineers is to evaluate the prequalifications and bids"—justify its importance in the context of Bangladesh. (10)

(c) Identify the "Time and Process Critical" equipments of the process plant you are designing in your ChE 408 project. Give reasons for your answer. (10)

Q.3 (a) Which type of contract will you recommend for the construction of the process plant you are designing in your ChE 408 project? Give reasons for your answer. (10)

(b) Who carries out **inspection** of a process plant? When will you appoint "third party" inspectors? Discuss this issue in the context of "construction" and "operation" of a process plant. (10)

(c) Discuss the steps, with respect to **inspection**, which should have been taken while designing, operating and maintaining the plant that could have prevented the "Bhopal Disaster" and the "Ghorasal Urea Control Room Explosion". (10)

SECTION-B

Marks in this Section: 60

There are THREE questions in this Section. Answer any TWO. ALL QUESTIONS CARRY EQUAL MARKS

Q.4 (a) What are the roles of process engineering in Detailed Engineering? (10)

(b) Discuss the experiences of process licensing in Bangladesh. (10)

(c) In the context of Bangladesh which aspects of Performance Test are most important? (10)

Q.5 (a) From the technical and economic aspects, what are the factors to be included in Feasibility Study. Briefly explain your choice of factors (10)

(b) Briefly discuss with example: Why is it essential to overdesign some package units? (10)

(c) "Procurement operation are complicated when multiple funding agencies and donors are involved in case of large projects in Bangladesh" - Discuss. (10)

Q.6 (a) Comment on the discussion issues during contract negotiation. Which issues, you feel, are more important than others in the context of Bangladesh? (10)

(b) Write a short note on "Liquidated Damage". (10)

(c) How important is the plot plan in planning a "safe" process plant? Draw a rough plot plan to show the possible "unsafe" or "hazardous" areas. (10)

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, BUET

L-4/T-2 B.Sc. Engineering Examinations 2018-2019

Sub: **ChE 409** (Corrosion Engineering)

Full Marks: 180   Time: 2 Hours

The figures in the margin indicate full marks.

Symbols used have their usual meaning and interpretation.

USE SEPARATE SCRIPTS FOR EACH SECTION

SECTION-A

There are **THREE** questions in this Section. Answer any **TWO**.

1. a) List and discuss the types of cells that can lead to corrosion of metals/alloys. Rank these cells from most likely to least likely mechanism to be found in process industries. Justify your choice. Is it possible to have combinations of mechanisms? (8+5+5+5=23)

b) Sketch a simplified Pourbiax diagram for any metal, and describe its salient features. With the help of this, discuss the usefulness of Pourbaix diagram. What are the benefits of superimposing Pourbaix diagram of water in the metal's Pourbaix diagram? (10+6+6=22)

2. a) Write the typical expressions for overvoltage of anodic dissolution and reduction. Why do the expressions vary significantly from each other? Explain. (4+6=10)

b) How does the relative size of the anodic and cathodic areas influence the rate of loss of metals/alloys in corrosive environment? Why? (5+5=10)

c) Draw typical potentiostatic and galvanostatic anodic polarization diagrams for an active-passive metal. Mention the reason(s) for dissimilarities in the diagrams. If a metal does not show a tendency to undergo passivation, will the shapes vary? Explain. (12+6+7=25)

3. a) Neatly sketch and label the Iron-Carbon phase diagram. Why the diagram does not go beyond carbon content of 6.7%. With the help of the phase diagram list the phases one is likely to see while cooling cast iron having carbon content of 2.1% (20+5+5=30)

b) Discuss the effect of pH on corrosion of iron in aerated soft water. (15)

SECTION-B

There are **THREE** questions in this Section. Answer any **TWO**.

4. a) State the general principle of cathodic protection. Justify why cathodic protection is a viable method for protecting buried pipelines and cables from corrosion. Can it be a method of choice for extremely corrosive systems? (5+7+5=17)

b) Describe the operation of cathodic protection with sacrificial anode. Explain how it can be applied in remote rural areas with no power supply lines. (8 +7 = 15)

c) Summarize the features of anodic polarization curve. Why the corrosion rate can never be reduced to zero in anodic protection? (8+ 5 = 13)

5. a) Describe briefly the mechanism of stray corrosion cracking (SCC). Write down the environments in which SCC gets significant for industrially important metals/alloys. List the appropriate measures for suppressing SCC. (8 + 8 + 7 = 23)

b) How does corrosion fatigue differ from dry fatigue? Corrosion fatigue strength of all steels is lower in salt water than in fresh water- why? (5 + 5 = 10)

c) What are the conditions for fretting corrosion to occur? Also list the remedial measures of fretting corrosion. (6 + 6 = 12)

6. a) Explain the concepts of corrosion reduction for metal by noble and sacrificial coatings. Justify the use of paints for suppressing the corrosion of metals/alloys. (8+7 =15)

b) With the help of appropriate diagram, show how the concentration of an inhibitor should be finalized for optimum inhabitation of corrosion rate. (12)

c) How does the removal of dissolved gasses from feed water affect the corrosion in boiler? Alkali addition is a standard practice for corrosion control in most high pressure boilers – describe shortly. (9+9 = 18)

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, BUET

L-4/T-2 B.Sc. Engineering Examinations **2018-2019**

Sub: **ChE 411** (Economics and Management for Chemical Process Industries)

Full Marks: 240   Time: 2 Hours

The figures in the margin indicate full marks.

Symbols used have their usual meanings and interpretation.

USE SEPARATE SCRIPTS FOR EACH SECTION

SECTION-A

There are **THREE** questions in this section. Answer any **TWO**

1. There are two (2) MEAs for pump models P200 and P300. Cash flows of the alternatives are given below:

Parameters	P200	P300
Capital Investment	$45,000	$35,000
Yearly electric energy cost	$1000	$2000
Yearly maintenance cost	$500	$1000
Yearly wages for operator	$500	$500
Useful life (years)	7	5
MV (at the end of useful life)	$8000	$4000
MARR	10%	

a) Find better alternative using CW method   **(20)**

b) Find better alternative using ERR method assuming a study period of 10 years   **(35)**

c) Comment on the results obtained in a) and b).   **(05)**

2. a) Data for a mine are given below: **(25)**

Estimated output from mining: 25,000 tons/year

Time to exhaust mining: 15 years

Selling price of mined and smelted ore: $15/ton

Management cost: $7,000/year

Cost of operating mine and smelter: $8/ton

Desired interest rate: 10%

Draw the cash flow diagram and comment on the economic merit of the project by FW method.

b) The prospective exploration for gas in the offshore by CHEVRON has produced a rather curious pattern of cash flows as follows: **(35)**

EoY	Cash flow
0	− $630,000
1-10	$230,000
10	− $800,000

Based on the projected cash flows what would you recommend regarding the pursuit of this project? The company expects to earn at a **continuous interest rate of 10%** on the invested capital before taxes. Deal the problem with IRR method.

3. a) Each year, sector 'A' purchases $ 5 billion of goods from sector 'B' and $ 10 billion from sector 'C'. Sector 'B' makes annual purchases of $ 2 billion from sector 'A' and $ 8 billion from sector 'C'. Annual purchases of sector 'C' are $ 3 billion from sector 'A' and $ 6 billion from sector 'B'. Within-sector purchases are $ 1 billion for sector 'A', $ 4 billion for sector 'B' and $ 5 billion for sector 'C'. Total annual sales in the sectors 'A', 'B' and 'C' are $ 20 billion, $ 20 billion and $ 30 billion, respectively.

    i) Write the transaction matrix for these three sectors   **(15)**

    ii) How much is value addition for sector 'A' and 'B'?   **(5)**

    iii) How much is final demand in sector 'C'?   **(5)**

    iv) Deduce the direct requirement matrix for the model.   **(5)**

b) Three (3) MEAs of a public project are under consideration. Their respective cash flows are included in the table below. If the nominal interest rate is 10%, which one of the MEAs should be selected with modified B/C ratio method? **(30)**

Parameters	MEA-I	MEA-II	MEA-III
Capital investment	$ 885 x 10^3	$ 775 x 10^3	$ 650 x 10^3
Annual O&M	$ 135 x 10^3	$ 125 x 10^3	$ 110 x 10^3
Annual benefit	$ 265 x 10^3	$ 250 x 10^3	$ 235 x 10^3
Useful life (years)	45	35	23

There are **FOUR** questions in this section. Answer any **THREE**

4. **(a)** A manager must be an effective communicator and be able to exercise good control. Explain the significance and importance of this statement. **(15)**

   (b) Draw an **Organization Chart** that has four (4) levels of personnel below the CEO/President/M.D. and has the following features – **(25)**

   - Mixture of functional and staff organizations
   - Headquarter and local factories in three (3) different locations
   - Produces a different product in each factory
   - The company believes strongly in research and development
   - All sales are coordinated from the Headquarter

5. **(a)** What type of organization and communication structure should a MODERN company have? Explain your answer with the help of examples both from developing and developed countries. **(15)**

   (b) Describe the special features of technology and discuss why developing countries fail to get effective **Technology Transfer**? Use examples to explain your answer. **(25)**

6. **(a)** Multiple choice questions – **(2×5=10)**
   (i) Which one is not a recognized key skill of management? *(Provide complete reason(s) for your choice)*
      a) Conceptual skills
      b) Human skills
      c) Technical skills
      d) Writing skills

   (ii) Which statement on authority is true? *(Provide complete reason(s) for your choice)*
      a) Authority & power are the same.
      b) Authority cannot be delegated.
      c) Authority and responsibility must be considered together.
      d) Authority comes with power.

   (b) Akij Group of Companies is trying to get into the LPG business. Is it advisable? Perform a **SWOT** analysis and comment on the decision. **(30)**

7. Marvel villain Thanos is back! And he is planning to destroy your city. But he needs 42 weeks to build the machine that can do it. You have the means to defeat him. But it consists of 8 activities. **(40)**

The following table shows the activities that need to be undertaken to defeat Thanos. Calculate the early start and finish time, late start and finish time and total float for each event, and identify the Critical Path of the given project with the help of an arrow network. Determine whether you will be able to defeat Thanos and save your city before he builds his machine.

Activity Symbol	Estimated time (Weeks)	Post Requisite
A	8	C, D, E
B	5	C, D
C	10	G
D	6	G
E	4	F, G
F	7	H
G	15	H
H	5	-

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, BUET

L-4/T-2 B.Sc. Engineering Examinations 2018-2019

Sub: **ChE 485** (Industrial Pollution Control)

Full Marks: 180   Time: 2 Hours

The figures in the margin indicate full marks.

Symbols used have their usual meaning and interpretation.

USE SEPARATE SCRIPTS FOR EACH SECTION

SECTION-A

There are **FOUR** questions in this section. Answer any **THREE**

1. a) How would you define air pollution?   **(5)**

   b) How would you measure the pollutant concentration in stack? What are the parameters affecting the stack emission measurement? Discuss the stack gas velocity and pollutants concentration measurement procedures.   **(25)**

2. a) Discuss the environmental impacts of brick industry in the context of Bangladesh. **(13)**

   b) What is the significance of atmospheric stability? Atmospheric stability can affect the quality of air significantly-Explain the statement with examples.   **(17)**

3. a) An industrial (i.e. petroleum industry) effluent contains volatile organic hydrocarbons gases like (BTEX). How would you evaluate the risk of releasing the effluent in the environment without any control? What control options would you recommend and why?
                                                                                (25)

   b) "Venturi scrubber is generally used to remove gaseous pollutants from the effluent stream"-True/False. Explain your answer.   **(5)**

4. a) Discuss the advantages and disadvantages of fabric filter as air pollution control equipment.   **(10)**

   b) A power plant is producing electricity from coal containing sulfur. Discuss the air pollutants formed during the electricity production process. What control options would you recommend to protect the environment and public health?   **(20)**

SECTION-B

There are **FOUR** questions in this section. Answer any **THREE**

5. The following data were obtained from a test program designed to evaluate a new diffused-air aeration system. Using the following data, determine the value of K_La at 20 °C and equilibrium dissolved oxygen concentration in the test tank. The test program was conducted using tap water at a temperature of 24 °C.   **(30)**

Page 1 of 2

C_t, mg/L	1.4	2.7	3.5	5.0	6.6	7.1	8.0
dC/dt, mg/L.h	8.5	7.6	5.5	5.0	4.5	2.8	2

6. a) Discuss the environmental impact of textile industry in context of Bangladesh. **(10)**

b) ABC Textile & Garment industry ltd is an export oriented industry which produces different fashion products. The raw materials used in the industry are cotton for the source of fibre and chemicals for the source of additives. The industry claimed themselves that they are operating their industry in a sustainable way. As an environmental inspector, you are going to visit the industry to justify the process in context of sustainability. List the factors need to consider for sustainable operation of this type of industry. Justify your answer where necessary. **(20)**

7. The following results were obtained from a 2.0 m settling column.

Time (min)	0	60	80	100	130	200	240	420
Concentration, mg/L	400	300	240	195	170	100	75	25

What is the theoretical removal efficiency in a settling basin with a loading rate of 24.7 m/day? (This is a volumetric flow of 24.7 m^3/day/m^2 of settling basin area). **(30)**

8. Show possible sources of environmental pollution from a Kraft process pulp and paper production with a neat sketch. Discuss the environmental management techniques in the context of zero discharge for such an industry. **(30)**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-4/T-2 B.Sc. Engineering Examinations 2018-2019

Sub: PMRE 411 (Petroleum Reservoir Engineering)

Full Marks: 180   Time: 2 Hours

USE SEPARATE SCRIPTS FOR EACH SECTION

The figures on the right hand side indicate full marks.

(OPEN BOOK EXAM)

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Section - A

There are FOUR questions in this section. Answer any THREE

Question 1:

    a. Write down the theories on the origin of petroleum with evidences.   **(20)**

    b. Explain the journey of petroleum through migration and production using appropriate pictures.   **(10)**

Question 2:

    a. Calculate the porosity of a rock sample that has a bulk density of 1.35 g/cm^3. Assume the particle density is 2.65 g/cm^3.   **(8)**

    b. Calculate the porosity of a 250 g sample that contains 65 g of water when 55% of the pores are full of water.   **(12)**

    c. Determine the bulk density of a cube of uniform grain size packing (cubic grain packing of uniform sizes) if the grain volume is 4.18 cc.   **(10)**

Question 3:

    a. A Normally pressured reservoir contains water, oil and free gas cap. The OWC of the reservoir is at 5,500 ft and GOC of the reservoir is at 5,200 ft. Determine the pressure of the reservoir at the OWC and GOC.   **(15)**

Typical Pressure gradients are (psi/ft):

Water – 0.45,

Oil – 0.35,

Gas – 0.08

Question 3 (contd.):

b. A core sample was brought into the laboratory for analysis. 70 gm of the core sample were placed in a mercury pump and found to have 0.71 cc of gas volume. 80 gm of the core sample was placed in a retort and was found to contain 4.5 cc of oil and 2.8 cc of water. A piece of the original sample weighing 105 gm was placed in a pycnometer and found to have a bulk volume of 45.7 cc. (Assume $\rho_w = 1.0$ gm/cc and 35° API oil). Determine the water and oil saturation of this sample.   (15)

Question 4:

a. Data from a Differential Liberation test for the black oil above at 160 degree F is given below.   (22)

Pressure, psig	Gas removed, CC (at 160°F, Cell Pr.)	Gas removed, SCF (at 60°F, 14.65 psia)	Oil Volume in Cell CC	Rel. Vol.
2800 =P_b	-	-	63.316	
2300	4.396	0.02265	61.496	
1900	4.292	0.01966	59.952	
1400	5.705	0.01618	55.876	
900	8.925	0.01543	53.462	
600	12.814	0.01642	52.236	
200	50.492	0.01721	49.228	
0	-	0.03908	42.540	
0	-	0.14663	39.572 @60° F	

i. Fill in the relative volume column for the Differential Liberation test.

ii. Calculate solution gas oil ratio from differential liberation (R_{SD}) at 1900 psig.

iii. Calculate solution gas oil ratio from differential liberation at P_b (R_{SDb})

iv. Calculate Compressibility factor at 1,900 psig.

v. Calculate Gas formation volume factor at 1,900 psig.

vi. Calculate relative total volume (B_{tD}) at 1,900 psig.

vii. Calculate formation volume factor of oil (Bo) at 1,900 psig.

viii. Calculate solution gas oil ratio (Rs) at 3,000 psig.

ix. Calculate solution gas oil ratio (Rs) at 1,900 psig.

b. Determine the average permeability in a zone near the wellbore. The given conditions are as follows: (8)

$$k1 = 10 \text{ md}; \quad r1 = 2 \text{ ft}$$
$$k2 = 200 \text{ md}; \quad r2 = 300 \text{ ft}; \quad rw = 0.25 \text{ ft}$$

PMRE 411

There are FOUR questions in this section. Answer any THREE

Question 5:

a. What are the common drive mechanisms found in oil/gas reservoirs? How can we estimate the contribution of each drive mechanism acting on an oil reservoir? (12)

b. Following data are obtained from an oil reservoir

P (psia)	Rs (SCF/STB)	Rp (SCF/STB)	Bo (bbl/STB)	Bg (bbl/SCF)
2,500	575	575	1.29	--
1,600	385	954	1.215	0.001569

Following data are also known:

Bubble point pressure = 2,200 psia; reservoir temperature = 150 F

Cumulative oil produced during this interval = 26 MMSTB;

Average porosity = 18%; average connate water saturation = 18%

Answer the following: (3X6 = 18)

i. Does the reservoir have a gas cap initially?

ii. Estimate the Initial oil in place.

iii. SCF of evolved (liberated) gas remaining in the reservoir at 1,600 psia.

Question 6:

a. A special form of the Material Balance Equation is shown below. Discuss where this equation can be and cannot be applied. Also mention what can be achieved by applying this equation. (10)

$$\frac{p}{z} = -\frac{p_i}{z_i G} G_p + \frac{p_i}{z_i}$$

Question 6 (contd.):

b. Following equation is established for a certain reservoir.

$$p/z = -8 \times 10^{-8} G_P + 2640;$$

Where, G_P is in SCF.

Answer the following: (2X10 = 20)

    i.   What is the Gas Initially In Place (GIIP)?

    ii.   What will be the Recovery Factor for an abandonment pressure of 1,100 psia? Assume the gas compressibility factor at that pressure and reservoir temperature is 0.88.

Question 7:

a. Compare the three decline models on a single plot.   (6)

b. Figure A.1 in Appendix A is showing a plot of oil rate versus producing time.

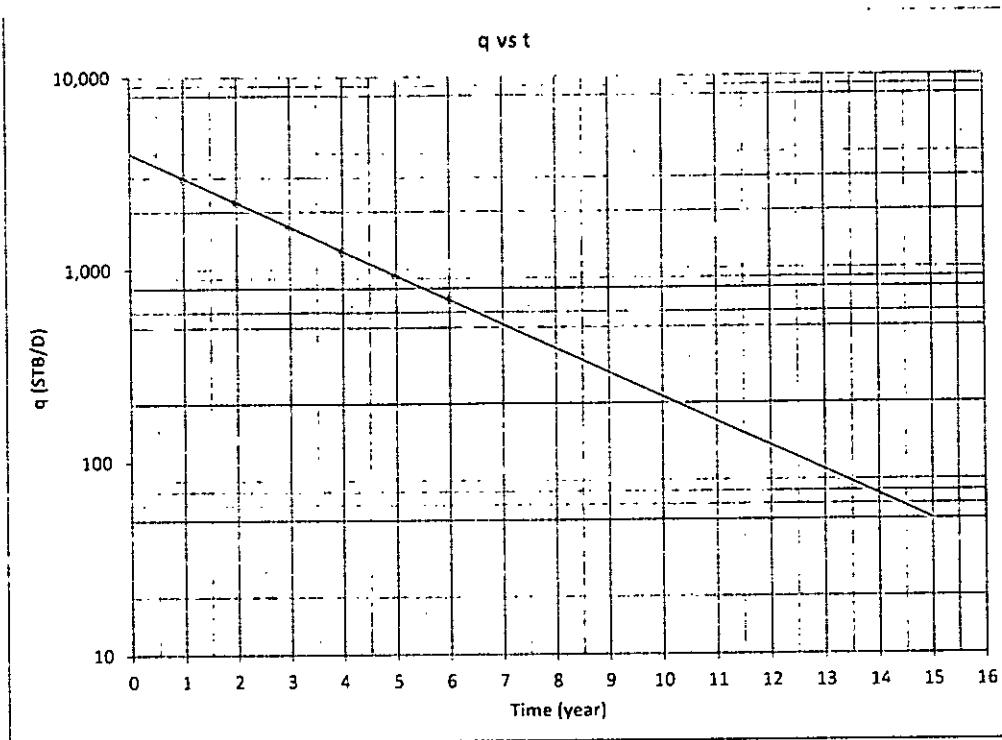Answer the following: (4X6 = 24)

    i.   What is the type of decline? Justify your answer.

    ii.   What is the initial oil rate? How did you get it?

    iii.   Determine the nominal yearly decline rate.

    iv.   What is the life of the field if we need to abandon it at a rate of 10 STB/Day?

Question 8:

a. Write down the Integral form of Darcy Equation for a slightly compressible fluid where the flow pattern is radial. Comment on the pressure distribution predicted by the above equation.   (15)

b. Describe, both mathematically and with physical meaning, the boundary conditions needed to establish "pseudo steady state" flow condition in a reservoir.   (15)

Figure A.1 (for Question 7b)

q vs t